DEUTSCHE
BUNDESBANK
EUROSYSTEM

Discussion Paper

Deutsche Bundesbank
No 34/2018

What are the real effects of financial market liquidity? Evidence on bank lending from the euro area

Andreas R. Dombret

Daniel Foos
(Deutsche Bundesbank)

Kamil Pliszka
(Deutsche Bundesbank)

Alexander Schulz
(Deutsche Bundesbank)

Deutsche Bundesbank, Wilhelm-Epstein-Straße 14, 60431 Frankfurt am Main,
Postfach 10 06 02, 60006 Frankfurt am Main

Tel +49 69 9566-0

Please address all orders in writing to: Deutsche Bundesbank,
Press and Public Relations Division, at the above address or via fax +49 69 9566-3077

Internet http://www.bundesbank.de

ISBN 978–3–95729–496–8 (Printversion)
ISBN 978–3–95729–497–5 (Internetversion)

Non-technical summary

Research question

How did the dry-up of financial market liquidity during the financial crisis of 2007–09 and the subsequent European debt crisis affect bank lending to the real economy? In this paper, we examine the transmission of market liquidity in the euro area via the bank lending channel to the real economy and analyze its impact on provided loan volumes and credit spreads. Furthermore, we break down aggregate results to the individual bank level in order to investigate which banks are most sensitive to market liquidity fluctuations.

Contribution

While previous research has mostly focused on the impact of banks' funding liquidity on their lending behaviour to the real economy, we assess the impact of market liquidity on loan volumes and credit spreads for corporate as well as household loans in the euro area covering the period 2003 to 2016. This time period allows us to examine how banks' lending changed in times of scarce market liquidity.

Results and policy implications

Our results on the aggregate level show that market liquidity is positively related to loan volumes and negatively related to credit spreads. Particularly during times of crisis, lending was reduced and we observe that banks requested higher credit spreads. Of particular importance is that market liquidity has an asymmetric effect on bank lending: The negative impact of a reduction in liquidity is more significant than the positive impact of an increase in liquidity. This is particularly true for corporate loans which would be restricted first in times of impaired market liquidity. The bank-level data confirm the strong impact of market liquidity on bank lending as well. More specifically, we show that non-listed banks, less profitable banks and banks which rely relatively more on net interest income, as well as banks with a high funding liquidity are particularly strongly exposed to market liquidity. Therefore, properly functioning and sufficiently liquid financial markets are necessary to avoid restrictions in bank lending which would eventually hamper the real economy. This is of the utmost importance against the background of the envisaged capital markets union in the European Union and the potential exit of the United Kingdom from the EU.

Nichttechnische Zusammenfassung

Fragestellung

Wie hat die Austrocknung der Liquidität an den Finanzmärkten während der Finanzmarktkrise der Jahre 2007 bis 2009 und der anschließenden europäischen Staatsschuldenkrise die Kreditvergabe von Banken an die Realwirtschaft beeinflusst? In diesem Papier wird untersucht, wie sich die Marktliquidität im Euroraum über die Kreditvergabe der Banken auf die Realwirtschaft auswirkt, indem ihr Einfluss auf Kreditvolumina und -spreads analysiert wird. Ergebnisse liegen sowohl auf aggregierter Ebene als auch auf Basis von Einzelinstitutsdaten vor, um aufzuzeigen, welche Banken in besonderem Maße auf Änderungen in der Marktliquidität reagieren.

Beitrag

Während vorherige Untersuchungen mehrheitlich auf den Einfluss von Finanzierungsliquidität der Banken auf die Kreditvergabe an die Realwirtschaft eingegangen sind, analysieren wir den Einfluss von Marktliquidität auf Kreditvolumina und -spreads sowohl für Unternehmens- als auch für Haushaltskredite im Euroraum über den Zeitraum 2003 bis 2016. Diese Zeitspanne ermöglicht es uns zu prüfen, wie sich die Kreditvergabe in Zeiten von niedriger Liquidität geändert hat.

Ergebnisse und Politikempfehlungen

Unsere Ergebnisse für den aggregierten Euroraum zeigen, dass Marktliquidität positiv mit Kreditvolumina und negativ mit Kreditspreads zusammenhängt. Vor allem in Krisenzeiten verringerte sich die Kreditvergabe und wir beobachten höhere Spreads in den Kreditzinssätzen der Banken. Hervorzuheben ist dabei, dass sich Marktliquidität asymmetrisch auf die Kreditvergabe auswirkt: Der negative Effekt eines Rückgangs von Liquidität ist deutlicher ausgeprägt als der positive Effekt einer Zunahme von Liquidität. Das trifft vor allem auf Unternehmenskredite zu, welche bei einer Verschlechterung von Marktliquidität als erstes eingeschränkt werden. Die bankspezifischen Daten bestätigen ebenfalls den starken Einfluss von Liquidität auf das Kreditvergabeverhalten. Nicht börsennotierte Banken, Banken mit relativ schwacher Rentabilität und einem hohen Anteil an Zinseinkünften sowie Banken mit hoher Finanzierungsliquidität sind dabei in besonderem Maße von Marktliquidität abhängig. Daher sind gut funktionierende und ausreichend liquide Finanzmärkte notwendig, um Einschnitte in der Kreditvergabe durch Banken zu vermeiden, die auch die Realwirtschaft treffen würden. Bedeutend ist dies vor dem Hintergrund der angedachten Kapitalmarktunion und des möglichen Austritts Großbritanniens aus der EU.

Bundesbank Discussion Paper No 34/2018

What are the real effects of financial market liquidity? Evidence on bank lending from the euro area*

Andreas R. Dombret

Daniel Foos
Deutsche Bundesbank

Kamil Pliszka
Deutsche Bundesbank

Alexander Schulz
Deutsche Bundesbank

Abstract

We analyze the impact of market liquidity on bank lending in the euro area for different segments over the period 2003 to 2016. Our results on the aggregate level show that market liquidity is positively related to loan volumes and negatively related to credit spreads. Particularly during the financial crisis of 2007-09 and the subsequent European debt crisis, lending was reduced and we observe that banks requested higher credit spreads. Of particular importance is that market liquidity has an asymmetric effect on bank lending: The negative impact of a reduction in liquidity is more significant than the positive impact of an increase in liquidity. This is particularly true for corporate loans where lending conditions would be restricted first in times of impaired market liquidity. The bank-level data confirm the strong impact of market liquidity on bank lending as well. More specifically, we show that non-listed banks, less profitable banks and banks which rely relatively more on net interest income, as well as banks with a high funding liquidity are particularly strongly exposed to market liquidity. Therefore, properly functioning and sufficiently liquid financial markets are necessary to avoid negative consequences of restrictions in bank lending which would eventually hamper the real economy. This is of the utmost importance against the background of the envisaged capital markets union in the European Union and the potential exit of the United Kingdom from the EU.

Keywords: Financial markets, bank lending, liquidity risk

JEL classification: G15, G21, G32

*E-mail addresses: daniel.foos@bundesbank.de, kamil.pliszka@bundesbank.de, alexander.schulz@bundesbank.de. Contact address: Deutsche Bundesbank, Wilhelm-Epstein-Strasse 14, 60431 Frankfurt am Main, Germany. We thank Thomas Lohner for his excellent research assistance and the participants at the Deutsche Bundesbank Seminar for their helpful comments. The views expressed in this paper are those of the authors and do not necessarily coincide with the views of the Deutsche Bundesbank or the Eurosystem.

1 Introduction

How did the dry-up of financial market liquidity during the financial crisis of 2007–09 affect bank lending to the real economy? In this paper, we examine the transmission of market liquidity via the bank lending channel to the real economy and analyze its impact on provided loan volumes and credit spreads. Prior research has shown a mutually reinforcing link between an asset's market liquidity and an investor's funding liquidity (see Brunnermeier and Pedersen (2009)).[1] Consequently, a shock in market liquidity can impair the liquidity of assets, particularly of loans which often dominate banks' balance sheets and drive the real economy. This "liquidity commonality phenomenon" which refers to a close relationship between an individual asset's liquidity and market liquidity, was first shown empirically by Chordia, Roll, and Subrahmanyam (2000).

These findings are important, as the financial crisis of 2007-09 revealed weaknesses in banks' funding liquidity and forced regulators to build up new requirements, namely the Liquidity Coverage Ratio (LCR) and the Net Stable Funding Ratio (NSFR) (see BCBS (2013, 2014)). These instruments are intended to ensure the resilience of the (short-term) liquidity risk profile (through the LCR) and the sustainability of the funding structure (through the NSFR). Even several years after the decision on the new regulatory instruments, the importance of funding liquidity is steadily emphasized (see Caruana (2016) and Dombret (2017a)). However, these instruments are aimed at protecting against funding liquidity issues and do not directly take into account fluctuations in the liquidity of asset markets. This is where our paper steps in and assesses the impact of market liquidity on the real economy via the bank lending channel.

Liquidity risks stemming from financial markets have recently gained in importance, as concerns about possible effects on the international corporate bond market are feared (IMF (2015)). Among many other consequences, a dry-up of liquidity could affect the profitability of banks through higher funding costs and make it even more difficult to earn their cost of capital (see Dombret, Gündüz, and Rocholl (2017) and Dombret (2017b)). Furthermore, a liquidity shock could affect bank lending and materialize in either a reduction in loan volumes or higher credit spreads – both of which can have a severe negative impact on the real economy.

The analysis of the real effects of market liquidity in this paper is conducted from two different angles (see Figure 1). First, we assess the impact of financial market liquidity on a macro level, as we focus on lending in the euro area as a whole and individual countries therein. This allows us to analyze the impact of market liquidity on aggregated loan volumes and average credit spreads. Second, we move to a micro level and analyze how loan volumes of individual banks in the euro area depend on market liquidity. This analysis allows us to identify bank characteristics which make lending particularly vulnerable to market liquidity changes, and it serves as a robustness check to the aggregate analyses.

[1] Market liquidity refers to the ability of a market to buy or sell assets without causing significant price changes. Funding liquidity describes the ability to obtain funding.

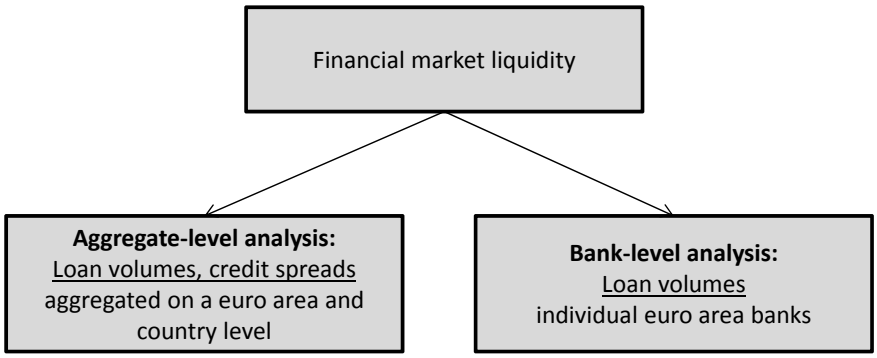

Figure 1: We run a twofold analysis: First, we conduct an aggregate-level analysis using data based on broad aggregates for the euro area which are then broken down to the individual countries. Second, we run a bank-level analysis based on bank-specific data. The former can be conducted for loan volumes and credit spreads. The latter is based on individual data from various banks from the euro area and limited to loan volumes.

We focus on bank lending in the euro area, which comes with several benefits. The member countries are subject to the same monetary policy, have the same currency, their financial markets are significantly related to each other and they have comparable legal and regulatory frameworks. These commonalities allow us to analyze the effects of shocks in the same market liquidity measures to euro area loan volumes and credit spreads. We retain this general set-up while diving in deeper to individual countries and banks.

Though funding and market liquidity are linked to each other, the majority of the existing literature deals with funding liquidity and examines a dedicated market or a cross-section of banks. More specifically, most papers analyze bank-specific factors – including liquidity risks arising from banks' funding structures – in order to explain banks' lending behaviour. In contrast, we contribute to the subject by examining how declines in market liquidity more generally affect bank lending in the euro area. We relate market liquidity to bank lending at various levels of aggregation, i.e. the entire euro area, specific countries and individual banks. Our data set ranges from 1/2003 to 5/2016 and allows us to assess the impact of liquidity in normal times and in times of crisis. In addition, we differentiate in the aggregate-level analysis between loans to corporates and households and make a more granular breakdown to their sub-segments. Finally, we test whether enhancements and deteriorations in market liquidity affect loan volumes and credit spreads to the same extent and analyze which type of loans would be hampered most if market liquidity goes down.

The strand of literature on the impact of market liquidity on bank lending is surprisingly sparse. However, several papers analyze the financial crisis of 2007–09 and explain its effects on bank behaviour mostly with a liquidity shock (see, for example, Schiozer and de Freitas Oliveira (2016) or Chouchène, Ftiti, and Khiari (2017)) without considering that factors other than a pure liquidity shock changed fundamentally during this period. The paper by Schiozer and de Freitas Oliveira (2016) is most closely related

to our analysis and concludes that, for Brazilian banks, a reduction in market liquidity makes banks strongly decrease their loan supply. In contrast, a positive liquidity shock has a small effect (if any) on loan supply. Other papers also looked at the real effects of central bank interventions with regard to financial market liquidity. García-Posada and Marchetti (2016) assess the impact of very long term refinancing operations (VLTROs) conducted by the Eurosystem for Spain. They conclude that VLTROs had a positive moderate-sized effect on the supply of bank credit to firms and that the effect was greater for illiquid banks. Furthermore, the effect was driven by credit to SMEs, as there was no impact on loans to large firms. Berger, Black, Bouwman, and Dlugosz (2017) analyze banks' reaction to the Federal Reserve's liquidity injection during the financial crisis of 2007–09. The authors conclude that that recipient banks increased their lending in most loan categories in both the short and long term. Jung and Kim (2015) analyze Korean commercial banks and find that when market liquidity shocks (as measured by increases in credit spreads) are severe, banks generally reduce their lending. However, banks with a high core funding ratio rather tend to increase their lending to firms during periods of market-wide liquidity shocks, thereby offsetting the reduction in lending by other banks. Schnabl (2012) shows that the Russian default event in 1998, which represented a significant market liquidity shock, was transferred to Peruvian banks, which reduced lending to domestic banks and corporates. Finally, the link to the impact of liquidity on credit spreads tends to be covered in the more recent literature. Rösch and Kaserer (2016) analyze, amongst other things, the relationship between credit spread risk and market liquidity risk. They show that in times of increased market uncertainty, the impact of liquidity amplifies credit spread risk.

The literature on the impact of funding liquidity, on the other hand, is abundant and increased considerably after the dry-up of liquidity during the financial crisis of 2007–09. Generally, these papers assume that impaired asset liquidity complicates funding and can materialize in the bank lending channel through reduced loan volumes and higher credit spreads. Cornett, McNutt, Strahan, and Tehranian (2011) analyze the relationship between different funding structures and lending. They conclude that more stable funding sources like deposits and equity made banks lend more in the financial crisis of 2007-09. Allen and Paligorova (2015) show for Canadian banks that banks which are more dependent on wholesale funding contracted lending to the highest degree during the financial crisis of 2007-09. Ongena, Peydro, and van Horen (2015) analyze the transmission of shocks from the banking sector to the real economy during the financial crisis of 2007-09, in particular among small and medium-sized firms in Eastern Europe and Turkey. They conclude that internationally-borrowing domestic and foreign-owned banks contract their credit levels more during the crisis than domestic banks that only rely on local funding. Vazquez and Federico (2015) analyze bank funding structures for US and European banks in the period 2001 to 2009. The results show that banks with weaker structural liquidity and higher leverage in the pre-crisis period were more likely to fail afterwards. The likelihood of bank failures also increasee with pre-crisis bank risk-taking. In the cross-section, the smaller domestically-oriented banks were relatively more vulnerable to liquidity risk, while the large cross-border (global) banks were more vulnerable to solvency risk due to excessive leverage. The joint effect of funding liquidity and bank capital on bank lending is analyzed by Kim and Sohn (2017), who observe a positive interaction of capital and

liquidity for larger banks and during crisis periods. The paper by Khan, Scheule, and Wu (2017) relates funding liquidity to risk-taking. The authors find evidence for the US market that banks with lower liquidity risk (as measured by a greater funding through deposits) take generally more risk, but also surprisingly less risk during the financial crisis of 2007-09. Alexandre and Clavier (2017) test whether the adoption of IAS/IFRS led to increased amounts of credit offered by liquidity-constrained European banks for the period 2003 to 2008. The authors observe an increase in the credit supply only for small and liquidity-constrained banks. Dubecq, Monfort, Renne, and Roussellet (2016) provide a framework for distinguishing between credit risk and funding liquidity components in unsecured interbank lending. They conclude that liquidity premia accounted for the high credit spreads during the financial crisis of 2007-09.

Conceptually, we define expectations based on prior literature and observations during the recent crisis. First, we expect a positive relationship between market liquidity and loan volumes (expectation 1). Second, we expect the impact of market liquidity on credit spreads to be negative. In addition, the impact of market liquidity on credit spreads should be stronger and swifter than on loan volumes (expectation 2). Third, we expect the role of market liquidity and bank lending to be particularly significant in times of crisis. Furthermore, the impact on bank lending should be more significant for liquidity reductions than for liquidity increases (expectation 3). Fourth, we expect differences in the dependence on market liquidity across various euro area countries (expectation 4). Fifth, we expect that the various lending segments, i.e. loans to corporates and households (and the sub-segments therein), differ with regard to their dependence on market liquidity, because loans in some segments can be interpreted as (short-term) replacement and others as (long-term) investment decisions (expectation 5). Sixth, we expect to confirm a significant impact of market liquidity on bank lending, which we may observe based on aggregate data, in the bank-level analysis. Using regression-based empirical analyses, we find evidence for all six expectations. Table 1 summarizes the expectations.

Table 1: Overview of expectations addressed in the analyses

	Explanation
Expectation 1	Positive relationship between market liquidity and loan volumes
Expectation 2	Negative relation between market liquidity and credit spreads.
	In addition, credit spreads react stronger and swifter to liquidity than loan volumes
Expectation 3	Relation of liquidity and bank lending is particularly significant in times of crisis
	Impact on bank lending is more significant for liquidity reductions than for increases
Expectation 4	Differences in the impact of market liquidity across various euro area countries
Expectation 5	Different dependencies on market liquidity for different lending segments
Expectation 6	Significant impact of market liquidity on lending is confirmed in bank-level analysis

The table summarizes the expectations raised in the analyses.

The remainder is structured as follows. Section 2 gives an overview of the data used and describes the methodology. The results are provided in Section 3 (aggregate-level data) and Section 4 (bank-level data). Section 5 concludes.

2 Data and methodology

Our analysis is composed of two parts; one is based on aggregate-level and the other on bank-level data. For the former part, we use loan volumes and credit spreads for the euro area as a whole and for the individual countries therein. In the latter part, we explain a bank's lending behaviour using bank-specific variables (e.g. balance sheet data) and macroeconomic as well as financial variables including liquidity indicators. The data set, the data preparation process and the methodology employed for the analysis are explained in this section.

2.1 Liquidity indicators

The European Systemic Risk Board's (ESRB) liquidity indicator for currency, equity and bonds (CEB) serves as our primary proxy for market liquidity and should be related to corporate and household loans. The reason for this is that we assume that bonds and loans have several commonalities and, accordingly, a change in bond liquidity should affect bank lending via the loan market. In addition, we supplement the CEB liquidity indicator with the ESRB's money market (MM) liquidity indicator. The main difference between these liquidity measures is that the CEB liquidity indicator focuses on instruments which mature in the medium and long term, whereas the MM liquidity indicator refers to instruments maturing in the short term. Furthermore, the money market is dominated by banks and other financial institutions, whereas currency, equity and bond markets are served by a broader variety of market players; this circumstance may suggest another notion of market liquidity as well. Banks in countries with a short maturity fixation of loans might be more exposed to liquidity in the money market (as measured by the MM liquidity indicator) than to liquidity in the bond market (as measured by the CEB liquidity indicator).

Both measures encompass tightness, depth/resilience and liquidity premiums (see Kyle (1985)). Tightness is the magnitude of risk premiums required by market makers for holding inventories of securities. It is captured by the width of bid-ask spreads. Depth/resilience is the degree to which trading affects asset prices and can be measured using ratios of price movements to transaction volumes in the relevant markets (e.g. ratio of absolute return of an asset to its trading volume). Liquidity premiums capture the compensation required by investors to cover the risk of the potential need to exit positions which could be challenged by uncertain market conditions in the future. It can be measured using spreads between different securities which are known to have varying degrees of liquidity (e.g. bond yields and LIBOR). Higher numbers of these indicators go along with better liquidity. Figure 2 shows the course in time of the liquidity indicators employed.

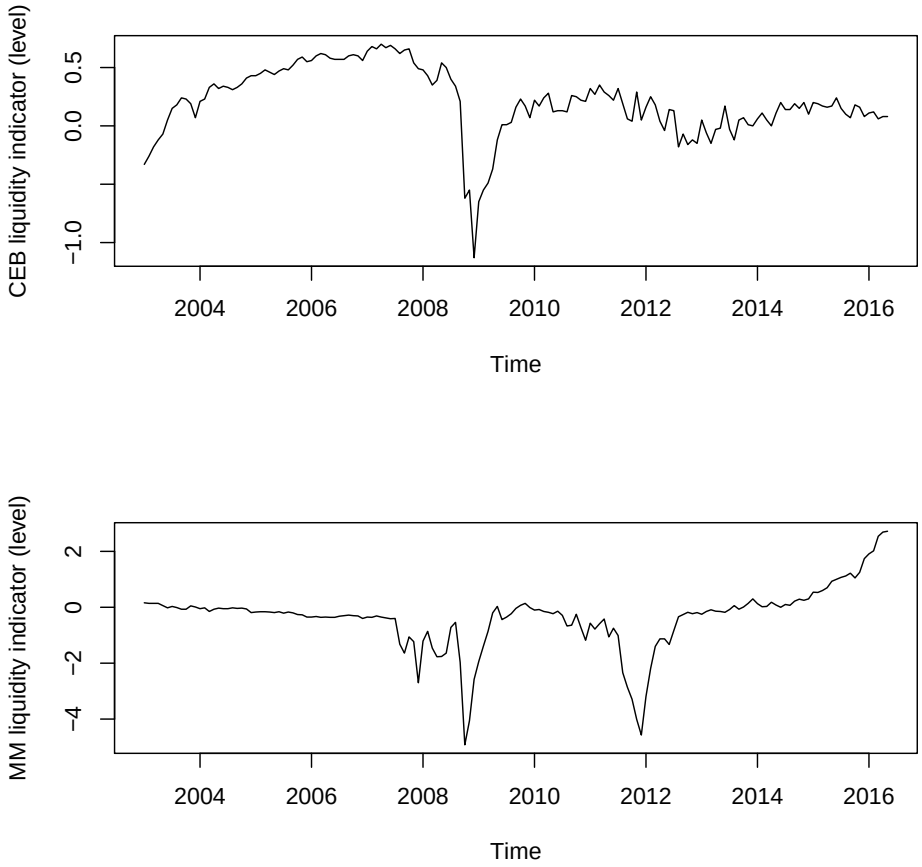

Figure 2: The figure shows the levels of the currency, equity and bond liquidity indicator (upper figure) and the money market liquidity indicator (lower figure) during the period 2003–2016.

The strong reaction of both indicators in the financial crisis of 2007-09 is the first thing to catch the eye. However, other events are captured by the indicators differently. This suggests that both indicators cannot be simply substituted for each other as they seem to measure partly other characteristics of market liquidity. In particular, the MM liquidity indicator reacted to the European sovereign debt crisis more strongly than the CEB liquidity indicator. After the crises, the MM liquidity indicator shows a steadily improving liquidity situation – a behaviour which cannot be observed in the CEB liquidity indicator.

For the sake of robustness, we also employ other market liquidity measures. This becomes even more important if one considers that several papers explain the effects of the financial crisis of 2007-09 mainly by a liquidity shock, meaning that the liquidity indicators used might not only refer to market liquidity but contain also a crisis component. In order to take a potential interplay between market liquidity and crisis into account, we adjust the liquidity indicators for crisis-related effects, using the broadly employed crisis measure CISS (Composite Indicator of System Stress) from the ECB. In doing so, we regress the respective liquidity indicator on the CISS; the residuals represent a "corrected" liquidity

indicator.[2] Then, we rerun the regressions using this clean liquidity indicator. In addition, we employ the VSTOXX as another market liquidity measure. This measure refers to the volatility of the EURO STOXX 50 and thus considers exclusively the liquidity in the stock market. This approach is motivated by Vayanos (2004) who shows that during volatile times, assets' liquidity premia increase and that assets become more negatively correlated with volatility.

2.2 Control variables, stationarity and variable selection

Bank lending to corporates and households in euro area countries can be driven by various systematic risk factors. Amongst other things, market liquidity, interest rates, macroeconomic circumstances and commodity prices can drive bank lending. Therefore, we consider – in addition to liquidity indicators – a battery of variables, i.e. control variables, to take factors besides liquidity into account.

We test each original time series of the candidate variables[3] for stationarity using the Augmented Dickey-Fuller (ADF) test. If the test suggests that a unit root is present, we take differences. However, if a time series increases (or is very likely to increase) exponentially, we take the log-return. Afterwards, the data is tested for stationarity again using the ADF test. We rely on a combination of Bayesian model averaging (BMA) and expert judgement for selecting variables. In doing so, we select the control variables based on their explanatory power for the loan volumes in the euro area as a whole from the aggregate-level analysis and then use these variables after performing sanity checks for credit spreads and for loan volumes in the bank-level analysis as well. We trust that this broad measure is best suited to explain the real effects of potential changes in the market liquidity. As a prerequisite, we assume that loan volumes respond with a delay to changes in the explanatory variables. This assumption is economically reasonable, as the loan granting process takes some time from the first request till the final granting. Further, it avoids potential endogeneity issues. In our first calculations, we conclude that a lag of one or two periods, i.e. one or two months in the case of the aggregate-level analysis, yields the best results. In contrast, credit spreads can be adjusted promptly by banks. Thus, we include contemporaneous realisations of the liquidity indicators for credit spreads. Besides, we include the same macroeconomic variables for both loan volumes and credit spreads. In addition, we include lagged loan volumes in the loan volume settings as well.[4] Eventually, we include the variables shown in Table 2. All these variables will be used in both the aggregate-level and the bank-level analysis. The variables unemployment rate, the EUCOM EcoSent and the CPI are collected on a country-specific basis.

[2] As our liquidity measures are provided on a daily basis and, in contrast, the CISS is announced weekly, we use the last announced value of the CISS in a month.

[3] Lagged loan volumes, CEB and MM liquidity indicator, Unemployment rate, EURIBOR 3M, German 5Y government bond yield, EUCOM sentiment indicator, industrial production, Bloomberg commodity index, FX rates EUR/USD, EUR/JPY and EUR/GBP, EURO STOXX 50, Term spreads 10Y-1Y based on bonds and swaps, CISS, consumer price index; see Table A.4 in the Annex for a detailed description.

[4] We provide a detailed description of the variable inclusion process in the Annex (Section A.3).

Table 2: Overview of included explanatory variables

Variable	Definition	Source	Stationarity adjustment method
Loan volumes (lagged)	Loan volumes on new business for euro area countries	ECB	Log-return
CEB liquidity indicator	ESRB's liquidity indicator for the currency, equity and bond market	ECB	Difference
MM liquidity indicator	ESRB's liquidity indicator for the money market	ECB	Difference
Unemployment rate	Euro area countries in %	EUROSTAT	Difference
EURIBOR 3M	Annualized rate of the three-month EURIBOR	Datastream	Difference
Economic Sentiment Index	EUCOM's indicator for the assessment of economic sentiment	EUCOM	Difference
FX rate EUR/USD	Exchange rate	Datastream	Difference
Term spread 10Y - 1Y	Spread between the ten-year and one-year yield of German government bonds	Bloomberg	Difference
CPI	Harmonized Consumer Price Index - all items	OECD	Log-return

One issue to consider after selecting relevant control variables for explaining loan volumes and credit spreads is the differentiation between supply and demand effects, which serves as a robustness check to our analyses. Constraints in loan supply are relevant from a policy perspective and have a potentially avoidable negative impact on the real economy. By contrast, effects stemming from the demand for loans may be more related to the general business cycle and reflect, amongst some other things, borrower's characteristics and the attractiveness of substitutes. Furthermore, borrowers might substitute loans by bonds or other funding sources. We use data from the bank lending survey (BLS) of the Eurosystem. These data are collected on a quarterly basis for around 140 banks in the euro area and provide, to the best of our knowledge, the most appropriate source for disentangling aggregate supply and demand effects of loans in the euro area. In this survey, banks are requested to indicate on an ordinal scale how the demand for loans and credit lines has changed (see ECB (2015)) and whether they apply stricter credit standards relative to the previous quarter. We control for demand effects which are provided for enterprises and households. The former are captured as a whole; the latter are captured differently for house purchases and consumer credit / other lending. In our regressions, the weighted average of loan demand from the BLS is included as an explanatory variable and interacted with an indicator function which is one if changes in loan demand are above average.

2.3 Aggregate-level data on the real effects of market liquidity

We use data from the ECB Monetary Financial Institution (MFI) interest rate statistics for loan volumes and loan interest rates covering the period 1/2003 to 5/2016 for the aggregate-level analysis.[5] These statistics cover information about the amounts and conditions of loans granted by a representative set of financial institutions for each euro area country. More specifically, we use statistics on new business which reflect the agreed conditions in the loan market. New business is defined as any new agreement which may stem from new financial contracts, terms and conditions that specify for the first time the interest rate of the loan or renegotiations of existing loans. Interest rates on new business cover all contracts made during a specific month irrespective of the point in time a loan is withdrawn. An interest rate on new business is the weighted average interest rate that has been agreed for all loans in the relevant category in the respective month.

[5] A detailed description of the data is given in ECB (2017).

The MFI interest rate statistics facilitate the comparison between various countries and between various lending segments. We use monthly data for the aggregate-level analysis on provided loan volumes and agreed interest rates for new business, whereby the data is broken down into (non-financial) corporates and households. Furthermore, the corporate data is divided into loans up to one million euro and loans over one million euro. The data for households are divided into consumption, mortgages and other loans.

As the reporting of MFI interest rate statistics to the ECB is mandatory for Eurosystem member countries, the data quality is generally very good.[6] However, as the euro was introduced in some EU countries during the time period analyzed, the time series start later in these cases. Besides that, the data is incomplete in some countries for some lending segments. In rare cases, individual data points are missing.

We focus on the euro area as a whole, which includes data from the Eurosystem member countries on a proportional basis. Furthermore, we include all individual countries for which the data is available without a break for the whole period considered – this leaves us with nine countries.

The different lending segments, i.e. for corporate and households loans (and the subsegments therein) allow us to analyze various types of loans with different characteristics. For example, the time between a borrower considers applying for a loan and signs the final contract differs across the considered segments. Corporate loans over one million euro, for which a longer time may elapse between a company's investment decision and the final settlement of the contract, and household mortgage loans might react differently to a liquidity shock than loans with a short period between the decision to take out the loan and the settlement of the contract. Besides that, other relevant characteristics which characterize different lending segments include differences in the value of collateral, different maturities and different negotiation positions of customers, i.e. (large) corporates can arrange better conditions than smaller borrowers.

We analyze the impact of market liquidity on bank lending with respect to two dependent variables – loan volumes and loan credit spreads. The former can be used directly after performing seasonal adjustment and ensuring stationarity of the time series. As only loans' contractually agreed interest rates (and not credit spreads) are available, the latter is calculated by deducting the risk-free rates from the loan rates in order to retain only the credit spread.

In order to adjust the data for seasonal effects, which differ significantly between loans from different countries, sectors and types, we adjust all time series using the X-13 ARIMA-SEATS methodology.[7] In doing so, the time series is divided in a cyclical, a trend and a seasonal component. Then, the seasonal influence is removed from the original time series.

[6] An overview of the data availability by country is provided in the Annex in Section A.1.

[7] A detailed description on this proceeding can be found in U.S. Census Bureau (2017).

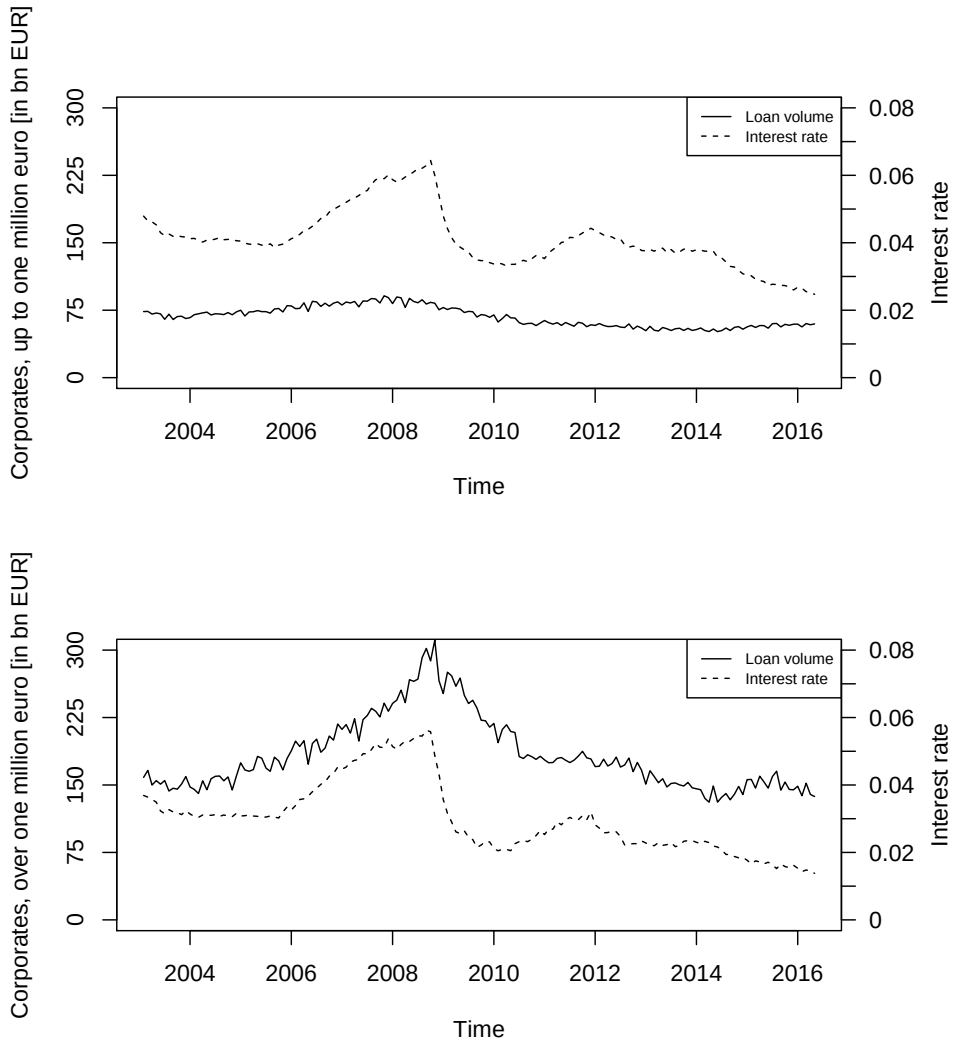

Figure 3: The figures show seasonally-adjusted loan volumes (solid line) and nominal interest rates (dashed line) for corporates in the euro area as a whole. Both lines refer to banks' new business. Corporate loans are divided into loans up to one million euro (upper figure) and loans over one million euro (lower figure).

Figure 3 shows how granted loan volumes and agreed interest rates in the new business for corporates (both after seasonal adjustment) evolved over time. The graphs are based on data stemming from the euro area as a whole. The sum of loans over one million euro clearly dominates corporate loans. On average, 73.60% of total corporate loans are loans over one million euro. Interestingly, these loans show a more cyclical pattern, as they endured strong volume changes in times of crisis. Though interest rates for both sub-segments of corporate loans follow a similar pattern in the course of time, the average interest rate for loans over one million euro is 3.01% and, thus, considerably lower than the interest rate for loans up to one million euros which is 4.11%.

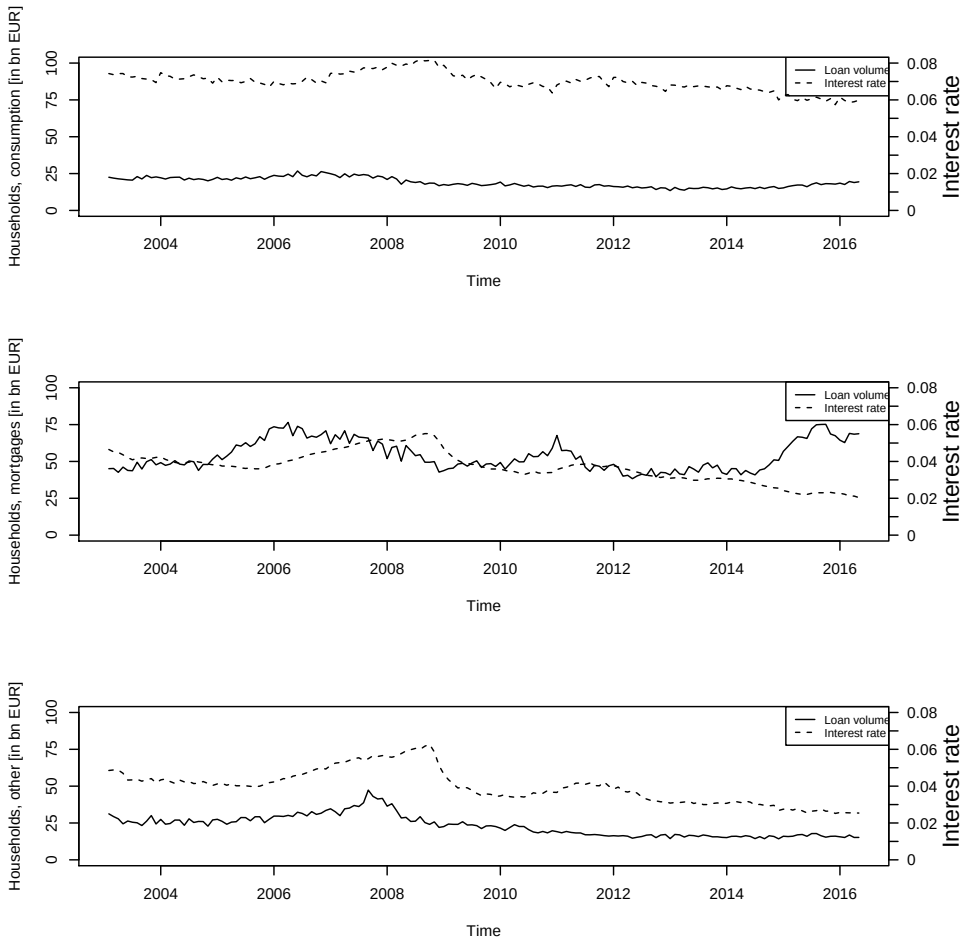

Figure 4: The figures show seasonally-adjusted loan volumes (solid line) and nominal interest rates (dashed line) for households in the euro area as a whole. Both lines refer to banks' new business. Household loans are divided into loans for consumption (upper figure), mortgages (middle figure) and other (lower figure).

Similarly, Figure 4 shows how loan volumes (after seasonal adjustment) and agreed interest rates in the new business for households in the euro area as a whole evolved over time. Household mortgage loans constitute – with an average proportion of 57.18% – the majority of household loans. The proportion increased significantly between 2014 and 2016, partially as a result of the low interest rate environment in the euro area. The interest rates for the various household lending segments differ strongly. At 3.73%, on average, mortgage loans have the lowest interest rate while the interest rates for consumption and other loans are, on average, 6.99% and 3.99%.

Aggregate loan volumes for new business to corporates steadily increased until the end of the financial crisis of 2007-09 and the onset of the European sovereign debt crisis. Then, the volume decreased till 2012 and, eventually, stabilized afterwards at the level of 2003-04. The interest rate seems to move in line with the loan volume, i.e. if loan volumes were higher, the interest rate increased as well. Household loan volumes generally

followed a similar pattern to amounts for corporate loans for the first years. However, the new business volume of mortgage loans has increased considerably since 2014 and is edging closer to its pre-crisis level. Interestingly, the interest rate seems to adjust – in comparison with corporates – with a lag of some months, particularly during the financial crisis of 2007-09.

In order to derive credit spreads from the interest rate data, we collect the volumes regarding the interest rate fixation period for each sub-segment of corporate (i.e. loans up to one and over one million euro) and household loans (i.e. loans for consumption, mortgages and others). This breakdown is available for the maturity buckets up to one year, one year till five years and more than five years for all sub-segments besides mortgage loans to households. For mortgage loans to households, even more granular data is available: Instead of maturities exceeding five years, maturities ranging from five years to ten years and maturities exceeding ten years are available. After collecting these more granular data, we deduct the respective yields of German government bonds, which serves as a proxy for the risk-free interest rate in the entire euro area. We take the maturity which equals the bucket mid-points, i.e. six months, three years, 7.5 years and 15 years - the last two maturities refer to buckets for maturities exceeding five and ten years. Unfortunately, loan data at this level of granularity are only available for the euro area as a whole. In order to calculate credit spreads for individual euro area countries, we have to assume an identical maturity structure as for the euro area aggregate and deduct the risk-free interest rates referring to the same maturities as calculated for the euro area aggregate.[8]

2.4 Bank-level data on the real effects of market liquidity

Our analysis is primarily based on loan volumes and credit spreads from the euro area as a whole and from specific euro area countries. However, we want to test our findings for robustness and verify at the individual bank level that market liquidity has also explanatory power in comparison to other macroeconomic and bank-specific factors.

Given the periodicity of balance sheet information, we are limited to annual data at this stage. We use data from SNL Financial covering the period 2005 to 2015 for 80 banks from 14 euro area countries.[9] We include only banks which are directly supervised by the European Central Bank in the European Single Supervisory Mechanism ('significant institutions' in an SSM context). This avoids arbitrariness, as we capture the most relevant banks in the euro area. Loan growth, as measured by log-returns of gross loan volumes to customers, is our main variable of interest and the dependent variable in our regressions. While this measure mirrors changes in aggregate loan volumes on the bank level, we are unfortunately neither able to observe new business on the individual bank level, nor can we retrieve a bank-specific proxy for the pricing of loans, i.e. credit spreads.

[8]Indeed, this is a strong assumption. However, we focus on the euro area as a whole and the results for individual countries are only intended to supplement the euro area aggregate results. Furthermore, risk-free interest rates constitute only a rather small part of the agreed interest rate. On average, 35.10% (corporates) and 39.97% (households) of the agreed interest rate was due to the risk-free interest rate.

[9]Banks are located in AT, BE, CY, DE, ES, FI, FR, GR, IE, IT, LU, MT, NL and PT.

Table 3: Descriptive statistics on the bank level

	Mean	p50	p5	p95	N
Dependent variable: Loan growth (annual log-return)	0.0627	0.0155	-0.1173	0.2720	702
Explanatory variables					
CEB liquidity index (orthog.)	0.0000	0.0454	-1.4936	2.3492	657
MM liquidity index (orthog.)	0.0000	0.1300	-1.5596	1.8143	657
EURIBOR 3M (orthog.)	0.0000	-0.2073	-1.4202	1.7891	657
FX USD/EUR (orthog.)	0.0000	-0.0462	-1.6605	1.7388	657
Term spread 10Y-1Y (orthog.)	0.0000	-0.2285	-1.4995	1.3829	657
CPI (orthog.)	0.0051	0.0640	-1.7273	1.5478	657
Unemployment rate (orthog.)	-0.0082	-0.1716	-1.1442	2.2719	657
EUCOM EcoSent (orthog.)	-0.0072	0.0035	-1.7491	1.7872	657
ln(Total assets)	18.3071	18.1899	15.9530	20.9472	822
RWA/Total assets (in %)	46.6647	46.4350	17.9240	77.8730	791
Return on average assets (in %)	-0.3922	0.2625	-1.8460	1.2900	748
Cost/Income ratio (in %)	63.3812	61.7530	40.9710	87.3970	808
Net Interest Income/Operating Revenue (in %)	64.1563	61.8855	31.5760	100.3970	808
Equity/Total assets (in %)	5.6410	5.7495	2.0250	10.6845	820
Deposits/Total assets (in %)	45.9457	46.0845	17.1940	81.8505	820
Interbank ratio (in %)	87.5678	59.2510	10.2220	270.2750	799

This table shows the mean, median (p50), as well as the 5^{th} and 95^{th} percentiles of the variables that are used in the regression analysis. The statistics refer to bank-year observations and cover the period 2005 to 2015. The interbank ratio describes the money lent relative to money borrowed from other banks. All macro variables have been orthonormalized using a modified Gram-Schmidt procedure (Golub and Loan (2013)).

We control for two types of factors. First, we include the same macroeconomic variables as for the euro area as a whole: The CEB or MM liquidity indicator, the unemployment rate, the 3M EURIBOR, the EUCOM sentiment index, the EUR/USD FX rate, the 10Y–1Y term spread and the consumer price index. However, given that we observe loan growth (measured as the log-return of total customer loans) only over annual periods, we use an average of monthly observations for the liquidity indicators to better capture the level of liquidity over the one-year horizon. We orthogonalize these variables using a modified Gram-Schmidt procedure (see Golub and Loan (2013)) in order to obtain linearly independent observations, and we normalize them so that they exhibit a zero mean. Furthermore, we include bank-specific data which serve as control variables. The orthogonalization is helpful due to the increased number of explanatory variables in the micro-level setting. We use contemporaneous values of the explanatory variables, because gross loans are only available on an annual basis and effects on lending are expected within this time frame. Specifically, we use the natural logarithm of total assets as a proxy for bank size, the ratio of risk-weighted assets (RWA) to total assets as a measure of risk in banks' assets, the return on average assets, the cost-to-income ratio and the ratio of net interest income to operating revenue as measures of banks' profitability and efficiency, the equity-to-total assets ratio as a measure of banks' solvency, and the deposits-to-total assets ratio as well as the interbank ratio (money lent relative to money borrowed from other banks) as indicators of banks' funding structure.[10] Table 3 provides the descriptive statistics of the variables after the orthonormalization procedure.

[10]This selection of variables covers the categories capital adequacy, asset quality, earnings and liquidity from the CAMELS rating by US agencies.

It turns out that loan growth has a yearly average of 6.30% but fluctuates significantly over the sample banks and years. Note again that the liquidity indicators and macroeconomic control variables have been orthogonalized and normalized such that they exhibit a zero mean. Other variables like the RWA density (mean of 46.7%) or the profitability and efficiency metrics show a relatively broad distribution across banks as well. The values for the return on average assets are low but at the median slightly positive. The average (non risk-weighted) equity-to-total assets ratio is 5.64%, meaning that banks in our sample are on average well-capitalized although this ratio differs significantly across banks, and the average deposits-to-total assets ratio indicates that they rely to a high degree on funding with customer deposits. Finally, average interbank ratios of below 100% stand for the fact that banks in the sample tend to lend less to other banks than to borrow from them.

2.5 Methodology

For the analysis based on aggregate-level data, we use a linear model where we explain the loan volume in the euro area in time t by the equation

$$\ln \frac{\text{LoanVol}_t}{\text{LoanVol}_{t-1}} = \alpha + \alpha_1 \cdot Liq_{t-1} + \alpha_2 \cdot Liq_{t-2} + A_{t-1}^T a + \epsilon_t. \tag{1}$$

Similarly, the credit spread for the euro area aggregate is given by

$$\Delta\text{CreditSpread}_t = \beta + \beta_1 \cdot Liq_t + \beta_2 \cdot Liq_{t-1} + A_{t-1}^T b + \nu_t, \tag{2}$$

where Liq_t is the liquidity indicator (CEB or MM liquidity indicator), A_{t-1} contains the macroeconomic control variables and ϵ_t as well as ν_t are error terms.

When these models are estimated for individual euro area countries, all dependent and explanatory variables except Liq_t as well as all coefficients and error terms are also country-specific. These results are presented in the Appendix (Table A.5 to Table A.8).

For the bank-level data, we employ a panel regression where loan growth, i.e. the log-return in gross loans to customers, of bank j in time period $(t-1, t]$ is given by

$$\ln \frac{\text{GrossLoans}_{j,t}}{\text{GrossLoans}_{j,t-1}} = \gamma_j + \gamma_1 \cdot Liq_t + A_{j,t}^T g + B_{j,t}^T c + \eta_{j,t}, \tag{3}$$

where Liq_t is the liquidity indicator (CEB or MM liquidity indicator), $A_{j,t}$ is the matrix of macroeconomic control variables, $B_{j,t}$ refers to the matrix of bank-specific characteristics, γ_j is the bank-specific fixed effect and $\eta_{j,t}$ is a normally distributed error term. For the purpose of the panel regression, we cluster the error terms at the yearly level. It is noteworthy that we use contemporaneous values of the liquidity indicators and other macroeconomic variables in Equation 3. This is because gross loans are taken from accounting data and are thus only available on a yearly basis (see Section 2.4).

3 Results of the aggregate-level analysis

When presenting our empirical results, we start with a brief overview of the main results of the aggregate-level analysis (Section 3.1). Then, we present regression results for loan volumes (Section 3.2) and credit spreads (Section 3.3). More detailed results on the impact of market liquidity on bank lending in times of crisis are presented in Section 3.4. Eventually, we provide evidence for the robustness of our findings and discuss the importance of the main results (Section 3.5).

3.1 Overview

The aggregate-level analysis employs data from the euro area as a whole and makes breakdowns to individual countries therein. We analyze loan volumes and credit spreads for different lending segments, i.e. corporate and household loans (and the sub-segments therein). We then delve into greater detail and analyze whether the impact of market liquidity differs between normal times and crisis periods, whereby the crisis is assumed to cover the period 9/2007 to 8/2012 from the escalation of the financial crisis in 2007 to Mario Draghi's "Whatever it takes" speech in end-July 2012. This time span has a high overlap with the crisis periods experienced in many euro area countries (European Systemic Risk Board, 2017). Besides this, we test for an asymmetric response of loan volumes and credit spreads to positive and negative liquidity changes. Table 4 provides an overview of the aggregate-level analysis and sets out a glimpse of the main results for the euro area as a whole.

Table 4: Overview of the tables for the aggregate-level data of the euro area as a whole

Dep. variable	Specification	Liquidity indicator	Impact of the liquidity indicator on the dependent variable		Table
			Corporates	Households	
Loan volume	Baseline	CEB liquidity indicator	+	+	Table 6
Loan volume	Baseline	MM liquidity indicator	∼	∼	Table 6
Loan volume	Crisis dummy	CEB liquidity indicator	+ (significant only in crisis)	+ (significant only in crisis)	Table 8
Loan volume	Asymmetry dummy	CEB liquidity indicator	+ (significant only for decreases)	+ (significant only for decreases)	Table 9
Credit spread	Baseline	CEB liquidity indicator	-	-	Table 7
Credit spread	Baseline	MM liquidity indicator	-	-	Table 7
Credit spread	Crisis dummy	CEB liquidity indicator	- (significant only in crisis)	- (significant only in crisis)	Table 10
Credit spread	Crisis dummy	MM liquidity indicator	- (significant only in crisis)	- (significant only in crisis)	Table 10
Credit spread	Asymmetry dummy	CEB liquidity indicator	- (significant only for decreases)	- (significant only for decreases)	Table 11
Credit spread	Asymmetry dummy	MM liquidity indicator	- (significant only for decreases)	- (significant only for decreases)	Table 11

Overview of the tables for the aggregate-level analysis of the euro area as a whole. The symbols + and - indicate a significant positive and significant negative impact of the liquidity indicator for the respective dependent variable. If the significant impact only holds under some circumstances, additional information are provided in brackets. The symbol ∼ denotes insignificance.

Sound market liquidity has a positive impact on the real economy and facilitates bank lending, i.e. is associated with higher loan volumes and lower credit spreads. This holds true for all lending segments in the euro area as a whole. Accordingly, we find evidence for a positive relationship between market liquidity and loan volumes (expectation 1, Table 6) and a negative relation between market liquidity and credit spreads, which is stronger and swifter than for loan volumes (expectation 2, Table 7). Furthermore, the lack of market liquidity has a strong negative impact on the real economy in times of crisis, i.e. during

the financial crisis of 2007–09 and the subsequent European sovereign debt crisis. Besides, market liquidity has an asymmetric effect on bank lending and thus the real economy: The negative impact of a reduction in liquidity is stronger and more significant than the positive impact of an increase in liquidity – on both loan volumes (Table 8/Table 9) and credit spreads (Table 10/Table 11). These results are in line with expectation 3.

The CEB liquidity indicator has a strong and significant effect on loan volumes, whereas the MM liquidity indicator is not significantly related to this variable. This is economically reasonable, as the CEB liquidity indicator focuses on the liquidity of instruments maturing – similarly to loans – in the mid-term and long-term. Besides the more realistic maturity to which the CEB liquidity indicator is referring, this measure covers markets in which the majority of banks actively participates. Given that we cannot find any significant relationship between the MM liquidity indicator and loan volumes, we drop this measure for the more specific calculations with the crisis and asymmetry-related interaction terms. Conversely, credit spreads are affected by both liquidity measures to a similar extent – the impact is in most cases significant at the 1% level.

Table 5 gives an overview of the results for the euro area as a whole and the countries therein. In order to keep the results clear and not overloaded, only the significance levels of the coefficients of the liquidity indicators referring to the shorter lag in the regression equations Equation 1 (i.e. $\alpha_{i,1}$) and Equation 2 (i.e. $\beta_{i,1}$) are shown. Put differently, the table summarizes the significance levels of the one-period lagged coefficients in the loan volume regression settings and the significance levels of the contemporaneous coefficients in the credit spread regression settings. Looking at the CEB liquidity indicator first (left panel of Table 5), we observe in each significant case the expected direction of the relationship between the CEB liquidity indicator and the dependent variables, i.e. a positive relation to loan volumes and a negative relation to credit spreads.

Table 5: Significance of the liquidity indicators on loan volumes and credit spreads

		Impact of **CEB** liquidity indicator on **loan volume**										Impact of **MM** liquidity indicator on **loan volume**									
Geographic region		EA	AT	BE	DE	ES	FI	FR	IE	IT	PT	EA	AT	BE	DE	ES	FI	FR	IE	IT	PT
Corporate	Total	***		*	**					*											
Households	Total	***		**	**			*		***	***										
Corporate	≤ 1 million	***	*		**		***	**		***											
Corporate	> 1 million	**			*																
Households	Consumption	***	*		**				*	***											
Households	Mortgages	***		**	*			**		**	***										
Households	Others	**						**		**	*								*		
		Impact of **CEB** liquidity indicator on **credit spreads**										Impact of **MM** liquidity indicator on **credit spreads**									
Geographic region		EA	AT	BE	DE	ES	FI	FR	IE	IT	PT	EA	AT	BE	DE	ES	FI	FR	IE	IT	PT
Corporate	Total	***	***	***	***	***	***	***	**	***		***	***	***	***	***	***	***	***	***	***
Households	Total	***	***	***			***	***	**	**		***	***	**			***	**	***		*
Corporate	≤ 1 million	***	***	***	***	***	***	***		***	***	***	***	***	***	***	***	***	***	***	***
Corporate	> 1 million	***	***	***	***	***	***	***	**	***		***	***	***	***	***	***	***	***	***	***
Households	Consumption	**	***	*		*	***	***		***			**				**				
Households	Mortgages	***	***	***	***	***	***	***	**	***	***	**	***				***	*	**	**	**
Households	Others	***	**	***	***	**	*	***		*		***	***	***	***	***	***	***	***	***	***

The table summarizes the cases in which the regression results show a significant impact of the CEB and MM liquidity indicator on loan volumes (one-period lagged coefficients) and credit spreads (contemporaneous coefficients) in banks' new business. The symbols *, ** and *** indicate significance at the 10%, 5% and 1% levels.

However, as Table 5 shows, loan volumes in the euro area are not significantly related to the MM liquidity indicator, while its impact on credit spreads is strong and significant across all countries and lending segments besides households' loans for consumption. Similarly to the table above for the CEB liquidity indicator (Table 5), only significance levels of the coefficients referring to the liquidity indicator are shown (significance levels of the one-period lagged coefficients in the loan volume regression settings and significance levels of the contemporaneous coefficients in the credit spread regression settings).

Looking at the cross-country differences in Table 5, loan volumes in Belgium, Germany, France and Italy are most strongly related to the CEB liquidity indicator.[11] As these countries encompass several major euro area economies, it is not surprising that the euro area as a whole is strongly exposed to market liquidity as well. We can even observe that the results for the euro area as a whole are clearer and more significant than the results in any of the countries therein. This indicates that a broad aggregate is generally more strongly exposed to systematic risk factors (i.e. market liquidity) than an individual country. Single countries tend to be exposed to individual frictions and are, thus, rather driven by idiosyncratic risk factors. That said, it is noteworthy that loan volumes in Austria, Spain, Finland and Ireland are in most cases insignificantly related to the CEB liquidity liquidity, although the direction of the impact is in the vast majority of cases positive (see Table A.5 and Table A.6). This heterogeneity in the impact of market liquidity across various euro area countries confirms our expectation 4. Generally, both corporate and household loans are exposed to the CEB liquidity indicator. However, the coefficient of the CEB liquidity indicator generally tends to be higher and more significant for households than for corporates (see Table 6). This suggests that loans to households are more strongly exposed to market liquidity and gives some evidence for expectation 5. This is particularly noteworthy in real terms, as households usually cannot rely on other funding sources like market funding (e.g. issuing bonds). Furthermore, the one-period lagged CEB liquidity indicator has in most cases a higher explanatory power and is more significant than the two-period lagged coefficient (see Table 6).

The CEB liquidity indicator affects credit spreads heavily across all lending segments and countries – the impact is in most cases significant at the 1% level. The contemporaneous realisation of the CEB liquidity indicator has a higher explanatory power than the one-period lagged one. This indicates that a liquidity shock materializes immediately in credit spreads and provides clear evidence for expectation 2 in full. Out of the individual lending segments, credit spreads of consumption loans are slightly less affected by market liquidity. As consumption loans are usually characterized by relatively high interest and default rates (see Table A.3), market liquidity seems to be dominated by other risk factors in the loan pricing process.

[11] Loan volume regression results for individual countries using the CEB liquidity indicator are shown in Table A.5 (total corporate loans) and Table A.6 (total household loans); the significance levels of the CEB liquidity indicator coincide with first two rows (total corporate and household loans) of the upper half of Table 5. Credit spread regression results for individual countries using the CEB liquidity indicator are shown in Table A.7 (total corporate loans) and Table A.8 (total household loans); the significance levels of the CEB liquidity indicator coincide with the first two rows of the lower half of Table 5. More detailed regression results are available upon request.

The results above highlight the importance of choosing the proper liquidity measure. The short-term oriented MM liquidity indicator fails to explain loan volumes in the euro area as a whole and the countries therein.[12] However, its impact on credit spreads is strong and significant. More specifically, credit spreads in most lending segments and countries are significantly affected at the 1% level; this corroborates the results gained from the CEB liquidity indicator and provides evidence for our expectation 2 again. Thus, liquidity changes in the money market seem to have a short-term effect on credit spreads which is not transmitted to loan volumes. Furthermore, it is noteworthy that credit spreads of households' consumption loans are only negligibly exposed to the MM liquidity indicator – the lower impact of credit spread in this lending segment to market liquidity was already indicated in the regression results of the CEB liquidity indicator.

3.2 The impact of market liquidity on loan volumes

Next, we will delve deeper and show regression results for loan volumes in the euro area as a whole for all considered lending segments. Table 6 shows the results of the baseline setting for loan volumes with the CEB liquidity indicator.

It turns out that the CEB liquidity indicator has a significant positive impact on lending in all segments (expectation 1). The effect on household loans is slightly higher than on corporate loans – this also holds true for the lending sub-segments therein. Furthermore, log-returns in loan volumes can be explained well by their history, i.e. both the one-month and the two-month lagged realisations have strong explanatory power. Out of the other control variables, the unemployment rate, economic sentiment indicator and CPI have a significant impact in at least one lending segment. Both the one-period and the two-period lagged realisations of the CEB liquidity indicator affect loan volumes, although the former exerts a much stronger effect on both corporate and household loans. Further, model fit, as measured by the coefficient of determination (R^2) is slightly higher for corporate loans than for household loans. More specifically, corporate loans up to one million euro (from the sub-segments of corporate loans) and consumption loans (from the sub-segments of household loans) can be explained best by systematic risk factors.

Instead, the MM liquidity indicator lacks power in explaining loan volumes – the coefficients point to both directions and are insignificant for any lending segment. This result emphasizes that the real effects of liquidity depend on the concept to measure it. However, the other control variables and the relation of the coefficients of determination across the lending segments are consistent with the previous results for the CEB liquidity indicator. As the CEB liquidity indicator is more appropriate in explaining loan volumes (see Table 6), we will only apply this liquidity indicator for any further analysis regarding loan volume, i.e. we do not perform the settings with a crisis and an asymmetry dummy for loan volumes using the MM liquidity indicator.

[12] In rare cases we find a significant impact on the two-period lagged MM liquidity indicator for some smaller countries.

Table 6: Regression results for the euro area as a whole for loan volumes in the baseline setting

	Regressions using the CEB liquidity index							Regressions using the MM liquidity index						
	Corporates	Households	Corporates		Households			Corporates	Households	Corporates		Households		
Dep. variable: Loan volume	Total	Total	≤ 1 Mio.	> 1 Mio.	Consumption	Mortgages	Other	Total	Total	≤ 1 Mio.	> 1 Mio.	Consumption	Mortgages	Other
CEB (t-1)	0.0956***	0.1267***	0.0882***	0.0963**	0.1117***	0.1347***	0.1282**							
	(0.0315)	(0.04)	(0.027)	(0.0371)	(0.0366)	(0.0488)	(0.0531)							
CEB (t-2)	0.0470	0.0852**	0.0317	0.0553	0.0818**	0.0981**	0.0439							
	(0.03)	(0.0389)	(0.026)	(0.0352)	(0.0355)	(0.0471)	(0.0511)							
MM (t-1)								0.0173	-0.0150	0.0016	0.0215	-0.0109	-0.0234	0.0004
								(0.0117)	(0.015)	(0.0103)	(0.0137)	(0.0138)	(0.0182)	(0.0198)
MM (t-2)								0.0119	0.0130	0.0041	0.0136	0.0095	0.0164	0.0043
								(0.0079)	(0.0103)	(0.0069)	(0.0093)	(0.0094)	(0.0124)	(0.0135)
Loan volume (t-1)	-0.5949***	-0.5748***	-0.7997***	-0.5229***	-0.7337***	-0.4835***	-0.4349***	-0.6157***	-0.5429***	-0.7912***	-0.5481***	-0.7070***	-0.4541***	-0.4268***
	(0.0739)	(0.0772)	(0.0674)	(0.0759)	(0.0745)	(0.0792)	(0.0785)	(0.0761)	(0.0781)	(0.0697)	(0.0776)	(0.0752)	(0.0796)	(0.0792)
Loan volume (t-2)	-0.3710***	-0.3580***	-0.5414***	-0.3007***	-0.4084***	-0.2808***	-0.2910***	-0.3734***	-0.3513***	-0.5433***	-0.3048***	-0.4199***	-0.2809***	-0.2835***
	(0.0734)	(0.0769)	(0.0671)	(0.0754)	(0.0739)	(0.0791)	(0.0783)	(0.0744)	(0.0796)	(0.0696)	(0.0757)	(0.0763)	(0.0813)	(0.0802)
Unemployment rate (t-1)	-0.0943**	-0.0961*	-0.0983***	-0.0929*	-0.1000**	-0.1258*	-0.0092	-0.0818*	-0.1174**	-0.0982**	-0.0765	-0.1175**	-0.1580**	-0.0093
	(0.0422)	(0.0543)	(0.0361)	(0.0497)	(0.0495)	(0.0659)	(0.0715)	(0.0451)	(0.0592)	(0.0394)	(0.0527)	(0.0542)	(0.0713)	(0.0766)
EURIBOR 3M (t-1)	0.0298	-0.0251	0.0092	0.0328	-0.0205	-0.0522	0.0234	0.0623	-0.0656	0.0040	0.0761*	-0.0511	-0.1107*	0.0114
	(0.0274)	(0.0347)	(0.0233)	(0.0324)	(0.0318)	(0.0422)	(0.0461)	(0.0382)	(0.0487)	(0.033)	(0.0445)	(0.0446)	(0.0589)	(0.0635)
EUCOM EcoSent (t-1)	-0.0083***	-0.0020	-0.0045**	-0.0093***	-0.0027	-0.0023	-0.0024	-0.0063***	0.0033	-0.0015	-0.0076***	0.0021	0.0037	0.0021
	(0.0024)	(0.0031)	(0.0021)	(0.0028)	(0.0028)	(0.0037)	(0.004)	(0.0022)	(0.0029)	(0.002)	(0.0026)	(0.0026)	(0.0035)	(0.0038)
FX EUR/USD (t-1)	0.0557	-0.1504	-0.0724	0.1140	-0.1060	-0.2459*	0.1329	0.0304	-0.0827	-0.0581	0.0790	-0.0503	-0.1589	0.1621
	(0.0898)	(0.1137)	(0.0762)	(0.1057)	(0.103)	(0.1379)	(0.1508)	(0.0942)	(0.1203)	(0.0812)	(0.11)	(0.1093)	(0.1444)	(0.1583)
Term spread 10Y-1Y (t-1)	-0.0035	-0.0113	-0.0088	-0.0013	0.0018	-0.0148	-0.0254	0.0079	-0.0300	-0.0083	0.0124	-0.0124	-0.0420	-0.0261
	(0.018)	(0.023)	(0.0154)	(0.0212)	(0.021)	(0.028)	(0.0304)	(0.0205)	(0.0267)	(0.018)	(0.024)	(0.0244)	(0.0322)	(0.035)
CPI (t-1)	4.9281**	-2.7813	1.8700	5.7177**	-2.4162	-2.0330	-1.7366	4.8761**	-1.2890	2.2395	5.5996**	-1.1352	-0.1219	-1.1993
	(2.2494)	(2.8997)	(1.9312)	(2.647)	(2.6227)	(3.5273)	(3.8109)	(2.304)	(3.0238)	(2.0232)	(2.6881)	(2.7441)	(3.647)	(3.9204)
Constant	-0.0069	0.0051	-0.0044	-0.0075	0.0020	0.0079	-0.0044	-0.0066	0.0025	-0.0050	-0.0069	-0.0001	0.0045	-0.0052
	(0.0046)	(0.0059)	(0.0039)	(0.0054)	(0.0053)	(0.0072)	(0.0078)	(0.0047)	(0.0062)	(0.0042)	(0.0055)	(0.0056)	(0.0075)	(0.008)
R^2	0.3956	0.3339	0.5321	0.3404	0.4392	0.2611	0.2382	0.3790	0.2886	0.4989	0.3331	0.3990	0.2263	0.2081
N	158	158	158	158	158	158	158	158	158	158	158	158	158	158

The table shows the regression results for log-returns of loan volumes (new business) as the dependent variable and the CEB or the MM liquidity indicator as an explanatory variable in the baseline setting. Standard errors are provided in brackets. The symbols *, ** and *** indicate significance at the 10%, 5% and 1% levels.

3.3 The impact of market liquidity on credit spreads

Next, we move to credit spreads and analyze their dependence on the liquidity indicators. Similar to our method for loan volumes, we show results for the baseline setting and expand it by including a crisis dummy and an asymmetry dummy. Table 7 shows the baseline setting where we explain the impact of the CEB and MM liquidity indicator on credit spreads for the euro area as a whole.

The impact of market liquidity on credit spreads is even more significant than on loan volumes – we find a strong significance of the contemporaneous realisation of the CEB liquidity indicator in each lending segment (expectation 2). Furthermore, credit spread adjustments to liquidity shocks are higher in terms of magnitude for corporates than for households. More specifically, credit spreads of corporate loans over one million euro are slightly more sensitive to market liquidity than credit spreads of corporate loans up to one million euro. Furthermore, out of the segments of household loans, mortgage loans are the most strongly affected by the contemporaneous realisation of the CEB liquidity indicator. In addition, model fit, as measured by the coefficient of determination (R^2) is considerably higher for corporate loans than for household loans. The EURIBOR 3M and the term spread prove to be the most relevant and significant control variables. The contemporaneous realisation of the CEB liquidity indicator predominantly affects credit spreads for all lending segments besides households' consumption loans and the impact of the one-period lagged realisation is in most cases insignificant.

The short-term oriented MM liquidity indicator confirms the results based on the CEB liquidity indicator for credit spreads (expectation 2). This is noteworthy, as loan volumes were only significantly related to the CEB liquidity indicator. In line with the results of the CEB liquidity indicator, the results for the MM liquidity indicator show that credit spreads of corporate loans react more strongly to changes in market liquidity than those of households. The impact of the contemporaneous MM liquidity indicator is stronger than the impact of the one-period lagged MM liquidity indicator. Furthermore, the one-period lagged MM liquidity indicator points in the positive direction, although its impact is small and only significant in a few cases. But the aggregate impact from both lags of the liquidity indicator on credit spreads is still negative in all cases. Besides this, the coefficient of determination (R^2) for corporate loans is considerably higher than for household loans (0.5840 compared to 0.1757) – this large difference between both lending segments could not be observed when using the CEB liquidity indicator. This suggests that the pricing of corporate loans is swiftly adjusted to changes in short-term market liquidity. Surprisingly, when using the MM instead of the CEB liquidity indicator, the majority of the control variables becomes significant although their signs or their magnitudes barely change.

Table 7: Regression results for the euro area as a whole for credit spreads in the baseline setting

	Regressions using the CEB liquidity index							Regressions using the MM liquidity index						
	Corporates	Households	Corporates		Households			Corporates	Households	Corporates		Households		
Dep. var.: Credit spread	Total	Total	≤ 1 Mio.	> 1 Mio.	Consumption	Mortgages	Other	Total	Total	≤ 1 Mio.	> 1 Mio.	Consumption	Mortgages	Other
CEB (t)	-0.5370***	-0.3291***	-0.5336***	-0.5711***	-0.3574**	-0.4904***	-0.3742***							
	(0.1168)	(0.1208)	(0.112)	(0.1231)	(0.1595)	(0.1033)	(0.118)							
CEB (t-1)	0.1223	-0.1671	0.0218	0.1455	-0.3648**	-0.1406	-0.0136							
	(0.1257)	(0.1299)	(0.1205)	(0.1325)	(0.1716)	(0.1112)	(0.127)							
MM (t)								-0.2852***	-0.0860***	-0.2626***	-0.3002***	-0.0392	-0.0671**	-0.2172***
								(0.0232)	(0.0324)	(0.0236)	(0.0245)	(0.0439)	(0.0292)	(0.0266)
MM (t-1)								0.1342***	0.0628	0.0935***	0.1507***	0.0176	0.0434	0.1171***
								(0.0326)	(0.0453)	(0.0331)	(0.0343)	(0.0615)	(0.0409)	(0.0373)
Unemployment rate (t-1)	0.1524	0.1723	0.2262	0.1536	0.1989	0.2539*	0.1793	0.2919**	0.1946	0.3150**	0.3084**	0.1461	0.2072	0.3092**
	(0.1692)	(0.1749)	(0.1622)	(0.1783)	(0.2311)	(0.1496)	(0.1709)	(0.1278)	(0.1779)	(0.1298)	(0.1345)	(0.2413)	(0.1605)	(0.1463)
EURIBOR 3M (t-1)	0.3566***	0.3276***	0.4057***	0.3521***	0.2574*	0.3570***	0.4064***	0.4026***	0.4203***	0.3950***	0.4189***	0.3171	0.4172***	0.4906***
	(0.1074)	(0.111)	(0.1029)	(0.1132)	(0.1467)	(0.095)	(0.1085)	(0.1083)	(0.1508)	(0.1101)	(0.114)	(0.2045)	(0.1361)	(0.124)
EUCOM EcoSent (t-1)	-0.0046	-0.0065	-0.0070	-0.0039	-0.0129	-0.0035	-0.0033	-0.0136**	-0.0194**	-0.0171***	-0.0134**	-0.0303**	-0.0164**	-0.0142*
	(0.0095)	(0.0098)	(0.0091)	(0.01)	(0.013)	(0.0084)	(0.0096)	(0.0064)	(0.0088)	(0.0065)	(0.0067)	(0.012)	(0.008)	(0.0073)
FX EUR/USD (t-1)	-0.1222	0.1468	0.0319	-0.1684	0.4059	0.1624	-0.0560	-0.4654*	-0.1116	-0.2499	-0.5505*	0.1749	-0.1397	-0.3472
	(0.3532)	(0.3652)	(0.3386)	(0.3722)	(0.4824)	(0.3124)	(0.3569)	(0.267)	(0.3719)	(0.2714)	(0.2811)	(0.5044)	(0.3355)	(0.3058)
Term spread 10Y-1Y (t-1)	0.1310*	0.2129***	0.1572**	0.1211	0.2226**	0.1919***	0.1721**	0.1656***	0.2544***	0.1656***	0.1666***	0.2466**	0.2456***	0.2036***
	(0.0719)	(0.0743)	(0.0689)	(0.0758)	(0.0982)	(0.0636)	(0.0727)	(0.0602)	(0.0838)	(0.0612)	(0.0634)	(0.1137)	(0.0756)	(0.0689)
CPI (t-1)	-8.4449	-12.0034	-9.6449	-8.0074	-17.1483	-12.4054	-14.3550	-14.8355**	-14.3714	-14.6013**	-14.9740**	-17.6160	-13.1010	-20.0785***
	(8.8684)	(9.1689)	(8.5008)	(9.3462)	(12.1112)	(7.8436)	(8.9604)	(6.6346)	(9.2391)	(6.7429)	(6.9848)	(12.5318)	(8.3365)	(7.5988)
Constant	0.0235	0.0269	0.0261	0.0227	0.0413*	0.0274*	0.0318*	0.0346**	0.0323*	0.0346**	0.0349**	0.0439*	0.0305*	0.0420***
	(0.0182)	(0.0189)	(0.0175)	(0.0192)	(0.0249)	(0.0161)	(0.0184)	(0.0137)	(0.019)	(0.0139)	(0.0144)	(0.0258)	(0.0172)	(0.0156)
R^2	0.2384	0.1682	0.2604	0.2336	0.1374	0.2673	0.1927	0.5840	0.1757	0.5458	0.5822	0.0986	0.1922	0.4334
N	158	158	158	158	158	158	158	158	158	158	158	158	158	158

The table shows the regression results for changes in credit spreads of loans (new business) as the dependent variable and the CEB or MM liquidity indicator as an explanatory variable in the baseline setting. Standard errors are provided in brackets. The symbols *, ** and *** indicate significance at the 10%, 5% and 1% levels.

3.4 The impact of market liquidity in times of crisis

We expect that the relation of market liquidity and bank lending is particularly significant in times of crisis, and that the impact of market liquidity on bank lending is more significant for liquidity reductions than for increases (expectation 3). Our first test of these hypotheses is based on regression analyses, where the liquidity indicators are indicated with a crisis dummy 1_{Crisis} that takes the value of 1 during the period 9/2007–8/2012 and is otherwise zero, and a non-crisis dummy $1_{Non-crisis}$ that takes the value of 1 during the periods 1/2003–8/2007 and 9/2012–5/2016 and is otherwise zero. When these indicators are interacted with the CEB and MM liquidity indices, we can differentiate the effect of market liquidity on bank lending between crisis and non-crisis times. Table 8 shows the results for loan volumes for the CEB liquidity indicator using a crisis dummy for the period 9/2007 to 8/2012.

Table 8: Regression results for the euro area as a whole for loan volumes using the CEB liquidity indicator in the setting with a crisis dummy

	Corporates	Households	Corporates		Households		
Dep. variable: Loan volume	Total	Total	≤ 1 Mio.	> 1 Mio.	Consumption	Mortgages	Other
CEB (t-1) $\cdot 1_{Crisis}$	0.1008***	0.1325***	0.0991***	0.095**	0.1023**	0.1371**	0.1289**
	(0.0373)	(0.0461)	(0.0308)	(0.0442)	(0.0427)	(0.0566)	(0.0624)
CEB (t-1) $\cdot 1_{Non-crisis}$	0.0798	0.1002	0.0514	0.0982	0.127*	0.1169	0.1173
	(0.0592)	(0.0736)	(0.0491)	(0.0701)	(0.0683)	(0.0903)	(0.0996)
CEB (t-2) $\cdot 1_{Crisis}$	0.0416	0.1164***	0.0568*	0.0372	0.0934**	0.1376**	0.0512
	(0.0346)	(0.0439)	(0.0292)	(0.0408)	(0.0405)	(0.0537)	(0.0586)
CEB (t-2) $\cdot 1_{Non-crisis}$	0.0636	0.002	-0.0374	0.1081	0.0481	-0.0138	0.0244
	(0.059)	(0.0738)	(0.0492)	(0.0696)	(0.0686)	(0.0904)	(0.0994)
1_{Crisis}	-0.0125	-0.0273***	-0.0197***	-0.0102	-0.0168*	-0.026**	-0.028**
	(0.008)	(0.0101)	(0.0067)	(0.0094)	(0.0093)	(0.0124)	(0.0135)
Loan volume (t-1)	-0.6146***	-0.6169***	-0.8352***	-0.5355***	-0.753***	-0.5144***	-0.4587***
	(0.0755)	(0.0776)	(0.0668)	(0.0776)	(0.0753)	(0.0799)	(0.0795)
Loan volume (t-2)	-0.3856***	-0.3914***	-0.5703***	-0.306***	-0.4204***	-0.3058***	-0.3096***
	(0.075)	(0.0765)	(0.0661)	(0.0774)	(0.0742)	(0.0789)	(0.0795)
Unemployment rate (t-1)	-0.0659	-0.0467	-0.0634*	-0.0658	-0.0675	-0.082	0.0487
	(0.0457)	(0.0577)	(0.038)	(0.054)	(0.0534)	(0.0706)	(0.0771)
EURIBOR 3M (t-1)	0.0329	-0.0312	0.006	0.0373	-0.0249	-0.0613	0.022
	(0.0279)	(0.0346)	(0.023)	(0.0331)	(0.0321)	(0.0424)	(0.0465)
EUCOM EcoSent (t-1)	-0.0089***	-0.0028	-0.0055***	-0.0096***	-0.0029	-0.0031	-0.0033
	(0.0025)	(0.0031)	(0.0021)	(0.003)	(0.0029)	(0.0038)	(0.0042)
FX EUR/USD (t-1)	0.0545	-0.1821	-0.0964	0.1249	-0.1144	-0.2814**	0.1223
	(0.0912)	(0.1131)	(0.0752)	(0.1075)	(0.1039)	(0.1383)	(0.1524)
Term spread 10Y-1Y (t-1)	-0.0039	-0.0075	-0.0063	-0.0029	0.0026	-0.0107	-0.0243
	(0.0181)	(0.0227)	(0.0151)	(0.0214)	(0.021)	(0.0278)	(0.0305)
CPI (t-1)	5.7953**	-1.3457	2.942	6.5451**	-1.3301	-0.6721	0.0468
	(2.3251)	(2.9224)	(1.9429)	(2.741)	(2.6916)	(3.5872)	(3.9059)
Constant	-0.0034	0.014	0.0021	-0.0052	0.0067	0.0166**	0.0036
	(0.0052)	(0.0066)	(0.0044)	(0.0061)	(0.0061)	(0.0082)	(0.0088)
R^2	0.4065	0.3719	0.565	0.3496	0.4537	0.2919	0.2604
N	158	158	158	158	158	158	158

The table shows the regression results for log-returns of loan volumes (new business) as the dependent variable and the CEB liquidity indicator as an explanatory variable in the setting with a crisis dummy. Standard errors are provided in brackets. The symbols *, ** and *** indicate significance at the 10%, 5% and 1% levels.

As indicated by the coefficients for the interaction terms, loan volumes are strongly and significantly affected by the CEB liquidity indicator in times of crisis (expectation 3). The impact remains positive but becomes insignificant in the non-crisis period. The negative coefficient for the crisis dummy means that lending was negatively affected in times of crisis, but this effect was more pronounced if there was also a lack of market liquidity. The observations for the other control variables, the dominance of the one-period over the two-period lagged coefficient of the liquidity indicator and the coefficients of determination (R^2) for the individual lending segments are similar to the baseline setting.

We also test the asymmetric effects of liquidity on loan volumes using the dummy $1_{CEB(t-1)<0}$, which takes the value of 1 if the liquidity indicator in $t-1$ was negative (similarly $1_{CEB(t-2)<0}$ for $t-2$). Table 9 reports regression results where the dummies are interacted with the liquidity index.

Table 9: Regression results for the euro area as a whole for loan volumes using the CEB liquidity indicator in the setting with an asymmetry dummy

	Corporates	Households	Corporates		Households		
Dep. variable: Loan volume	Total	Total	≤ 1 Mio.	> 1 Mio.	Consumption	Mortgages	Other
CEB (t-1) $\cdot 1_{CEB(t-1)\geq 0}$	0.0242	0.0949	0.0755	-0.0019	0.1169	0.0436	0.1835
	(0.0798)	(0.1009)	(0.0687)	(0.0942)	(0.0905)	(0.1242)	(0.1344)
CEB (t-1) $\cdot 1_{CEB(t-1)<0}$	0.1602***	0.1411**	0.1233***	0.1636***	0.1152**	0.1439*	0.1475*
	(0.0506)	(0.0641)	(0.0438)	(0.0597)	(0.0577)	(0.0791)	(0.0848)
$1_{CEB(t-1)\geq 0}$	-0.0054	0.0007	-0.007	-0.0026	-0.0038	0.0111	-0.0135
	(0.0091)	(0.0115)	(0.0078)	(0.0108)	(0.0102)	(0.0142)	(0.0152)
CEB (t-2) $\cdot 1_{CEB(t-1)\geq 0}$	0.0282	-0.0104	0.014	0.028	-0.0199	0.0955	-0.0391
	(0.0699)	(0.0882)	(0.0598)	(0.0826)	(0.0787)	(0.1085)	(0.1167)
CEB (t-2) $\cdot 1_{CEB(t-1)<0}$	-0.0122	0.044	0.0306	-0.0233	0.0233	0.0181	-0.0574
	(0.0546)	(0.0708)	(0.0481)	(0.0638)	(0.0631)	(0.0868)	(0.0919)
$1_{CEB(t-2)\geq 0}$	0.0144	0.0249***	0.0046	0.0191	0.0316***	0.013	0.037**
	(0.0091)	(0.0114)	(0.0078)	(0.0107)	(0.0102)	(0.014)	(0.0151)
Loan volume (t-1)	-0.6119***	-0.5824***	-0.7976***	-0.5389***	-0.7221***	-0.4988***	-0.4452***
	(0.0766)	(0.0783)	(0.0695)	(0.0789)	(0.074)	(0.0814)	(0.0792)
Loan volume (t-2)	-0.3678***	-0.3562***	-0.5358***	-0.2947***	-0.4041***	-0.2892***	-0.2804***
	(0.0739)	(0.0771)	(0.0678)	(0.0761)	(0.0724)	(0.0807)	(0.0786)
Unemployment rate (t-1)	-0.0614	-0.0679	-0.0881	-0.0533	-0.0827	-0.1027	0.0217
	(0.0458)	(0.0591)	(0.0394)	(0.0539)	(0.0526)	(0.0725)	(0.0768)
EURIBOR 3M (t-1)	0.0312	-0.0119	0.0138	0.035	0.015	-0.0585	0.0604
	(0.0312)	(0.0397)	(0.027)	(0.0368)	(0.0358)	(0.0489)	(0.0524)
EUCOM EcoSent (t-1)	-0.0091***	-0.0025	-0.0049**	-0.0102***	-0.0031	-0.0025	-0.0033
	(0.0024)	(0.0031)	(0.0021)	(0.0029)	(0.0028)	(0.0038)	(0.0041)
FX EUR/USD (t-1)	0.0434	-0.1656	-0.0649	0.0953	-0.0955	-0.2795*	0.1432
	(0.0917)	(0.1164)	(0.0788)	(0.1078)	(0.1036)	(0.1429)	(0.1527)
Term spread 10Y-1Y (t-1)	0.011	-0.0034	-0.0033	0.0165	0.0078	-0.0042	-0.0224
	(0.0201)	(0.0257)	(0.0175)	(0.0237)	(0.0231)	(0.0317)	(0.034)
CPI (t-1)	4.2547*	-2.8923	1.3862	5.1371*	-2.3935	-1.7816	-2.4258
	(2.308)	(2.9918)	(2.0076)	(2.7102)	(2.648)	(3.6748)	(3.898)
Constant	-0.0043	-0.0046	-0.0012	-0.0075	-0.0139	0.0012	-0.0161
	(0.0093)	(0.012)	(0.0081)	(0.011)	(0.0107)	(0.0148)	(0.0156)
R^2	0.4173	0.3565	0.5382	0.3654	0.4777	0.2712	0.2721
N	158	158	158	158	158	158	158

The table shows the regression results for log-returns of loan volumes (new business) as the dependent variable and the CEB liquidity indicator as an explanatory variable in the setting with an asymmetry dummy. Standard errors are provided in brackets. The symbols *, ** and *** indicate significance at the 10%, 5% and 1% levels.

Again, the interaction terms indicate that market liquidity has a significant impact on loan volumes when liquidity is deteriorating – a finding that squares well with our analyses using the crisis dummy and is in line with our expectation 3. However, the impact of liquidity weakens and becomes insignificant for liquidity increases. It is of particular relevance that corporate loans in general and particularly corporate loans over one million euro – representing long-term corporate investment decisions – are affected most when times get tough and market liquidity is contracted. In contrast, corporate loans barely react to liquidity increases. It is noteworthy that, while earlier analyses indicated that household loans seemed to be more strongly exposed to market liquidity, this relation reverses when we isolate the reaction to tightenings in market liquidity. Similarly to corporate loans, mortgage loans are affected to a much stronger degree by liquidity deteriorations than by liquidity increases. This asymmetric reaction is in line with the findings in Schiozer and de Freitas Oliveira (2016) for Brazilian banks. Interestingly, household loans for consumption and for other purposes – though their sensitivity to market liquidity tends to be generally slightly higher than to corporate loans (see Table 6) – do not show this strong asymmetric reaction to liquidity increases and decreases. Their reaction to on liquidity changes is almost symmetrical but lacks significance for liquidity increases. Again, the observations for the other control variables, the dominance of the one-period over the two-period lagged coefficient of the liquidity indicator and the coefficients of determination for the individual lending segments are similar to the baseline setting.

Next, we analyze how the impact of market liquidity on loan spreads differs between crisis and non-crisis times. Results are reported in Table 10. When we interact the CEB and MM liquidity indices with a crisis dummy 1_{Crisis} and a non-crisis dummy $1_{Non-crisis}$, we find that the liquidity indicators have a negative impact on credit spreads in both market phases. However, in line with our expectation 3, these coefficients are only significant under stressed market conditions. As expected, the coefficient for the crisis dummy takes a positive value, which suggests higher credit spreads in crisis times, while the spreads increase further if market liquidity is lacking in crisis times. The statements regarding the control variables, the dominance of the contemporaneous over the one-period lagged coefficient of the liquidity indicator and the higher coefficients of determination for corporate loans are similar to the baseline setting.

Finally, we test the effect of market liquidity on loan spreads for any asymmetries. Regression results using the interaction terms $1_{CEB(t)<0}$ and $1_{CEB(t-1)<0}$ (or respectively $1_{MM(t)<0}$ and $1_{MM(t-1)<0}$) are reported in Table 11. Again, the coefficients for interaction terms with the liquidity indicators show an asymmetric reaction of loan credit spreads to positive and negative changes in market liquidity. Decreases in liquidity are associated with rising credit spreads – the impact of liquidity increases is, however, smaller and only significant for corporate loans (when using the MM liquidity index) and for mortgage loans (when using the CEB liquidity index). Overall, these findings square well with our expectations 3. Please note regression results are conclusive when we consider the MM liquidity index, as there are partly offsetting effects of the contemporaneous and the one-period lagged coefficients for the CEB liquidity index. The statements regarding the significance of control variables and the higher coefficients of determination (R^2) for corporate loans are similar to the baseline setting.

Table 10: Regression results for the euro area as a whole for credit spreads in the setting with a crisis dummy

	Regressions using the CEB liquidity index							Regressions using the MM liquidity index						
	Corporates	Households	Corporates		Households			Corporates	Households	Corporates		Households		
Dep. variable: Credit spread	Total	Total	$\leq$ 1 Mio.	$>$ 1 Mio.	Consumption	Mortgages	Other	Total	Total	$\leq$ 1 Mio.	$>$ 1 Mio.	Consumption	Mortgages	Other
CEB (t) $\cdot 1_{Crisis}$	-0.5981***	-0.4038***	-0.5819***	-0.6326***	-0.4631**	-0.4918***	-0.4172***							
	(0.1306)	(0.1346)	(0.124)	(0.1382)	(0.1781)	(0.1168)	(0.1319)							
CEB (t) $\cdot 1_{Non-crisis}$	-0.1375	0.1406	-0.1327	-0.1946	0.2557	-0.381	-0.0279							
	(0.2632)	(0.2712)	(0.2498)	(0.2785)	(0.359)	(0.2354)	(0.2659)							
CEB (t-1) $\cdot 1_{Crisis}$	0.1455	-0.1767	0.01	0.1873	-0.4198**	-0.131	-0.0306							
	(0.1464)	(0.1508)	(0.139)	(0.1549)	(0.1996)	(0.1309)	(0.1479)							
CEB (t-1) $\cdot 1_{Non-crisis}$	0.1137	-0.082	0.1232	0.0795	-0.1512	-0.1323	0.0906							
	(0.2352)	(0.2423)	(0.2233)	(0.2489)	(0.3208)	(0.2104)	(0.2376)							
MM (t) $\cdot 1_{Crisis}$								-0.2888***	-0.071**	-0.2591***	-0.3068***	-0.0207	-0.0536*	-0.2165***
								(0.0237)	(0.0332)	(0.024)	(0.025)	(0.0452)	(0.03)	(0.0273)
MM (t) $\cdot 1_{Non-crisis}$								-0.0606	-0.2691	-0.149	-0.0224	-0.2654	-0.2441	-0.0498
								(0.1231)	(0.1724)	(0.1245)	(0.1296)	(0.2345)	(0.1559)	(0.1415)
MM (t-1) $\cdot 1_{Crisis}$								0.1432***	0.0645	0.101***	0.1622***	0.0202	0.047	0.1293***
								(0.0337)	(0.0472)	(0.0341)	(0.0355)	(0.0642)	(0.0427)	(0.0387)
MM (t-1) $\cdot 1_{Non-crisis}$								0.0528	0.1253	0.0631	0.0279	0.0895	0.0745	0.0222
								(0.1095)	(0.1532)	(0.1107)	(0.1152)	(0.2084)	(0.1385)	(0.1257)
1_{Crisis}	0.0524	0.0614*	0.0754**	0.0416	0.0728*	0.0364	0.0638**	0.0387*	0.0621*	0.0626***	0.0282	0.0765*	0.0493*	0.0508*
	(0.0319)	(0.0329)	(0.0303)	(0.0338)	(0.0435)	(0.0285)	(0.0322)	(0.0233)	(0.0326)	(0.0236)	(0.0245)	(0.0444)	(0.0295)	(0.0268)
Unemployment rate (t-1)	0.0556	0.0582	0.0758	0.0811	0.0659	0.1767***	0.0523	0.2704*	0.0103	0.2129***	0.3213**	-0.0819	0.0483	0.2417
	(0.1829)	(0.1884)	(0.1736)	(0.1936)	(0.2495)	(0.1636)	(0.1848)	(0.1404)	(0.1965)	(0.142)	(0.1477)	(0.2674)	(0.1777)	(0.1613)
EURIBOR 3M (t-1)	0.3682***	0.3344***	0.4108***	0.3667***	0.2585*	0.3607	0.4096***	0.4351***	0.4237***	0.423**	0.4566***	0.322	0.422***	0.5274***
	(0.1075)	(0.1108)	(0.1021)	(0.1138)	(0.1467)	(0.0962)	(0.1086)	(0.1088)	(0.1523)	(0.11)	(0.1145)	(0.2072)	(0.1377)	(0.125)
EUCOM EcoSent (t-1)	-0.0028	-0.0033	-0.0037	-0.003	-0.0077	-0.0026	-0.0003	-0.0121*	-0.0181**	-0.0151	-0.0123*	-0.0288**	-0.0157*	-0.0128*
	(0.0098)	(0.0101)	(0.0093)	(0.0103)	(0.0133)	(0.0087)	(0.0099)	(0.0064)	(0.0089)	(0.0065)	(0.0067)	(0.0122)	(0.0081)	(0.0073)
FX EUR/USD (t-1)	-0.0868	0.1965	0.0665	-0.1364	0.4828	0.1631	-0.0241	-0.4487*	-0.1588	-0.2539	-0.5284*	0.1154	-0.1887	-0.3507
	(0.3533)	(0.364)	(0.3354)	(0.3738)	(0.4818)	(0.316)	(0.3569)	(0.2661)	(0.3724)	(0.2691)	(0.28)	(0.5066)	(0.3367)	(0.3056)
Term spread 10Y-1Y (t-1)	0.1299*	0.2098***	0.1556**	0.1207	0.2161**	0.1929***	0.1703**	0.1702***	0.2651***	0.1729***	0.1723***	0.2606**	0.2584***	0.215***
	(0.0716)	(0.0738)	(0.068)	(0.0758)	(0.0977)	(0.064)	(0.0723)	(0.0612)	(0.0857)	(0.0619)	(0.0644)	(0.1166)	(0.0775)	(0.0703)
CPI (t-1)	-12.7707	-16.7319*	-15.0948*	-11.7733	-22.4633*	-15.0088*	-18.9155**	-16.8578**	-19.3722**	-18.5566***	-16.3018**	-23.8314*	-17.4663**	-23.4682***
	(9.0857)	(9.3603)	(8.6245)	(9.6141)	(12.3915)	(8.126)	(9.1778)	(6.8327)	(9.5636)	(6.9089)	(7.1888)	(13.0094)	(8.6471)	(7.8485)
Constant	0.0071	0.0062	0.0019	0.0102	0.0149	0.0168	0.011	0.021	0.0185	0.0159	0.0243	0.0271	0.0211	0.0274
	(0.0206)	(0.0213)	(0.0196)	(0.0218)	(0.0281)	(0.0185)	(0.0208)	(0.0158)	(0.022)	(0.0159)	(0.0166)	(0.03)	(0.0199)	(0.0181)
R^2	0.264	0.2019	0.2992	0.2534	0.1687	0.276	0.2203	0.6015	0.2023	0.5694	0.6003	0.1227	0.2151	0.4541
N	158	158	158	158	158	158	158	158	158	158	158	158	158	158

The table shows the regression results for changes in credit spreads of loans (new business) as the dependent variable and the CEB or MM liquidity indicator as an explanatory variable in the setting with a crisis dummy. Standard errors are provided in brackets. The symbols *, ** and *** indicate significance at the 10%, 5% and 1% levels.

Table 11: Regression results for the euro area as a whole for credit spreads in the setting with an asymmetry dummy

	Regressions using the CEB liquidity index							Regressions using the MM liquidity index						
	Corporates	Households	Corporates		Households			Corporates	Households	Corporates		Households		
Dep. variable: Credit spread	Total	Total	≤ 1 Mio.	> 1 Mio.	Consumption	Mortgages	Other	Total	Total	≤ 1 Mio.	> 1 Mio.	Consumption	Mortgages	Other
CEB (t) $\cdot 1_{CEB(t)\geq 0}$	0.0416	-0.3127	0.2107	0.0375	-0.3935	-0.7332***	0.2227							
	(0.2987)	(0.3188)	(0.2847)	(0.3135)	(0.4226)	(0.2718)	(0.3074)							
CEB (t) $\cdot 1_{CEB(t)<0}$	-0.6217***	-0.4265**	-0.7331***	-0.5903***	-0.4397*	-0.4108**	-0.5412***							
	(0.1783)	(0.1903)	(0.1699)	(0.1872)	(0.2523)	(0.1623)	(0.1835)							
$1_{CEB(t)\geq 0}$	-0.0362	0.0159	-0.0361	-0.0509	0.0207	0.0021	-0.0292							
	(0.0343)	(0.0366)	(0.0327)	(0.036)	(0.0486)	(0.0312)	(0.0353)							
CEB (t-1) $\cdot 1_{CEB(t)\geq 0}$	0.0739	0.2104	0.186	-0.0929	-0.0596	0.1605	0.0813							
	(0.3081)	(0.3287)	(0.2935)	(0.3233)	(0.4358)	(0.2803)	(0.317)							
CEB (t-1) $\cdot 1_{CEB(t)<0}$	0.5662***	-0.2352	0.356*	0.684***	-0.4107	-0.3074*	0.1997							
	(0.2033)	(0.2169)	(0.1937)	(0.2133)	(0.2876)	(0.185)	(0.2092)							
$1_{CEB(t-1)\geq 0}$	-0.067*	-0.0351	-0.0616*	-0.0617*	-0.0328	-0.0172	-0.0314							
	(0.0348)	(0.0372)	(0.0332)	(0.0366)	(0.0493)	(0.0317)	(0.0359)							
MM (t)$\cdot 1_{MM(t)\geq 0}$								-0.1397***	0.0632	-0.0956*	-0.1569***	0.1194	0.0626	-0.0925
								(0.0506)	(0.0698)	(0.0492)	(0.0542)	(0.0967)	(0.0645)	(0.0565)
MM (t) $\cdot 1_{MM(t)<0}$								-0.3859***	-0.2066***	-0.3898***	-0.3896***	-0.1541**	-0.1527***	-0.3457***
								(0.0342)	(0.0472)	(0.0333)	(0.0366)	(0.0654)	(0.0436)	(0.0382)
$1_{MM(t)\geq 0}$								0.0136	0.0115	0.0198	0.0078	-0.0079	-0.0057	0.0443*
								(0.0228)	(0.0315)	(0.0222)	(0.0244)	(0.0436)	(0.0291)	(0.0255)
MM (t-1) $\cdot 1_{MM(t)\geq 0}$								0.1359**	0.1767**	0.1436***	0.1323**	0.1818*	0.1093	0.2068***
								(0.0536)	(0.074)	(0.0522)	(0.0574)	(0.1025)	(0.0683)	(0.0599)
MM (t-1) $\cdot 1_{MM(t)<0}$								0.1648***	0.0178	0.1017**	0.2013***	-0.0459	0.0185	0.1116**
								(0.0481)	(0.0665)	(0.0469)	(0.0515)	(0.0921)	(0.0613)	(0.0538)
$1_{MM(t-1)\geq 0}$								0.0085	0.0087	0.0055	0.0016	-0.0055	0.0121	-0.0115
								(0.0228)	(0.0315)	(0.0222)	(0.0244)	(0.0436)	(0.0291)	(0.0255)
Unemployment rate (t-1)	0.1715	0.1365	0.1901	0.1992	0.1772	0.2406	0.1407	0.2514**	0.0969	0.2487**	0.2763**	0.0115	0.1272	0.2569
	(0.1723)	(0.1839)	(0.1642)	(0.1809)	(0.2438)	(0.1568)	(0.1773)	(0.1255)	(0.1732)	(0.1221)	(0.1343)	(0.2399)	(0.1599)	(0.1403)
EURIBOR 3M (t-1)	0.407***	0.3729***	0.5039***	0.3805***	0.2896*	0.3548***	0.4838***	0.4749***	0.5339***	0.4991***	0.4796***	0.4414**	0.4922***	0.6102***
	(0.1144)	(0.1221)	(0.109)	(0.1201)	(0.1619)	(0.1041)	(0.1178)	(0.1062)	(0.1466)	(0.1034)	(0.1137)	(0.2031)	(0.1353)	(0.1187)
EUCOM EcoSent (t-1)	-0.0095	-0.0055	-0.0103	-0.01	-0.0121	-0.0021	-0.0053	-0.0063	-0.0029	-0.005	-0.0085	-0.0112	-0.0048	-0.0015
	(0.0095)	(0.0101)	(0.009)	(0.0099)	(0.0134)	(0.0086)	(0.0097)	(0.0068)	(0.0094)	(0.0066)	(0.0073)	(0.013)	(0.0087)	(0.0076)
FX EUR/USD (t-1)	-0.2113	0.2227	-0.0633	-0.2994	0.4842	0.2516	-0.148	-0.5083*	-0.1477	-0.2986	-0.6028**	0.1194	-0.1731	-0.3874
	(0.3544)	(0.3782)	(0.3377)	(0.3719)	(0.5014)	(0.3225)	(0.3647)	(0.2579)	(0.356)	(0.2511)	(0.2761)	(0.4932)	(0.3287)	(0.2883)
Term spread 10Y-1Y (t-1)	0.1632**	0.1625*	0.1481*	0.1852**	0.1829	0.1566**	0.1628*	0.147**	0.1881**	0.1253**	0.1625**	0.1721	0.2034***	0.153**
	(0.0818)	(0.0873)	(0.0779)	(0.0858)	(0.1157)	(0.0744)	(0.0841)	(0.0605)	(0.0836)	(0.0589)	(0.0648)	(0.1158)	(0.0772)	(0.0677)
CPI (t-1)	-11.7943	-12.0682	-11.0056	-12.2389	-17.3929	-13.4076	-14.4164	-15.5643**	-17.1194*	-16.4141***	-15.4787**	-21.6071*	-14.74*	-22.8317***
	(8.9919)	(9.5953)	(8.5682)	(9.4365)	(12.7201)	(8.1813)	(9.2527)	(6.4514)	(8.9066)	(6.2808)	(6.908)	(12.3383)	(8.2223)	(7.2121)
Constant	0.0778**	0.0171	0.0534	0.0948**	0.0337	0.0311	0.0419	-0.0025	-0.026	-0.0168	0.0111	-0.0024	-0.0072	-0.0137
	(0.0372)	(0.0397)	(0.0354)	(0.039)	(0.0526)	(0.0338)	(0.0383)	(0.0247)	(0.034)	(0.024)	(0.0264)	(0.0471)	(0.0314)	(0.0276)
R^2	0.2942	0.1789	0.3227	0.2958	0.1424	0.2815	0.2241	0.6282	0.2761	0.6276	0.6138	0.1743	0.2574	0.5176
N	158	158	158	158	158	158	158	158	158	158	158	158	158	158

The table shows the regression results for changes in credit spreads of loans (new business) as the dependent variable and the liquidity indicator as an explanatory variable in the setting with an asymmetry dummy. Standard errors are provided in brackets. The symbols *, ** and *** indicate significance at the 10%, 5% and 1% levels.

3.5 Discussion of aggregate results and further robustness checks

In sum, changes in loan volumes in the euro area are strongly related to the currency, equity and bond (CEB) liquidity indicator (expectation 1), whereas there is no significant relation to money market (MM) liquidity (see Table 6). Apparently, a mid-term/long-term oriented market liquidity measure encompassing a high number of market participants is better suited to explain loan volumes. Furthermore, we show that liquidity plays a more prominent role under stressed market conditions (expectation 2). Put differently, higher liquidity is positively related to loan volumes in all lending segments but the impact is only significant in times of crisis. This result accompanies well our test for an asymmetric reaction of loan volumes to liquidity increases and decreases. It turns out that loan volumes are significantly reduced by tightenings in market liquidity; the impact of improved liquidity on loan volumes is, however, small. This is particularly true for corporate loans which would be restricted first in times of contracted market liquidity (expectation 3). Particularly corporate loans over one million euro, which account for the majority of corporate loans (see Table A.2) and represent long-term corporate investment decisions, would be affected most. Resiliance against a fragmentation of financial markets – a realistic scenario given the potential exit of the United Kingdom from the European Union – may also be enhanced by the envisaged European capital markets union. Our findings indicate that fostering market liquidity by such measures may be accompanied by stronger loan growth and lower credit spreads in the real economy.

Credit spreads are driven by both the mid-term/long-term oriented CEB liquidity indicator and the short-term oriented MM liquidity indicator (see Table 7) – in most cases, the impact is significant at the 1% level (expectation 2). Apparently, short-term market liquidity variations materialize directly in credit spreads which banks can adjust promptly – particularly for corporate loans. Compared to the CEB liquidity index, Regression results with the MM liquidity indicator show a substantially higher coefficient of determination for credit spreads – particularly for corporate loans. In terms of magnitude, credit spreads of corporate loans react more strongly and swiftly than credit spreads of household loans to changes in market liquidity (expectation 5). This can be explained by a better negotiation position of corporates which allows for a loan pricing that is more dependent and closer to market factors. Similar to our findings for loan volumes, market liquidity becomes more relevant in times of crisis and is associated with an additional liquidity premium in credit spreads. Finally, credit spreads react, also in line with our results for loan volumes, asymmetrically to positive and negative changes in market liquidity, meaning that increases in credit spreads due to tightenings in liquidity are higher than decreases in credit spreads due to improved market liquidity (expectation 3).

We have observed results which emphasize the importance of the choice of the liquidity indicator and, accordingly, call for robustness checks.[13] It should be noted that, although the CEB liquidity indicator is calculated based on the methodology by Kyle (1985), its composition and calculation method are partly opaque. Particularly, it may be questioned whether the liquidity indicators are generally capturing the effects of financial crises and

[13]The robustness checks are shown for the baseline setting but hold also true for the settings with the crisis dummy and asymmetry dummy. These results are available upon request.

are not specifically looking at market liquidity. As explained in Section 2.1, we adjust the CEB liquidity indicator for the impact of the crisis and rerun the regressions using this clean CEB liquidity indicator. The results are reported in the Appendix. Table A.9 and Table A.10 display findings for the euro area as a whole that confirm fully our previous results for the CEB liquidity measure (i.e. the specifications after deducting the crisis component) in Table 6 and Table 7. Accordingly, the crisis component constitutes only a minor part (if any) to the CEB liquidity indicator.

In addition, as the calculation of the CEB liquidity indicator is very broad and partly opaque, we employ the VSTOXX as another market liquidity measure that focuses exclusively on the equity market. Again, the results are reported in the Appendix. Results regarding loan volumes (Table A.11) and credit spreads (Table A.12) for the euro area as a whole confirm our previous results overwhelmingly: the VSTOXX is negatively related to loan volumes and positively related to credit spreads. It should be noted that we include only the two-period lagged VSTOXX in the model, because the one-month lagged realisation has only an insignificant impact on loan volumes for all lending segments. In contrast, the contemporaneous (and partly the one-month lagged) realisations of the VSTOXX significantly affect credit spreads at the 1% level. This corroborates our finding that credit spreads exhibit an even closer relation to market liquidity changes.

Another potential area of concern is the differentiation between supply and demand effects. The transmission of market liquidity via the bank lending channel to loan volumes and spreads hinges on the assumption that changes in loan supply due to market liquidity fluctuations determine this relation. Therefore, controlling for increases in loan demand is a relevant robustness check, and we conduct this additional analysis using an additional control variables that is based on information from the ESCB's bank lending survey (BLS), as described in Section 2.2.[14] Table A.13 and Table A.14 in the Appendix display regression results for loan volumes and spreads. The coefficients of the CEB liquidity indicator remain significant for all lending segments and barely change in magnitude (see the results without control for demand effects in Table 6 for loan volumes and Table 7 for credit spreads). This is important because constraints in loan supply are relevant from a policy perspective and have a potentially avoidable negative impact on the real economy. By contrast, effects stemming from the demand for loans are more related to the business cycle and reflect, amongst some other things, borrower's characteristics and the attractiveness of substitutes.

To sum up, all three robustness checks – the crisis-adjustment of liquidity indicators, the use of the VSTOXX as alternative measure of market liquidity, and the inclusion of a survey-based variable that captures loan demand – lead to results that are very much in line with the findings from our baseline regressions.

[14] As the categories from the BLS do not coincide with the loan segments from the MFI interest rate statistics, we use data for enterprises from the BLS for total corporate loans as well as for the sub-segments therein, i.e. loans up to one million and loans over one million euro. Loans to households are provided by the BLS for, first, house purchases and, second, consumer credit and other lending. The former are used for household loans, whereas the latter are used for both consumption and other loans. In addition, a proxy the demand of total household loans is constructed by weighting the BLS indicators of for, first, house purchases and, second, consumer credit and other lending with their respective volume.

4 Results of the bank-level analysis

We conclude our empirical analysis by looking at the impact of market liquidity on bank lending to the real economy using bank-level data. While the previous results have clearly shown that market liquidity is positively related to loan volumes and negatively related to credit spreads, it remains an open question *which* banks adjust their lending volumes and loan rates when market liquidity fluctuates.

Thus, we test our findings for robustness and aim to verify on the bank-by-bank level that market liquidity has also explanatory power in comparison to other macroeconomic and bank-specfic factors. We use annual data from large banks in the euro area stemming from SNL financial, focusing on 'significant institutions' (SIs) which are directly supervised by the European Central Bank in the Single Supervisory Mechanism (SSM).

The empirical model is explained in Section 2.5: We regress loan growth, as measured by log-returns of gross loan volumes to customers, on the CEB and MM liquidity indicators, other macroeconomic indicators, and bank-specific control variables. Liquidity indicators and macro controls have been orthogonalized using a modified Gram-Schmidt procedure (Golub and Loan (2013)) in order to obtain linearly independent observations. This procedure helps us to avoid any analytical issues due to a correlation of our liquidity indicators and macro variables which may be more pronounced when using the annual panel of bank-level data than the time series of aggregate data. Further, the orthogonalisation procedure eases the interpretation of regression results, as coefficients for the liquidity indicator mirror the 'pure' effect of market liquidity on bank lending. Our set of bank-level control variables is explained in Section 2.4 and includes indicators of bank size, asset risk, profitability, efficiency, solvency, and funding structure.

In Table 12 below, we show regression results using bank-level data. In models (1) and (2), we refer to yearly averages of the CEB indicator as our measure of market liquidity, while models (3) and (4) are estimated using yearly averages of the MM liquidity indicator. As our liquidity metrics as well as our macroeconomic control variables are only available on an annual level, we apply yearly clustering of standard errors in all models. Furthermore, we add bank-level fixed effects as regressors in models (1) and (3).

First and foremost, the CEB liquidity indicator is also significantly and positively related to loan growth if we apply bank-level data. This finding is in line with expectation 6, adds robustness to the aggregate results shown above and is independent of whether we include bank-level fixed effects in the regression (model (1)) or not (model (2)). Instead, coefficients for models (3) and (4) show that the MM liquidity indicator is still insignificant for loan growth on the bank level, which is also consistent with the aggregate findings. Furthermore, coefficients for the control variables indicate that larger banks (ln(Total assets)) tend to grow at lower rates, while more profitable banks (ROAA) show higher average growth rates. While banks with a funding structure that largely relies on customer deposits tend to grow more slowly, it seems that a higher degree of solvency (Equity/Total assets) does not lead to higher loan growth.

Table 12: Bank-level regressions of loan growth: Full sample results

	(1)	(2)	(3)	(4)
Dep. variable: Loan growth	Full sample	Full sample	Full sample	Full sample
CEB liquidity index (orthog.)	0.019***	0.033**		
	(0.005)	(0.015)		
MM liquidity index (orthog.)			-0.015	-0.054
			(0.017)	(0.036)
EURIBOR 3M (orthog.)	-0.012	0.012	-0.013	0.014
	(0.011)	(0.012)	(0.009)	(0.014)
FX EUR/USD (orthog.)	-0.017	-0.007	-0.016	-0.006
	(0.016)	(0.014)	(0.015)	(0.011)
Term spread 10Y-1Y (orthog.)	-0.008	-0.011	-0.008	-0.007
	(0.014)	(0.014)	(0.013)	(0.016)
CPI (orthog.)	0.020	0.030	0.018	0.028
	(0.015)	(0.028)	(0.013)	(0.018)
Unemployment rate (orthog.)	-0.002	-0.007	0.008	-0.003
	(0.045)	(0.011)	(0.048)	(0.012)
EUCOM EcoSent (orthog.)	0.021	-0.014	0.020	-0.015
	(0.012)	(0.018)	(0.012)	(0.019)
ln(Total assets)	0.060	-0.046*	0.042	-0.046*
	(0.088)	(0.024)	(0.093)	(0.024)
RWA/Total assets	-0.001	-0.003	-0.001	-0.003
	(0.003)	(0.003)	(0.003)	(0.003)
Return on average assets	0.092	0.074	0.097*	0.076*
	(0.053)	(0.040)	(0.051)	(0.038)
Cost/Income ratio	0.004	0.004	0.004	0.004
	(0.003)	(0.004)	(0.004)	(0.004)
Net Interest Inc./Operating Rev.	-0.002	-0.002	-0.001	-0.002
	(0.003)	(0.002)	(0.003)	(0.002)
Equity/Total assets	-0.024*	0.002	-0.025	0.007
	(0.012)	(0.011)	(0.014)	(0.017)
Deposits/Total assets	-0.010**	0.001	-0.009*	0.001
	(0.004)	(0.002)	(0.004)	(0.003)
Interbank ratio	0.000	-0.000	0.000	-0.000
	(0.000)	(0.000)	(0.000)	(0.000)
Constant	-1.005	0.833	-0.655	0.780
	(1.991)	(0.474)	(2.115)	(0.466)
Bank-level Fixed Effects	yes	no	yes	no
Yearly clustered SE	yes	yes	yes	yes
R^2	0.32	0.08	0.32	0.09
N	504	513	504	513

The dependent variable is the loan growth rate on the bank level, as measured by annual log-returns of total customer loans. Explanatory variables are the liquidity indicators as explained in Section 2.1 and the macroeconomic control variables as explained in Section 2.2, both orthogonalized using a modified Gram-Schmidt procedure (Golub and Loan (2013)). Control variables on the bank-year level are included as explained in Section 2.4. Bank-level fixed effects are included in models (1) and (3). Standard errors are clustered on an annual level. Standard errors are provided in brackets. The symbols *, ** and *** indicate significance at the 10%, 5% and 1% levels.

Next, we investigate whether banks with different characteristics vary in terms of their dependency on market liquidity. Therefore, we estimate our baseline model ((1) from Table 12) for sub-samples of banks with different characteristics. As the MM liquidity indicator performs badly to explain loan volumes in the aggregate regressions and to explain loan growth in the bank-level regressions, we concentrate on the CEB liquidity indicator. We differentiate between banks from the Southern EMU (CY, ES, GR, IT, MT, PT, SI) or Ireland (model (1a)) and banks from other euro area countries (model 1b). Furthermore, we apply a median split regarding bank characteristics and differentiate between small and large banks (models (2a) and (2b)), more or less risky banks in terms of RWA/Total assets (models 3a and 3b), more or less profitable banks in terms of ROAA (models (4a) and (4b)), banks with higher or lower cost efficiency (models (5a) and (5b)), banks with a higher or lower equity-to-total assets ratio (models (6a) and (6b)), banks that rely more or less on deposit funding (models (7a) and (7b)) or interbank funding (models (8a) and (8b)), and banks with a high or low net interest income (models (9a) and (9b). Finally, we estimate the baseline regression for exchange-listed (model (10a)) and non-listed banks (model (10b)). Table 13 presents regression estimates.

It turns out that the impact of market liquidity on bank behaviour is similar for banks from those countries that were most heavily hit by the crisis (CY, ES, GR, IE, IT, MT, PT, SI) and those banks from the rest of the euro area (models (1a) and (1b)), and that the differentiation by bank size (models (2a) and (2b)) does not yield significantly different coefficients. However, non-listed banks (model (10b)) exhibit a significantly higher sensitivity to market liquidity than listed banks (model (10a)). This may be found surprising as one may argue that their business is generally less focused on capital market activities, and their lending should hence be less sensitive to market liquidity. But on the other side, listed banks are closer to the market, which allows for a more balanced funding structure and a better diversified asset portfolio and makes market liquidity less important for them.

This explanation is very much in line with our finding that less profitable banks in terms of return on average assets (model (4b)) are more sensitive to market liquidity fluctuations, which is similar for banks whose interest income is the major income source (high ratio of NII over operating revenue; model (9a)). The coefficient for banks with high cost-income ratios (model (5a)) is higher, but not significantly different from banks with low cost-income ratios (model (5b)) Likewise, asset risk models (3a) and (3b)) as well as bank solvency (models (6a) and (6b)) do not seem to matter significantly for banks' dependency on market liquidity.

The banks in our sample also differ with respect to their funding structure, but our results reveal that asset liquidity and funding liquidity are distinct concepts indeed. While banks with a high fraction of funding via deposits (model (7a)) and a high interbank ratio (high fraction of money lent relative to money borrowed on the interbank market; model (8a)) could be considered as having much funding liquidity, particularly the latter banks' lending is relatively more sensitive to market liquidity fluctuations. However, this finding is in contrast to the evidence by Jung and Kim (2015) on the Korean market, who conclude that banks with high core funding ratios tend to increase their lending to firms in periods of market-wide liquidity shocks.

Table 13: Bank-level regressions of loan growth: Sample split results

	(1a)	(1b)	(2a)	(2b)	(3a)	(3b)	(4a)	(4b)	(5a)	(5b)	(6a)	(6b)	(7a)	(7b)	(8a)	(8b)	(9a)	(9b)	(10a)	(10b)
Dep. variable: Loan growth	Southern EMU	Northern EMU	Small banks	Large banks	High risk	Low risk	High return	Low return	High CIR	Low CIR	High equity	Low equity	High deposits	Low deposits	High interbank	Low interbank	High NII	Low NII	Listed	Non-Listed
CEB liquidity index (orthog.)	0.028***	0.027	0.054*	0.021***	0.032***	0.030	0.005	0.037**	0.045*	0.021*	0.025**	0.014	0.029*	0.011	0.038**	0.018*	0.036**	-0.003	0.015	0.048**
	(0.006)	(0.023)	(0.028)	(0.004)	(0.005)	(0.018)	(0.008)	(0.015)	(0.023)	(0.009)	(0.007)	(0.017)	(0.013)	(0.015)	(0.016)	(0.008)	(0.012)	(0.021)	(0.008)	(0.019)
EURIBOR 3M (orthog.)	0.009	-0.026	-0.036	0.034***	0.021**	-0.042	0.018*	-0.046*	-0.014	0.010	0.016***	-0.050*	0.023**	-0.047**	-0.003	0.022**	0.023**	-0.057*	0.022***	-0.044*
	(0.006)	(0.028)	(0.021)	(0.005)	(0.007)	(0.024)	(0.008)	(0.022)	(0.024)	(0.008)	(0.005)	(0.022)	(0.007)	(0.017)	(0.020)	(0.009)	(0.008)	(0.029)	(0.006)	(0.022)
FX EUR/USD (orthog.)	-0.007	-0.015	-0.015	-0.019**	-0.014	-0.023	-0.007	-0.024	-0.021	-0.016*	-0.016	-0.021	-0.010	-0.026	-0.017	-0.011**	-0.015**	-0.004	-0.017*	-0.032
	(0.011)	(0.027)	(0.032)	(0.006)	(0.008)	(0.028)	(0.005)	(0.033)	(0.020)	(0.008)	(0.010)	(0.026)	(0.007)	(0.026)	(0.024)	(0.004)	(0.006)	(0.031)	(0.008)	(0.022)
Term spread 10Y-1Y (orthog.)	-0.011	-0.003	-0.025	-0.004	0.005	-0.005	-0.012**	-0.010	0.025	-0.020**	-0.003	-0.013	-0.002	0.002	0.004	-0.003	-0.008	-0.021	-0.002	-0.020
	(0.011)	(0.027)	(0.025)	(0.007)	(0.009)	(0.025)	(0.004)	(0.034)	(0.032)	(0.008)	(0.007)	(0.032)	(0.012)	(0.028)	(0.030)	(0.009)	(0.009)	(0.025)	(0.011)	(0.015)
CPI (orthog.)	0.030	0.067	0.035	-0.003	0.021	0.065	-0.011	0.059*	0.018	0.011	0.015	0.038	0.024	0.018	0.065	-0.019	0.030	0.031	-0.017***	0.045
	(0.024)	(0.047)	(0.031)	(0.005)	(0.013)	(0.054)	(0.010)	(0.030)	(0.027)	(0.025)	(0.016)	(0.028)	(0.023)	(0.015)	(0.040)	(0.016)	(0.027)	(0.018)	(0.005)	(0.036)
Unemployment rate (orthog.)	-0.058	-0.107	0.061	-0.008	-0.004	-0.080	0.014	-0.019	-0.101	-0.006	0.012	-0.012	-0.011	-0.045	-0.052	0.015	-0.048	-0.009	0.031	-0.002
	(0.061)	(0.107)	(0.116)	(0.032)	(0.025)	(0.117)	(0.022)	(0.078)	(0.141)	(0.039)	(0.039)	(0.072)	(0.026)	(0.075)	(0.065)	(0.032)	(0.027)	(0.106)	(0.029)	(0.095)
EUCOM EcoSent (orthog.)	0.027	-0.017	0.033	-0.005	-0.001	-0.017	0.024*	0.020	0.040	-0.003	0.012	0.015	-0.008	0.042	-0.004	0.013	-0.025	0.095**	-0.017*	0.026
	(0.019)	(0.030)	(0.025)	(0.007)	(0.013)	(0.035)	(0.011)	(0.036)	(0.028)	(0.019)	(0.019)	(0.017)	(0.016)	(0.025)	(0.023)	(0.011)	(0.021)	(0.039)	(0.008)	(0.024)
ln(Total assets)	0.117	0.074	0.023	0.193**	0.239	-0.065	-0.074	0.156	0.164	0.183	0.107	-0.003	0.249	-0.024	0.174	-0.066	0.275	-0.166	0.220**	0.046
	(0.147)	(0.180)	(0.127)	(0.067)	(0.134)	(0.130)	(0.186)	(0.108)	(0.143)	(0.174)	(0.207)	(0.136)	(0.142)	(0.122)	(0.144)	(0.157)	(0.175)	(0.134)	(0.074)	(0.134)
RWA/Total assets	-0.002	-0.000	-0.002	0.001	0.002	-0.005	-0.006	0.002	0.000	-0.003	-0.002	0.001	0.003	-0.004	-0.001	-0.006	0.002	-0.006	0.001	0.001
	(0.004)	(0.004)	(0.004)	(0.001)	(0.002)	(0.007)	(0.006)	(0.003)	(0.004)	(0.005)	(0.004)	(0.004)	(0.002)	(0.004)	(0.004)	(0.006)	(0.003)	(0.004)	(0.001)	(0.005)
Return on average assets	0.024**	0.435	0.151	0.021	0.030*	0.490**	0.124**	0.083	0.309	0.057**	0.036**	0.362*	0.038*	0.233	0.072	0.061***	0.034*	0.251	0.046***	0.142
	(0.009)	(0.272)	(0.100)	(0.013)	(0.016)	(0.204)	(0.053)	(0.051)	(0.204)	(0.022)	(0.015)	(0.189)	(0.017)	(0.146)	(0.049)	(0.017)	(0.017)	(0.154)	(0.013)	(0.099)
Cost/income ratio	-0.000	0.004	0.015	-0.000	0.001	0.003	0.000	0.004	0.016	-0.000	0.000	0.004	0.001	0.004	0.017	0.000	-0.001	0.007	0.000	0.011
	(0.001)	(0.003)	(0.012)	(0.000)	(0.001)	(0.004)	(0.001)	(0.004)	(0.012)	(0.000)	(0.001)	(0.004)	(0.001)	(0.004)	(0.014)	(0.001)	(0.001)	(0.006)	(0.000)	(0.010)
Equity/Total assets	0.005	-0.086*	-0.044	0.006	0.004	-0.101*	-0.016	-0.011	-0.060	-0.011	-0.006	-0.090*	0.006	-0.073	-0.005	-0.002	0.010	-0.068	-0.006	-0.055*
	(0.016)	(0.041)	(0.029)	(0.008)	(0.008)	(0.048)	(0.010)	(0.012)	(0.045)	(0.014)	(0.010)	(0.041)	(0.016)	(0.041)	(0.017)	(0.007)	(0.016)	(0.037)	(0.006)	(0.029)
Deposits/Total assets	-0.007	-0.013	-0.018**	0.001	-0.000	-0.020*	-0.009	-0.012	-0.014	-0.007	-0.010	-0.010	0.001	-0.021**	-0.010	-0.010	0.001	-0.020**	-0.001	-0.017**
	(0.005)	(0.013)	(0.007)	(0.002)	(0.001)	(0.010)	(0.007)	(0.007)	(0.009)	(0.005)	(0.007)	(0.008)	(0.002)	(0.008)	(0.006)	(0.006)	(0.002)	(0.007)	(0.002)	(0.007)
Interbank ratio	0.000	0.000	0.000	0.000	-0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	-0.000	0.002	0.000	-0.000	-0.000	0.001	-0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.001)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.001)	(0.000)	(0.000)	(0.000)	(0.001)	(0.000)	(0.000)
Net Interest Inc./Operating Rev.	-0.001	-0.000	-0.009	0.000	0.000	0.000	0.001	-0.002	-0.011	0.001	-0.001	-0.001	0.000	-0.002	-0.011	0.001	0.001	0.000	0.002*	-0.009
	(0.002)	(0.002)	(0.009)	(0.000)	(0.001)	(0.003)	(0.001)	(0.003)	(0.010)	(0.002)	(0.002)	(0.003)	(0.001)	(0.003)	(0.011)	(0.001)	(0.001)	(0.002)	(0.001)	(0.009)
Constant	-1.715	-1.134	1.538	-4.078**	-5.020	2.164	1.994	-3.225	-3.449	-3.350	-1.485	0.386	-5.528	1.178	-3.942	1.815	-6.068	3.940	-4.676**	-0.194
	(3.367)	(4.138)	(2.516)	(1.410)	(2.940)	(3.016)	(4.246)	(2.332)	(3.156)	(4.074)	(4.755)	(2.994)	(3.178)	(2.667)	(3.254)	(3.595)	(3.839)	(2.721)	(1.557)	(2.782)
Bank-level Fixed Effects	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
Yearly clustered SE	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
R^2	0.41	0.34	0.39	0.35	0.34	0.37	0.48	0.32	0.40	0.40	0.41	0.34	0.35	0.35	0.36	0.51	0.35	0.37	0.42	0.37
N	235	269	222	282	252	252	270	234	269	235	235	269	221	283	266	238	228	276	258	246

The dependent variable is the loan growth rate on the bank level, as measured by annual log-returns of total customer loans. Explanatory variables are the liquidity indicators as explained in Section 2.1 and the macroeconomic control variables as explained in Section 2.2, both orthogonalized using a modified Gram-Schmidt procedure (Golub and Loan (2013)). Control variables on the bank-year level are included as explained in Section 2.4. Bank-level fixed effects are included as well. Standard errors are clustered on an annual level. Standard errors are provided in brackets. The symbols *, ** and *** indicate significance at the 10%, 5% and 1% levels.

5 Conclusions

Our results provide evidence that market liquidity plays a major role for bank lending in the euro area and affects the real economy through this channel. As expected, market liquidity is positively related to loan volumes and negatively related to credit spreads for all considered lending segments in the euro area as a whole. Furthermore, credit spreads react more swiftly and more intensely to changes in market liquidity.

These effects are particularly significant in times of crisis. Moreover, reductions in liquidity lead to more significant effects than liquidity increases – a finding that is particularly true for corporate loans which would be restricted first in times of impaired market liquidity. Robustness checks show that our results hold true if we control for a crisis component in the market liquidity indicators and if we control for demand effects in loan volumes. Therefore, properly functioning and sufficiently liquid financial markets are necessary to avoid negative consequences of restrictions in bank lending which would eventually hamper the real economy. This is of the utmost importance against the background of the envisaged capital markets union in the European Union and the potential exit of the United Kingdom from the EU.

We do not only provide evidence on the transmission of market liquidity to bank lending for the euro area as a whole; lending in individual euro area countries is strongly linked to market liquidity as well. We find that liquidity plays an important role for loan volumes of the euro area as a whole and of its major member states – particularly Belgium, Germany, France and Italy. The results for credit spreads are even clearer: Generally speaking, we find significant effects basically for each lending segment and each country.

The bank-level data confirm the strong impact of market liquidity on bank lending as well. More specifically, we show that non-listed banks, less profitable banks and banks which rely relatively more on net interest income, as well as banks with a high funding liquidity are particularly strongly exposed to market liquidity.

We also observe differences in the dependence of corporate and household loans to market liquidity which are more difficult to grasp. Liquidity affects loan volumes of household loans slightly more strongly in terms of magnitude and significance level. However, this relation reverses and corporate loans are affected more strongly if one looks only at the (negative) impact of liquidity contractions. This is because volumes of corporate loans are barely affected by improvements in market liquidity. Besides that, credit spreads of corporate loans react more strongly and swiftly than credit spreads of household loans to changes in liquidity. This could be explained by a better negotiation position of corporate clients which calls for a loan pricing that is more dependent and closer to market factors. Further differences between the liquidity dependence of larger and smaller corporate loans as well as between the different types of household loans may be explained by differences in the competition on these markets and by the degree of standardisation in these lending segments. While it is beyond the scope of our paper to provide precise evidence on the channels for the transmission of market liquidity in different lending segments, we would encourage further research that that sheds light on these aspects.

References

Alexandre, H. and J. Clavier (2017). Adoption of IAS/IFRS, liquidity constraints, and credit rationing: The case of the European banking industry. *The Quarterly Review of Economics and Finance Vol. 63*, 249–258.

Allen, J. and T. Paligorova (2015). Bank loans for private and public firms in a liquidity crunch. *Journal of Financial Stability 18*, 106–116.

BCBS (2013). Basel III: The Liquidity Coverage Ratio and liquidity risk monitoring tools. *Bank for International Settlements*.

BCBS (2014). Basel III: The net stable funding ratio. *Bank for International Settlements*.

Berger, A. N., L. K. Black, C. H. Bouwman, and J. Dlugosz (2017). Bank loan supply responses to Federal Reserve emergency liquidity facilities. *Journal of Financial Intermediation 32*, 1–15.

Brunnermeier, M. and L. Pedersen (2009). Market liquidity and funding liquidity. *The Review of Financial Studies 22*(6), 2201–2238.

Caruana, J. (2016). Post-crisis financial safety net framework: lessons, responses and remaining challenges. *Keynote address at the 2016 FSI-IADI Conference in Basel*.

Chordia, T., R. Roll, and A. Subrahmanyam (2000). Commonality in liquidity. *Journal of Financial Economics 56*(1), 3–28.

Chouchène, M., Z. Ftiti, and W. Khiari (2017). Bank-to-bank lending channel and the transmission of bank liquidity shocks: Evidence from France. *Research in International Business and Finance 39*(Part B), 940–950.

Cornett, M. M., J. J. McNutt, P. E. Strahan, and H. Tehranian (2011). Liquidity risk management and credit supply in the financial crisis. *Journal of Financial Economics 101*, 297–312.

Dombret, A. (2017a). Failing or likely to fail? Putting the European banking union to the test. *Speech delivered at the Deutsche Bundesbank's University of Applied Sciences*. Hachenburg, 21 August 2017.

Dombret, A. (2017b). Opening statement at the press conference presenting the results of the low-interest-rate survey conducted by the Bundesbank and BaFin. Frankfurt am Main, 30 August 2017.

Dombret, A., Y. Gündüz, and J. Rocholl (2017). Will German banks earn their cost of capital? *Bundesbank Discussion Paper 1/2017*.

Dubecq, S., A. Monfort, J.-P. Renne, and G. Roussellet (2016). Credit and liquidity in interbank rates: A quadratic approach. *Journal of Banking & Finance 68*, 29–46.

ECB (2015). Bank lending survey for the euro area - The questionnaire (Revised version introduced in April 2015).

ECB (2017). Manual on MFI interest rate statistics.

European Systemic Risk Board (2017). ECB/ESRB EU crises database. *ESRB Occasional Paper No 13*.

García-Posada, M. and M. Marchetti (2016). The bank lending channel of unconventional monetary policy: The impact of the VLTROs on credit supply in Spain. *Economic Modelling 58*, 427–441.

Golub, G. H. and C. F. V. Loan (2013). *Matrix Computations, 4th Edition*. Johns Hopkins University Press, Baltimore.

Hayden, E., A. Stomper, and A. Westerkamp (2014). Selection versus averaging of logistic credit risk models. *Journal of Risk 16(5)*, 39–52.

IMF (October 2015). Vulnerabilities, Legacies, and Policy Challenges - Risks Rotating to Emerging Markets - Risks Rotating to Emerging Markets. *Global Financial Stability Report*.

Jung, H. and D. Kim (2015). Bank funding structure and lending under liquidity shocks: Evidence from Korea. *Pacific-Basin Finance Journal 33*, 62–80.

Khan, H. H., R. B. Ahmad, and C. S. Gee (2016). Bank competition and monetary policy transmission through the bank lending channel: Evidence from ASEAN. *International Review of Economics and Finance 44*, 19–39.

Khan, M. S., H. Scheule, and E. Wu (2017). Funding Liquidity and Bank Risk Taking. *Journal of Banking & Finance 82*, 203–216.

Kim, D. and W. Sohn (2017). The effect of bank capital on lending: Does liquidity matter? *Journal of Banking & Finance 77*, 95–107.

Kyle, A. (1985). Continuous auctions and insider trading. *Econometrica 53*(6), 1315–1335.

Madigan, D. and J. York (1995). Bayesian Graphical Models for Discrete Data. *International Statistical Review 63(2)*, 215–232.

Ongena, S., J. L. Peydro, and N. van Horen (2015). Shocks Abroad, Pain at Home? Bank-Firm Level Evidence on the International Transmission of Financial Shocks. *IMF Economic Review 63*(4), 698–750.

Raftery, A., D. Madigan, and J. Hoeting (1997). Bayesian Model Averaging for Linear Regression Models. *Journal of the American Statistical Association 92(437)*, 179–191.

Rösch, C. G. and C. Kaserer (2016). Market liquidity in the financial crisis: The role of liquidity commonality and flight-to-quality. *Journal of Banking and Finance 37*(7), 152–170.

Sala-i-Martin, X., G. Doppelhofer, and R. I. Miller (2004). Determinants of Long-Term Growth: A Bayesian Averaging of Classical Estimates (BACE) Approach. *The American Economic Review 94(4)*, 813–835.

Schiozer, R. F. and R. de Freitas Oliveira (2016). Asymmetric transmission of a bank liquidity shock. *Journal of Financial Stability 25*, 234–246.

Schnabl, P. (2012). The International Transmission of Bank Liquidity Shocks: Evidence from an Emerging Market. *Journal of Finance 67*(3), 897–932.

U.S. Census Bureau (2017). X-13ARIMA-SEATS Reference Manual Accessible HTML Output Version, Version 1.1.

Vayanos, D. (2004). Flight to Quality, Flight to Liquidity, and the Pricing of Risk. *NBER Working Paper 10327*.

Vazquez, F. and P. Federico (2015). Bank funding structures and risk: Evidence from the global financial crisis. *Journal of Banking and Finance 61*, 1–14.

Zellner, A. (1986). On assessing prior distributions and Bayesian regression analysis with g prior distributions. In P. Goel and A. Zellner (Eds.), *Bayesian Inference and Decision Techiques - Essays in Honor of Bruno de Finetti*, pp. 233–243. Elsevier, Amsterdam.

A Appendix

A.1 Data availability for individual countries in the euro area

Table A.1 summarizes the data availability for euro area member countries.[15]

Table A.1: Data availability for euro area countries

Country	Data availability volume		Data availability interest rate	
	Corporates	Households	Corporates	Households
Euro area (EA)	Complete data	Complete data	Complete data	Complete data
Austria (AT)	Complete data	Complete data	Complete data	Complete data
Belgium (BE)	Complete data	Complete data	Complete data	Complete data
Cyprus (CY)	Missing: 1/2003 to 11/2008	Missing: 1/2008 to 11/2008	Missing: 1/2003 to 11/2008	Missing: 1/2008 to 11/2008
Estonia (EE)	Incomplete for 2003 to 2007	Incomplete for 2003 to 2007	Incomplete for 2003 to 2007	Incomplete for 2003 to 2007
Germany (DE)	Complete data	Complete data	Complete data	Complete data
Finland (FI)	Complete data	Complete data	Complete data	Complete data
France (FR)	Complete data	Complete data	Complete data	Complete data
Spain (ES)	Complete data	Complete data	Complete data	Complete data
Greece (GR)	Incomplete for 2004 to 2016	Incomplete for 2004 to 2016	Incomplete for 2004 to 2016	Incomplete for 2004 to 2016
Ireland (IE)	Complete data	Complete data	Complete data	Complete data
Italy (IT)	Complete data	Complete data	Complete data	Complete data
Latvia (LV)	Incomplete for 2003 to 2016	Incomplete for 2003 to 2016	Incomplete for 2003 to 2016	Incomplete for 2003 to 2016
Lithuania	Incomplete for 2003 to 2004	Incomplete for 2003 to 2004	Incomplete for 2003 to 2004	Incomplete for 2003 to 2004
Luxembourg (LU)	Incomplete for 2003 to 2016	Incomplete for 2003 to 2016	Incomplete for 2003 to 2016	Incomplete for 2003 to 2016
Malta (MT)	Incomplete for 2003 to 2016	Incomplete for 2003 to 2016	Incomplete for 2003 to 2016	Incomplete for 2003 to 2016
Netherlands (NL)	Complete data	Missing: 1/2003 to 5/2010	Complete data	Missing: 1/2003 to 5/2010
Portugal (PT)	Complete data	Complete data	Complete data	Complete data
Slovakia (SK)	Incomplete for 2003 to 2007	Incomplete for 2003 to 2008	Incomplete for 2003 to 2007	Incomplete for 2003 to 2008
Slovenia (SI)	Missing: 5/2005 to 12/2005	Missing: 5/2005 to 12/2005	Missing: 5/2005 to 12/2005	Missing: 5/2005 to 12/2005

The table shows the data availability. Data quality is classified as incomplete if at least one of the sub-segments was incomplete. Sub-segments for corporate loans are loans less than and greater than one million. Sub-segments for household loans are loans for mortgages, consumption and other.

[15]For Belgium, the interest rate for corporate loans exceeding one million was not available. However, we were able to derive it from the volumes and rates of loans below one million and total corporate loans.

A.2 Materiality of lending segments and average interest rates

The various segments of loans differ in terms of volume and interest rates. Table A.2 shows the average proportion of the sub-segments comprising total corporate and total household loans of the seasonally-adjusted times series.

Table A.2: Average proportions of the sub-segments of corporate and household loans

Segment	Sub-segment	EA	AT	BE	DE	ES	FI	FR	IE	IT	PT
Corporate	Total										
Corporate	$\leq$ 1 million	26.40%	14.54%	22.16%	16.32%	37.45%	23.39%	30.64%	27.20%	35.60%	47.68%
Corporate	$>$ 1 million	73.60%	85.46%	77.84%	83.68%	62.55%	76.61%	69.36%	72.80%	64.40%	52.32%
Households	Total										
Households	Consumption	19.36%	19.15%	8.66%	22.57%	21.03%	16.34%	25.88%	15.58%	19.30%	19.19%
Households	Mortgages	57.18%	52.50%	68.58%	46.11%	52.50%	70.03%	67.86%	73.35%	49.11%	55.77%
Households	Others	23.46%	28.35%	22.76%	31.32%	26.48%	13.63%	6.25%	11.07%	31.60%	25.04%

The table shows the average proportions of the sub-segments of corporate and household loan volumes. The averages are calculated as the arithmetic mean of the seasonally-adjusted time series across time.

Loans over one million euro dominate the corporate loans. Out of the household loans, mortgages loans account for the largest share.

Table A.3 shows the average interest rates for corporate and household loans.

Table A.3: Average interest rates for corporate and household loans

Segment	Sub-segments	EA	AT	BE	DE	ES	FI	FR	IE	IT	PT
Corporate	Total	3.31%	2.85%	2.81%	3.28%	3.60%	2.99%	3.10%	4.04%	3.47%	5.21%
Corporate	$\leq$ 1 million	4.11%	3.29%	3.36%	4.10%	4.44%	3.59%	3.76%	4.90%	4.19%	6.06%
Corporate	$>$ 1 million	3.01%	2.77%	2.66%	3.11%	3.11%	2.80%	2.81%	3.77%	3.04%	4.38%
Households	Total	4.44%	3.77%	4.06%	4.42%	5.09%	3.10%	4.43%	4.19%	5.07%	5.65%
Households	Consumption	6.99%	5.23%	7.19%	6.71%	8.54%	4.46%	6.17%	6.85%	8.11%	9.18%
Households	Mortgages	3.73%	3.38%	3.81%	3.85%	3.46%	2.80%	3.75%	3.68%	3.81%	3.54%
Households	Others	3.99%	3.55%	3.44%	3.59%	5.26%	3.34%	3.80%	5.10%	5.01%	6.51%

The table shows the average interest rates for corporate and household loans. The averages are calculated as the arithmetic mean across time.

As for the corporate loans, those over one million euro are closed at a far lower interest rate. This can be explained by the better negotiation position of large corporates and a slightly lower average maturity.[16] Mortgage loans differ significantly from other household loans in two aspects: They have a relatively long interest rate fixation period[17] and they are usually collateralized. As these loans have the lowest interest rate, the latter aspect seems to dominate. It is noteworthy that loans for consumption are settled at a relatively high rate. The main explanation for that is their higher credit risk, which requires banks to set higher commercial margins.

[16] Loans up to one million euro have an average maturity of 1.25 years, whereas loans over one million euro have an average maturity of 1.04 years.

[17] The average maturity of mortgage loans is 6.7 years. This is considerably more than the average maturity of consumption loans (four years) and other loans (two years).

A.3 Variable selection process

We aim to identify systematic risk factors which are applicable for the euro area as as whole and each country therein. In order to avoid arbitrariness to the greatest extent possible, we select a uniform set of variables for both the aggregate-level and the bank-level analysis based on the loan volumes for the euro area as a whole and then apply this set of variables to credit spreads and other countries as well. This method ensures that we have a consistent set of explanatory variable across all euro area countries which facilitates the comparison of the results between individual countries. In order to select variables for the volumes of euro area loans to, first, corporates and, second, households, we apply the Bayesian model averaging (BMA). This can be motivated by simulation studies that reveal that model averaging leads to models with a better forecasting ability than other techniques (see, for example, Raftery, Madigan, and Hoeting (1997), Hayden, Stomper, and Westerkamp (2014)). Given that the sample of candidate variables contains, amongst other things, all the financial and macroeconomic factors that have a univariately significant impact on loan volumes, the BMA should provide us with a tailor-made set of explanatory variables. The idea of the BMA is to calculate for a given number of K candidate variables – in our case the lagged dependent variable, the liquidity indicator and 14 variables as shown in Table A.4 – all linear models $M_l, l \in \{1, ..., 2^K\}$, consisting of subsets of the systematic risk factors. Instead of including all candidate variables, only those that prove to be sufficiently likely will be part of the final model. The criterion for including a systematic risk factor is the posterior inclusion probability (PIP), which is given for any component β_h of the parameter vector β_{BMA} as a weighted sum of each parameter's conditional probability over all models:

$$PIP := Pr(\beta_h|\Delta LoanAmount) = \sum_{l=1}^{2^K} Pr(\beta_h|M_l) \cdot Pr(M_l|\Delta LoanAmount). \quad (4)$$

Obtaining a variables's conditional inclusion probability $Pr(\beta_h|M_l)$ is straightforward as this can be done once the corresponding model has been calculated. It is noteworthy that the conditional marginal likelihood $Pr(M_l|\Delta LoanAmount)$ takes into account the goodness of fit as well as the model size (see, for instance, Sala-i-Martin, Doppelhofer, and Miller (2004)).

Initially, a distribution assumption for the parameter vector is required. We assume the commonly used g-priors (see Zellner (1986))

$$\beta|g = N\Big(0, \Big(\frac{1}{g}\Lambda'\Lambda\Big)^{-1}\Big), \quad (5)$$

where the matrix $\Lambda \in \mathbb{R}^{T\times K}$ contains all T historical observations for the K candidate variables. The parameter g makes it possible to consider the degree of a priori certainty, i.e. a smaller value of the parameter implies a lower variance.

In order to set the parameter g, we apply the unit information prior (UIP) by the setting $g = T$. Moreover, the Bayesian framework requires assumptions concerning the initial model probabilities $Pr(M_l), l \in \{1, ..., 2^K\}$. For this purpose, we run a specification

with a uniform distribution of the model size.[18] Evaluating the models $Pr(M_l|\Delta S), l \in \{1, .., 2^K\}$, is done by the Markov chain Monte Carlo sampler (see, for example, Madigan and York (1995)).

We select the control variables based on their explanatory power for the loan volumes in the euro area as a whole from the aggregate-level analysis and then use these variables after performing sanity checks for credit spreads and for loan volumes in the bank-level analysis as well. We trust that loan volumes in the euro area as a whole are best suited to explain the real effects of potential tightenings in market liquidity. We consider the variables as given in Table A.4 for the selection procedure – each lagged by one and two months. More specifically, we run the BMA model for total corporate and household loan volumes as well as for their sub-segments – there are seven segments of loan volumes totalled. We retain only those variables which are ranked among the best ten according to the PIP in at least two loan segments. Then, we control for the correlation structure and exclude all variables which have a higher correlation than |0.4|. In doing so, we take a set of correlated variables and conduct a regression analysis; we keep the variable yielding best results in terms of the overall explained variance. In the next stage, expert judgement comes into play. If the model requires us to include a two month-lagged variable, we include the one-month lagged variable as well. Furthermore, we avoid including variables which can economically be interpreted as substitutes; in these cases, we include the variable yielding better results in a regression setting.

Table A.4 gives an overview of candidate explanatory variables before the final model is selected.

Table A.4: Overview of candidate explanatory variables

Variable	Definition	Source	Stationarity method
Loan volumes (lagged)	Loan volumes on new business for euro area countries	ECB	Log-return
CEB liquidity indicator	ESRB's liquidity indicator for the currency, equity and bond market	ECB	Difference
MM liquidity indicator	ESRB's liquidity indicator for the money market	ECB	Difference
Unemployment rate	Euro area countries in %	EUROSTAT	Difference
EURIBOR 3M	Annualized rate of the three-month EURIBOR	Datastream	Difference
German government bond 5Y	Yield	Datastream	Difference
EUCOM EcoSent	EUCOM's indicator for the assessment of economic sentiment	EUCOM	Difference
Industrial production	Index excl. construction	Eurostat	Log-return
Bloomberg Commodity Index	USD, reflects commodity futures price movements	Bloomberg	Log-return
FX EUR/USD	Exchange rate	Datastream	Difference
FX EUR/JPY	Exchange rate	Datastream	Difference
FX EUR/GBP	Exchange rate	Datastream	Difference
EURO STOXX 50	Currency base: EUR	Datastream	Log-return
Term spread 10Y-1Y bond	Spread between the ten-year and one-year yield of German Government bonds	Bloomberg	Difference
Term spread 10Y-1Y swap	Spread between the ten-year and one-year yield of Swap rates	Bloomberg	Difference
CISS	ECB's Composite Indicator of System Stress	ECB	Difference
CPI	Harmonized Consumer Price Index - all items	OECD	Log-return

The table shows the variables considered for the variable selection procedure.

The Composite Indicator of Systemic Stress in the financial system (CISS), the data on loan volumes and interest rates and the ESRB's CEB and MM liquidity indicators are

[18] In addition, we test our results by using a beta-binomial (random) distribution of the model size.

taken from the ECB's Statistical Data Warehouse (SDW). The remaining data stems from Bloomberg, Datastream, Eurostat, European Commission (EUCOM) and the Organisation for Economic Cooperation and Development (OECD). The variables that are finally included are shown in Table 2.

A.4 Aggregate-level analysis: Results for individual countries

In this section, we show the results of the impact of market liquidity on bank lending on the volume (Section A.4.1) and credit spread (Section A.4.2) for the baseline model based on the CEB liquidity indicator for individual countries in the euro area.

A.4.1 Loan volumes

In a developed market like the euro area, liquidity might be expected to have a greater impact on credit spreads than on loan volumes. This is because banks can, if they perceive more risk in loans or want to apply stricter lending standards, compensate their unwillingness to lend more easily via the credit spread than by refusing to close the contract. However, the results in Table A.5 of the impact of liquidity on the loan volumes for corporates suggest that there is a relationship between liquidity and the volumes of provided loans – particularly for the euro area as a whole.

Table A.5: Regression results for euro area countries for corporate loan volumes using the CEB liquidity indicator

Dep. variable: Loan volume	EA	AT	BE	DE	ES	FI	FR	IE	IT	PT
CEB (t-1)	0.0956 ***	0.0287	0.0541*	0.0869**	0.0666	-0.0412	0.1046	0.0090	0.0994*	-0.0040
	(0.0315)	(0.0327)	(0.0322)	(0.0427)	(0.055)	(0.0893)	(0.1005)	(0.1636)	(0.0526)	(0.0754)
CEB (t-2)	0.0470	-0.0166	0.0032	0.0490	0.0331	-0.0316	0.1283	0.1347	0.0825	-0.0730
	(0.03)	(0.0341)	(0.0318)	(0.0442)	(0.0539)	(0.0946)	(0.0941)	(0.1537)	(0.0536)	(0.0794)
Loan volume (t-1)	-0.5949***	-0.5858***	-0.2624***	-0.3723***	-0.6858***	-0.2928***	-0.4915***	-0.4641***	-0.4787***	-0.5383***
	(0.0739)	(0.0744)	(0.0843)	(0.0737)	(0.0806)	(0.0785)	(0.0784)	(0.0764)	(0.0781)	(0.0785)
Loan volume (t-2)	-0.3710***	-0.2458***	-0.0249	-0.4112***	-0.2733***	-0.2705***	-0.2251***	-0.3735***	-0.3338***	-0.2816***
	(0.0734)	(0.074)	(0.0684)	(0.0736)	(0.0811)	(0.0785)	(0.0771)	(0.0744)	(0.0762)	(0.0794)
Unemployment rate (t-1)	-0.0943**	0.0438*	-0.0123	-0.0105	0.0104	-0.0059	-0.1496	-0.1652*	-0.0182	0.0543
	(0.0422)	(0.0261)	(0.019)	(0.0617)	(0.0296)	(0.1404)	(0.1353)	(0.086)	(0.03)	(0.0478)
EURIBOR 3M (t-1)	0.0298	0.0566**	0.0353	0.0559	0.0506	0.0493	-0.0056	-0.0212	0.0753*	0.0474
	(0.0274)	(0.0275)	(0.0255)	(0.0371)	(0.0482)	(0.0774)	(0.0836)	(0.13)	(0.0415)	(0.0634)
EUCOM EcoSent (t-1)	-0.0083***	-0.0029*	-0.0035**	-0.0096***	-0.0021	0.0004	-0.0058	-0.0167	-0.0017	0.0046
	(0.0024)	(0.0016)	(0.0016)	(0.0028)	(0.0036)	(0.0046)	(0.0061)	(0.0123)	(0.0029)	(0.0036)
FX EUR/USD (t-1)	0.0557	-0.0301	0.0748	0.1811	0.0662	0.3398	0.0705	0.8510*	0.1438	0.1256
	(0.0898)	(0.1013)	(0.0935)	(0.1256)	(0.1649)	(0.2701)	(0.2863)	(0.4613)	(0.1575)	(0.2411)
Term spread 10Y-1Y (t-1)	-0.0035	0.0079	-0.0032	-0.0209	-0.0024	-0.0890	-0.0521	0.1671*	0.0105	-0.0162
	(0.018)	(0.0206)	(0.0193)	(0.026)	(0.0338)	(0.0572)	(0.0588)	(0.0932)	(0.0333)	(0.0481)
CPI (t-1)	4.9281**	6.9695***	1.0724	3.7218	-2.4660	0.6858	1.2294	-3.2472	5.5974	4.3217
	(2.2494)	(2.3315)	(1.3828)	(2.3399)	(2.7185)	(4.158)	(7.1821)	(7.4248)	(4.1723)	(3.516)
Constant	-0.0069	-0.0085	-0.0020	-0.0027	-0.0064	0.0022	0.0009	0.0018	-0.0041	-0.0130
	(0.0046)	(0.0054)	(0.0042)	(0.006)	(0.0077)	(0.0118)	(0.0142)	(0.0188)	(0.0086)	(0.0103)
R^2	0.3956	0.3430	0.1114	0.2877	0.3667	0.1576	0.2370	0.2968	0.2966	0.2715
N	158	158	158	158	158	158	158	158	158	158

The table shows the regression results for log-returns of volumes in corporate loans as the dependent variable and the CEB liquidity indicator as an explanatory variable. Standard errors are provided in brackets. The symbols *, ** and *** indicate significance at the 10%, 5% and 1% levels.

The one-period lagged CEB liquidity indicator is significant and positive. This is the case for the euro area as a whole and for three of its main contributors – Belgium, Germany and Italy. Lending to corporates for European periphery countries seems to be less reliant on liquidity. It turns out that the lagged volumes constitute the most relevant variable – this finding can be observed in a bank-level analysis by Khan, Ahmad, and Gee (2016).

The regression results for the impact of liquidity on volumes of corporate loans are shown in Table A.6. In general, the results point in the same direction as the results for corporate loans.

Table A.6: Regression results for euro area countries for household loan volumes using the CEB liquidity indicator

Dep. variable: Loan volume	EA	AT	BE	DE	ES	FI	FR	IE	IT	PT
CEB (t-1)	0.1267***	0.0311	0.1665**	0.1037**	0.0933	0.0999	0.1199*	-0.0217	0.0922***	0.2197***
	(0.04)	(0.0575)	(0.0663)	(0.0467)	(0.0759)	(0.0692)	(0.061)	(0.068)	(0.0342)	(0.0724)
CEB (t-2)	0.0852**	0.1048*	-0.0176	0.0279	0.0358	-0.1719**	0.0811	0.0788	0.0554	0.0880
	(0.0389)	(0.0601)	(0.0668)	(0.0491)	(0.0748)	(0.0737)	(0.0572)	(0.0642)	(0.0353)	(0.0787)
Loan volume (t-1)	-0.5748***	-0.6509***	0.0247	-0.4350***	-0.5180***	-0.2376***	-0.3988***	-0.4015***	-0.3368***	-0.4775***
	(0.0772)	(0.0768)	(0.0812)	(0.0784)	(0.0826)	(0.0766)	(0.0821)	(0.0782)	(0.0837)	(0.0801)
Loan volume (t-2)	-0.3580***	-0.2875***	0.2148***	-0.2836***	-0.2722***	-0.1561**	-0.0516	-0.1316*	0.0167	-0.1094
	(0.0769)	(0.076)	(0.0804)	(0.0784)	(0.083)	(0.0766)	(0.0831)	(0.0779)	(0.0806)	(0.0802)
Unemployment rate (t-1)	-0.0961*	0.0146	-0.0254	0.0974	-0.1213***	-0.2003*	-0.0255	-0.0871**	-0.0420**	-0.0785*
	(0.0543)	(0.0461)	(0.0389)	(0.0677)	(0.0421)	(0.1092)	(0.0815)	(0.0359)	(0.0196)	(0.0459)
EURIBOR 3M (t-1)	-0.0251	0.0036	-0.0041	0.0401	-0.1081	-0.0997	0.0082	-0.0670	-0.0016	-0.0253
	(0.0347)	(0.0479)	(0.0524)	(0.0398)	(0.0666)	(0.0608)	(0.05)	(0.0542)	(0.0266)	(0.0612)
EUCOM EcoSent (t-1)	-0.0020	0.0009	-0.0064**	-0.0042	-0.0032	0.0011	-0.0002	-0.0030	0.0014	0.0036
	(0.0031)	(0.0027)	(0.0032)	(0.003)	(0.0049)	(0.0036)	(0.0037)	(0.0052)	(0.0019)	(0.0036)
FX EUR/USD (t-1)	-0.1504	-0.4600**	0.1337	-0.0020	-0.3899*	-0.0531	-0.3032*	0.3385*	-0.0025	-0.2005
	(0.1137)	(0.1799)	(0.1943)	(0.1384)	(0.2227)	(0.2137)	(0.1725)	(0.1877)	(0.1013)	(0.2303)
Term spread 10Y-1Y (t-1)	-0.0113	0.0349	-0.0108	-0.0216	0.0132	-0.1564***	-0.0224	-0.0660*	-0.0071	-0.0005
	(0.023)	(0.0362)	(0.0397)	(0.0285)	(0.0465)	(0.0439)	(0.0355)	(0.0391)	(0.0217)	(0.0467)
CPI (t-1)	-2.7813	12.5255***	-0.1378	-0.9527	-3.1364	-7.7219**	-2.1021	-0.2725	-4.1351	2.3143
	(2.8997)	(4.0833)	(2.8562)	(2.576)	(3.7146)	(3.2179)	(4.3322)	(3.0942)	(2.8048)	(3.3856)
Constant	0.0051	-0.0112	0.0074	0.0025	0.0015	0.0110	0.0101	-0.0116	0.0102*	-0.0092
	(0.0059)	(0.0094)	(0.0089)	(0.0066)	(0.0104)	(0.0091)	(0.0087)	(0.0079)	(0.0058)	(0.0099)
R^2	0.3339	0.3650	0.0991	0.2383	0.2472	0.2275	0.1761	0.2504	0.1880	0.2753
N	158	158	158	158	158	158	158	158	158	158

The table shows the regression results for log-returns of volumes in household loans as the dependent variable and the CEB liquidity indicator as an explanatory variable. Standard errors are provided in brackets. The symbols *, ** and *** indicate significance at the 10%, 5% and 1% levels.

As expected, the relation between the CEB liquidity indicator and the log-returns of household loan volumes for the euro area as a whole is significant and positive. Loan volumes in Austria, Belgium, Germany, Finland, France, Italy and Portugal show the same relation as well.

A.4.2 Credit spreads

The regression results on the impact of market liquidity on credit spreads for corporate loans are shown in Table A.7. As expected, a strong and significant negative relation between corporate loans and the CEB liquidity indicator exists. Put differently, improved liquidity is associated with decreases in credit spreads. Indeed, there seems to be a liquidity premium.

Table A.7: Regression results for euro area countries for corporate credit spreads using the CEB liquidity indicator

Dep. variable: Credit spread	EA	AT	BE	DE	ES	FI	FR	IE	IT	PT
CEB (t)	-0.5370***	-0.7958***	-0.4980***	-0.5425***	-0.5342***	-0.5265***	-0.5840***	-0.4920**	-0.5598***	-0.3179
	(0.1168)	(0.1247)	(0.1105)	(0.1324)	(0.152)	(0.1478)	(0.1215)	(0.2095)	(0.1329)	(0.1927)
CEB (t-1)	0.1223	0.1941	-0.0161	0.1275	0.1494	0.1844	0.2532*	0.2489	0.0658	-0.5274***
	(0.1257)	(0.1243)	(0.1156)	(0.1314)	(0.1587)	(0.1463)	(0.1337)	(0.2263)	(0.1374)	(0.1919)
Unemployment rate (t-1)	0.1524	0.0148	0.1385**	-0.1186	0.1169	0.1275	0.1495	0.2042*	0.0365	-0.0231
	(0.1692)	(0.0996)	(0.0676)	(0.1877)	(0.0847)	(0.2235)	(0.1802)	(0.1187)	(0.0771)	(0.1177)
EURIBOR 3M (t-1)	0.3566***	0.3739***	0.4083***	0.2123*	0.3890***	0.3258***	0.3345***	0.4107**	0.2725**	0.2806*
	(0.1074)	(0.1028)	(0.0892)	(0.1094)	(0.1377)	(0.1218)	(0.1094)	(0.1774)	(0.1063)	(0.155)
EUCOM EcoSent (t-1)	-0.0046	-0.0004	-0.0046	-0.0029	0.0012	-0.0011	0.0066	-0.0004	0.0014	-0.0186**
	(0.0095)	(0.0058)	(0.0055)	(0.0087)	(0.0104)	(0.0076)	(0.0081)	(0.017)	(0.0074)	(0.0092)
FX EUR/USD (t-1)	-0.1222	-0.2767	-0.0793	-0.1220	0.0227	-0.9659**	-0.1565	0.1531	-0.6541	0.3716
	(0.3532)	(0.386)	(0.3347)	(0.3836)	(0.4627)	(0.4411)	(0.3829)	(0.6229)	(0.4114)	(0.6023)
Term spread 10Y-1Y (t-1)	0.1310*	0.1330*	0.1389**	0.1461*	0.0984	-0.0046	0.1268	0.0002	0.1199	0.1029
	(0.0719)	(0.0782)	(0.0688)	(0.0794)	(0.0964)	(0.0927)	(0.0784)	(0.1289)	(0.087)	(0.1223)
CPI (t-1)	-8.4449	-2.5792	-5.7896	-9.4825	1.3544	0.9243	-14.3760	-2.7960	10.6105	14.2188
	(8.8684)	(8.8995)	(4.9098)	(7.0655)	(7.7841)	(6.7883)	(9.5096)	(10.3937)	(10.7445)	(8.9013)
Constant	0.0235	0.0160	0.0251	0.0146	0.0092	0.0115	0.0304	0.0102	-0.0043	-0.0020
	(0.0182)	(0.0205)	(0.0152)	(0.0185)	(0.0219)	(0.0192)	(0.019)	(0.026)	(0.0224)	(0.026)
R^2	0.2384	0.3331	0.2574	0.1985	0.1611	0.1828	0.2569	0.0972	0.2128	0.1455
N	158	158	158	158	158	158	158	158	158	158

The table shows the regression results for changes of credit spreads in corporate loans as the dependent variable and the CEB liquidity indicator as an explanatory variable. Standard errors are provided in brackets. The symbols *, ** and *** indicate significance at the 10%, 5% and 1% levels.

The CEB liquidity indicator is, in comparison with the other variables, the most significant variable in our variable set for explaining credit spreads for corporate loans. It is noteworthy that for most countries the contemporaneous indicator is significant; the one-period lagged CEB liquidity indicator is only significant for Portugal. Accordingly, when looking at the lag structure, liquidity shocks materialize first in credit spreads and then in loan volumes. The EURIBOR 3M and the term spread have a strong and significant impact on credit spreads, too. Banks seem to demand higher credit spreads if the risk-free interest rate increases.

The CEB liquidity indicator is also strongly related to credit spreads of household loans Table A.8. The impact is negative for all countries and, with the exception of Germany, at least one of the coefficients for lagged liquidity is statistically significant.

Table A.8: Regression results for euro area countries for household credit spreads using the CEB liquidity indicator

Dep. variable: Credit spread	EA	AT	BE	DE	ES	FI	FR	IE	IT	PT
CEB (t)	-0.3291***	-0.4647***	-0.4135***	-0.1984	-0.3269	-0.3598***	-0.4412***	-0.3242**	-0.3840**	-0.2602
	(0.1208)	(0.1211)	(0.1259)	(0.1358)	(0.2221)	(0.1021)	(0.1313)	(0.1495)	(0.1939)	(0.314)
CEB (t-1)	-0.1671	-0.2305*	-0.2612**	-0.1652	-0.6348***	0.0800	-0.4219***	-0.0572	-0.3520*	-0.9079***
	(0.1299)	(0.1207)	(0.1318)	(0.1347)	(0.2317)	(0.101)	(0.1445)	(0.1615)	(0.2005)	(0.3127)
Unemployment rate (t-1)	0.1723	-0.0238	0.1982**	-0.2010	0.1040	0.3012*	-0.2687	0.0328	0.1448	0.2010
	(0.1749)	(0.0967)	(0.0771)	(0.1924)	(0.1237)	(0.1544)	(0.1948)	(0.0847)	(0.1125)	(0.1917)
EURIBOR 3M (t-1)	0.3276***	0.3284***	0.3133***	0.1579	0.5149 **	0.5526***	-0.0684	0.3172**	0.2494	0.5216**
	(0.111)	(0.0999)	(0.1017)	(0.1121)	(0.2012)	(0.0841)	(0.1183)	(0.1266)	(0.1552)	(0.2526)
EUCOM EcoSent (t-1)	-0.0065	-0.0015	-0.0045	-0.0076	0.0182	-0.0061	-0.0023	-0.0029	-0.0038	-0.0084
	(0.0098)	(0.0057)	(0.0062)	(0.0089)	(0.0151)	(0.0052)	(0.0087)	(0.0121)	(0.0108)	(0.0149)
FX EUR/USD (t-1)	0.1468	-0.0969	-0.0034	-0.0440	1.0224	-0.0068	-0.2067	-0.0649	0.6057	0.0640
	(0.3652)	(0.375)	(0.3816)	(0.3932)	(0.6759)	(0.3046)	(0.4139)	(0.4444)	(0.6002)	(0.9814)
Term spread 10Y-1Y (t-1)	0.2129***	0.2170***	0.1376*	0.2251***	0.1579	0.1956 ***	0.1763**	0.0432	0.2182*	0.0429
	(0.0743)	(0.0759)	(0.0785)	(0.0813)	(0.1409)	(0.064)	(0.0848)	(0.092)	(0.127)	(0.1992)
CPI (t-1)	-12.0034	-2.2255	-10.8218*	-6.9640	-4.5255	4.2518	-9.6855	-10.5214	7.8994	-7.0384
	(9.1689)	(8.6447)	(5.5968)	(7.2422)	(11.3703)	(4.6879)	(10.2789)	(7.4155)	(15.677)	(14.5032)
Constant	0.0269	0.0133	0.0233	0.0103	0.0269	0.0106	0.0148	0.0321*	-0.0014	0.0229
	(0.0189)	(0.0199)	(0.0174)	(0.019)	(0.032)	(0.0133)	(0.0205)	(0.0185)	(0.0326)	(0.0424)
R^2	0.1682	0.2237	0.1852	0.1165	0.1173	0.3300	0.1744	0.0816	0.0958	0.1004
N	158	158	158	159	158	158	158	158	158	158

The table shows the regression results for changes of credit spreads in household loans as the dependent variable and the CEB liquidity indicator as an explanatory variable. Standard errors are provided in brackets. The symbols *, ** and *** indicate significance at the 10%, 5% and 1% levels.

It is noteworthy that the coefficients of household's credit spreads tend to be smaller than the ones for corporate loans (see Table A.7). Accordingly, credit spreads of corporate loans react more strongly and swiftly than credit spreads of household loans to changes in market liquidity.

A.5 Robustness: CEB (clean), VSTOXX and control for increases in loan demand

Table A.9: Regression results for the euro area as a whole for loan volumes using the CEB (clean) liquidity indicator in the baseline setting

	Corporates	Households	Corporates		Households		
Dep. variable: Loan volume	Total	Total	≤ 1 Mio.	> 1 Mio.	Consumption	Mortgages	Other
CEB (clean) (t)	0.1042***	0.1285***	0.0939***	0.1051***	0.1155***	0.1323***	0.1426***
	(0.0311)	(0.0397)	(0.0266)	(0.0368)	(0.0363)	(0.0485)	(0.0525)
CEB (clean) (t-1)	0.0488	0.0815**	0.029	0.0586*	0.0794**	0.0911*	0.0453
	(0.0297)	(0.0387)	(0.0258)	(0.0349)	(0.0353)	(0.0469)	(0.0509)
Loan volume (t-1)	-0.5975***	-0.5686***	-0.7985***	-0.5258***	-0.7312***	-0.4769***	-0.4325***
	(0.0734)	(0.0772)	(0.0671)	(0.0755)	(0.0745)	(0.0792)	(0.0784)
Loan volume (t-2)	-0.3753***	-0.3522***	-0.5437***	-0.3043***	-0.406***	-0.275***	-0.2898***
	(0.0729)	(0.0767)	(0.0668)	(0.075)	(0.0736)	(0.0791)	(0.0779)
Unemployment rate (t-1)	-0.0934**	-0.0934*	-0.0977***	-0.0917*	-0.0976**	-0.1226*	-0.0083
	(0.0419)	(0.0542)	(0.0358)	(0.0494)	(0.0493)	(0.0659)	(0.0711)
EURIBOR 3M (t-1)	0.0276	-0.0283	0.0072	0.0304	-0.0232	-0.0556	0.0205
	(0.0271)	(0.0345)	(0.023)	(0.032)	(0.0315)	(0.0421)	(0.0456)
EUCOM EcoSent (t-1)	-0.0083***	-0.0016	-0.0044**	-0.0093***	-0.0024	-0.0018	-0.0025
	(0.0023)	(0.003)	(0.002)	(0.0027)	(0.0027)	(0.0037)	(0.0039)
FX EUR/USD (t-1)	0.0572	-0.1385	-0.0715	0.1167	-0.0958	-0.2305*	0.1328
	(0.0023)	(0.003)	(0.002)	(0.0027)	(0.0027)	(0.0037)	(0.0039)
Term spread 10Y-1Y (t-1)	-0.0063	-0.0155	-0.0113	-0.0042	-0.0021	-0.0195	-0.0289
	(0.0178)	(0.0228)	(0.0153)	(0.021)	(0.0208)	(0.0279)	(0.0302)
CPI (t-1)	5.0233**	-2.6376	2.0001	5.7935**	-2.3166	-1.8626	-1.5945
	(2.2344)	(2.8976)	(1.9218)	(2.6328)	(2.6158)	(3.5329)	(3.7952)
Constant	-0.0067	0.0054	-0.0043	-0.0072	0.0023	0.0081	-0.0041
	(0.0046)	(0.0059)	(0.0039)	(0.0054)	(0.0053)	(0.0072)	(0.0078)
R^2	0.4046	0.3369	0.5372	0.3484	0.4432	0.2606	0.2462
N	158	158	158	158	158	158	158

The table shows the regression results for log-returns of loan volumes as the dependent variable and the CEB (clean) liquidity indicator as an explanatory variable in the baseline setting. Standard errors are provided in brackets. The symbols *, ** and *** indicate significance at the 10%, 5% and 1% levels.

Table A.10: Regression results for the euro area as a whole for credit spreads using the CEB (clean) liquidity indicator in the baseline setting

	Corporates	Households	Corporates		Households		
Dep. variable: Credit spreads	Total	Total	$\leq$ 1 Mio.	$>$ 1 Mio.	Consumption	Mortgages	Other
CEB (clean) (t)	-0.4609***	-0.2877**	-0.4651***	-0.4832***	-0.3134*	-0.4555***	-0.3092**
	(0.1188)	(0.1226)	(0.1139)	(0.1256)	(0.1623)	(0.1052)	(0.1195)
CEB (clean) (t-1)	0.2467*	-0.031	0.1603	0.2624*	-0.2297	-0.0472	0.128
	(0.1262)	(0.1303)	(0.1211)	(0.1335)	(0.1725)	(0.1118)	(0.127)
Unemployment rate (t-1)	0.1124	0.1493	0.1881	0.1097	0.1746	0.2252	0.1491
	(0.1699)	(0.1754)	(0.163)	(0.1797)	(0.2322)	(0.1505)	(0.1709)
EURIBOR 3M (t-1)	0.351***	0.3392***	0.4051***	0.3441***	0.2748*	0.3574***	0.4125***
	(0.1078)	(0.1113)	(0.1034)	(0.1141)	(0.1474)	(0.0955)	(0.1085)
EUCOM EcoSent (t-1)	-0.0092	-0.0117	-0.0122	-0.0083	-0.0185	-0.0073	-0.0086
	(0.0094)	(0.0097)	(0.009)	(0.0099)	(0.0128)	(0.0083)	(0.0094)
FX EUR/USD (t-1)	-0.1956	0.1049	-0.0359	-0.2476	0.3717	0.1267	-0.1178
	(0.3565)	(0.3679)	(0.3419)	(0.377)	(0.4871)	(0.3158)	(0.3585)
Term spread 10Y-1Y (t-1)	0.1267*	0.2106***	0.153**	0.118	0.2235**	0.1887***	0.1696**
	(0.0729)	(0.0752)	(0.0699)	(0.0771)	(0.0996)	(0.0646)	(0.0733)
CPI (t-1)	-7.4365	-11.8145	-8.8284	-6.8805	-17.2231	-11.9695	-13.8033
	(8.9407)	(9.2278)	(8.5751)	(9.4564)	(12.2178)	(7.9205)	(8.9933)
Constant	0.0219	0.0262	0.0246	0.0209	0.0406	0.0258	0.031*
	(0.0184)	(0.019)	(0.0177)	(0.0195)	(0.0252)	(0.0163)	(0.0185)
R^2	0.2246	0.1561	0.2462	0.2141	0.1207	0.2516	0.1854
N	158	158	158	158	158	158	158

The table shows the regression results for log-returns of credit spreads as the dependent variable and the CEB (clean) liquidity indicator as an explanatory variable in the baseline setting. Standard errors are provided in brackets. The symbols *, ** and *** indicate significance at the 10%, 5% and 1% levels.

Table A.11: Regression results for the euro area as a whole for loan volumes using VSTOXX as the liquidity indicator in the baseline setting

	Corporates	Households	Corporates		Households		
Dep. variable: Loan Volumes	Total	Total	$\leq$ 1 Mio.	$>$ 1 Mio.	Consumption	Mortgages	Other
VSTOXX (t-2)	-0.0024***	-0.0018*	-0.0013**	-0.0028***	-0.0015*	-0.0018	-0.0026**
	(0.0007)	(0.0009)	(0.0006)	(0.0008)	(0.0008)	(0.0011)	(0.0012)
Loan volume (t-1)	-0.5584***	-0.5229***	-0.7748***	-0.4936***	-0.6977***	-0.4375***	-0.41***
	(0.0729)	(0.0783)	(0.0678)	(0.0746)	(0.0747)	(0.0802)	(0.0776)
Loan volume (t-2)	-0.3179***	-0.3187***	-0.5162***	-0.2552***	-0.3902***	-0.2498***	-0.2574***
	(0.0731)	(0.0806)	(0.0691)	(0.0744)	(0.0767)	(0.0818)	(0.0791)
Unemployment rate (t-1)	-0.0865**	-0.0882	-0.0939**	-0.0845*	-0.0948*	-0.1174*	-0.0019
	(0.0417)	(0.0557)	(0.0367)	(0.0489)	(0.0508)	(0.0672)	(0.0715)
EURIBOR 3M (t-1)	0.0352	-0.0211	0.0084	0.0413	-0.0169	-0.0468	0.0267
	(0.0269)	(0.0355)	(0.0235)	(0.0315)	(0.0324)	(0.0429)	(0.0458)
EUCOM EcoSent (t-1)	-0.0062***	0.0017	-0.0021	-0.0073***	0.0008	0.0017	0.0003
	(0.0021)	(0.0028)	(0.0019)	(0.0025)	(0.0026)	(0.0035)	(0.0036)
FX EUR/USD (t-1)	0.0844	-0.1016	-0.0526	0.1426	-0.0667	-0.1931	0.1621
	(0.0878)	(0.1151)	(0.0767)	(0.1028)	(0.1045)	(0.1391)	(0.1492)
Term spread 10Y-1Y (t-1)	-0.0039	-0.0164	-0.0087	-0.0025	-0.0027	-0.0208	-0.0258
	(0.0175)	(0.0232)	(0.0155)	(0.0206)	(0.0212)	(0.0281)	(0.03)
CPI (t-1)	4.2254*	-2.5613	1.67	4.9228*	-2.2102	-1.7331	-2.2923
	(2.2372)	(2.9706)	(1.9706)	(2.6168)	(2.6965)	(3.5984)	(3.8193)
Constant	-0.006	0.0047	-0.0042	-0.0064	0.0018	0.0073	-0.0035
	(0.0046)	(0.006)	(0.004)	(0.0053)	(0.0055)	(0.0073)	(0.0078)
R^2	0.4051	0.2961	0.5134	0.3583	0.4064	0.2261	0.2336
N	158	158	158	158	158	158	158

The table shows the regression results for log-returns of loan volumes as the dependent variable and the VSTOXX as an explanatory variable in the baseline setting. Standard errors are provided in brackets. The symbols *, ** and *** indicate significance at the 10%, 5% and 1% levels.

Table A.12: Regression results for the euro area as a whole for credit spreads using VSTOXX as the liquidity indicator in the baseline setting

	Corporates	Households	Corporates		Households		
Dep. variable: Credit spreads	Total	Total	≤ 1 Mio.	> 1 Mio.	Consumption	Mortgages	Other
VSTOXX (t)	0.0168***	0.0148***	0.0168***	0.0168***	0.0151***	0.0119***	0.0171***
	(0.0026)	(0.0026)	(0.0025)	(0.0028)	(0.0036)	(0.0024)	(0.0025)
VSTOXX (t-1)	0.0059**	0.004	0.0055**	0.0058*	0.0047	0.0033	0.0044
	(0.0029)	(0.0029)	(0.0027)	(0.0031)	(0.004)	(0.0026)	(0.0027)
Unemployment rate (t-1)	0.0452	0.1066	0.1175	0.0375	0.1302	0.1448	0.1036
	(0.1604)	(0.1614)	(0.1512)	(0.1719)	(0.222)	(0.1472)	(0.1526)
EURIBOR 3M (t-1)	0.2247**	0.2574**	0.2899***	0.2164*	0.2124	0.2997***	0.2994***
	(0.103)	(0.1036)	(0.097)	(0.1104)	(0.1425)	(0.0945)	(0.098)
EUCOM EcoSent (t-1)	-0.0029	-0.0134	-0.009	-0.0019	-0.0263**	-0.0119	-0.0053
	(0.0081)	(0.0081)	(0.0076)	(0.0087)	(0.0112)	(0.0074)	(0.0077)
FX EUR/USD (t-1)	-0.112	0.1383	0.0143	-0.1736	0.3866	0.0497	-0.0487
	(0.3544)	(0.3565)	(0.3339)	(0.3797)	(0.4904)	(0.3252)	(0.3371)
Term spread 10Y-1Y (t-1)	0.107	0.1713**	0.1309**	0.1017	0.1742*	0.1833***	0.1299*
	(0.0697)	(0.0701)	(0.0656)	(0.0747)	(0.0964)	(0.0639)	(0.0663)
CPI (t-1)	-5.888	-10.7573	-7.2523	-5.2415	-16.3103	-10.4607	-12.5133
	(8.4865)	(8.5364)	(7.9956)	(9.0937)	(11.7438)	(7.7884)	(8.0719)
Constant	0.0212	0.0268	0.0243	0.0202	0.0423*	0.0266*	0.0307*
	(0.0175)	(0.0176)	(0.0164)	(0.0187)	(0.0241)	(0.016)	(0.0166)
R^2	0.3026	0.2791	0.3458	0.2745	0.1891	0.2777	0.345
N	158	158	158	158	158	158	158

The table shows the regression results for log-returns of credit spreads as the dependent variable and the VSTOXX as an explanatory variable in the baseline setting. Standard errors are provided in brackets. The symbols *, ** and *** indicate significance at the 10%, 5% and 1% levels.

Table A.13: Regression results for the euro area as a whole for loan volumes using the CEB liquidity indicator and controlling for loan demand in the baseline setting

	Corporates	Households	Corporates		Households		
Dep. variable: Loan volumes	Total	Total	$\leq$ 1 Mio.	$>$ 1 Mio.	Consumption	Mortgages	Other
CEB (t-1)	0.0951***	0.1346***	0.0869***	0.0945**	0.107***	0.1407***	0.1251**
	(0.0345)	(0.0434)	(0.0286)	(0.0408)	(0.0386)	(0.0522)	(0.0556)
CEB (t-2)	0.0443	0.083**	0.0166	0.0546	0.0817**	0.093*	0.0392
	(0.0328)	(0.0416)	(0.0277)	(0.0388)	(0.0371)	(0.0498)	(0.0532)
CEB (t-1)$\cdot 1_{\{\text{Loan demand above average}\}}$	-0.013	-0.0539	-0.0005	-0.0081	0.0208	-0.0587	-0.0101
	(0.0785)	(0.1094)	(0.0656)	(0.0928)	(0.1217)	(0.1341)	(0.1768)
CEB (t-2) $\cdot 1_{\{\text{Loan demand above average}\}}$	0.0383	0.0375	0.128**	0.0237	0.0377	0.0406	0.1362
	(0.0774)	(0.107)	(0.0647)	(0.0918)	(0.1164)	(0.1314)	(0.1683)
$1_{\{\text{Loan demand above average}\}}$	0.0121	0.0205**	0.0169***	0.0111	0.0136	0.0292**	0.0267*
	(0.0076)	(0.0103)	(0.0064)	(0.009)	(0.0095)	(0.0117)	(0.0138)
Loan volume (t-1)	-0.609 ***	-0.5953***	-0.8409***	-0.53***	-0.7516***	-0.5087***	-0.4651***
	(0.0744)	(0.0778)	(0.0669)	(0.0767)	(0.0756)	(0.0789)	(0.0802)
Loan volume (t-2)	-0.3809***	-0.3583***	-0.5775***	-0.3051***	-0.4192***	-0.2854***	-0.3019***
	(0.0742)	(0.077)	(0.0666)	(0.0764)	(0.0744)	(0.0785)	(0.0787)
Unemployment rate (t-1)	-0.0693	-0.0437	-0.0597	-0.0705	-0.0604	-0.0673	0.0734
	(0.0448)	(0.0596)	(0.0372)	(0.0531)	(0.0568)	(0.0689)	(0.0818)
EURIBOR 3M (t-1)	0.0261	-0.0176	0.007	0.0284	-0.0203	-0.0433	0.0287
	(0.028)	(0.0348)	(0.0232)	(0.0333)	(0.0322)	(0.0419)	(0.0464)
EUCOM EcoSent (t-1)	-0.0077***	-0.0034	-0.0037*	-0.0087***	-0.0024	-0.0041	-0.0022
	(0.0024)	(0.0032)	(0.002)	(0.0029)	(0.0028)	(0.0038)	(0.004)
FX EUR/USD (t-1)	0.0614	-0.1322	-0.0585	0.1193	-0.1045	-0.2121	0.1392
	(0.0902)	(0.1139)	(0.0744)	(0.1067)	(0.1034)	(0.1373)	(0.1501)
Term spread 10Y-1Y (t-1)	-0.0013	-0.0101	-0.0061	0.0007	0.0037	-0.0118	-0.022
	(0.0182)	(0.0229)	(0.0152)	(0.0215)	(0.0211)	(0.0277)	(0.0303)
CPI (t-1)	4.7015**	-2.8401	1.6765	5.5038**	-2.2044	-1.7879	-1.6096
	(2.2702)	(2.8859)	(1.8967)	(2.6838)	(2.6674)	(3.4865)	(3.8476)
Constant	-0.0134**	-0.0061	-0.0136***	-0.0134*	-0.0055	-0.0073	-0.0188*
	(0.0062)	(0.0081)	(0.0052)	(0.0073)	(0.0073)	(0.0093)	(0.0107)
R^2	0.4076	0.3541	0.566	0.3478	0.4484	0.2945	0.2628
N	158	158	158	158	158	158	158

The table shows the regression results for log-returns of loan volumes using an indicator function for credit demand in the baseline setting. Standard errors are provided in brackets. The symbols *, ** and *** indicate significance at the 10%, 5% and 1% levels.

Table A.14: Regression results for the euro area as a whole for credit spreads using the CEB liquidity indicator and controlling for loan demand in the baseline setting

	Corporates	Households	Corporates		Households		
Dep. variable: Credit spreads	Total	Total	$\leq$ 1 Mio.	$>$ 1 Mio.	Consumption	Mortgages	Other
CEB (t)	-0.471***	-0.3937***	-0.5012***	-0.4821***	-0.3947**	-0.4815***	-0.3741***
	(0.1267)	(0.1299)	(0.122)	(0.1329)	(0.1665)	(0.1121)	(0.1236)
CEB (t-1)	0.1253	-0.1508	0.0564	0.124	-0.3169*	-0.1112	0.0279
	(0.1383)	(0.1405)	(0.1331)	(0.145)	(0.1807)	(0.1216)	(0.1342)
CEB (t) $\cdot 1_{\{\text{Loan demand above average}\}}$	-0.4012	0.6438*	-0.1753	-0.5648*	0.7151	-0.0055	0.182
	(0.3013)	(0.3415)	(0.2899)	(0.3159)	(0.5857)	(0.3007)	(0.4349)
CEB (t-1)$\cdot 1_{\{\text{Loan demand above average}\}}$	-0.0623	-0.1113	-0.188	0.0299	-0.4705	-0.1818	-0.3683
	(0.3071)	(0.351)	(0.2955)	(0.3219)	(0.5684)	(0.3097)	(0.4221)
$1_{\{\text{Loan demand above average}\}}$	-0.0086	-0.045	-0.011	-0.0045	-0.0243	-0.0088	-0.0218
	(0.0306)	(0.0331)	(0.0294)	(0.032)	(0.0439)	(0.0271)	(0.0326)
Unemployment rate (t-1)	0.1492	0.0557	0.2085	0.166	0.1418	0.2322	0.126
	(0.1811)	(0.1929)	(0.1743)	(0.1899)	(0.2663)	(0.1608)	(0.1978)
EURIBOR 3M (t-1	0.3745***	0.3153***	0.4209***	0.3707***	0.26*	0.3545***	0.4145***
	(0.1097)	(0.1105)	(0.1056)	(0.115)	(0.148)	(0.096)	(0.1099)
EUCOM EcoSent (t-1)	-0.0041	-0.0042	-0.0079	-0.0021	-0.0154	-0.0039	-0.005
	(0.0099)	(0.01)	(0.0095)	(0.0104)	(0.0131)	(0.0087)	(0.0097)
FX EUR/USD (t-1)	-0.1454	0.1448	0.0179	-0.1964	0.4854	0.1301	-0.0364
	(0.3555)	(0.3681)	(0.3421)	(0.3727)	(0.4877)	(0.3196)	(0.3622)
Term spread 10Y-1Y (t-1)	0.1215*	0.2094***	0.1575**	0.1047	0.2253**	0.1909***	0.1707**
	(0.0731)	(0.0738)	(0.0703)	(0.0766)	(0.0985)	(0.0642)	(0.0732)
CPI (t-1)	-9.2854	-12.3071	-10.4081	-8.9501	-17.822	-12.3908	-15.6388*
	(9.0229)	(9.0983)	(8.6813)	(9.4581)	(12.3433)	(7.9214)	(9.1664)
Constant	0.0305	0.0493*	0.034	0.0277	0.0544	0.0333	0.0455*
	(0.0246)	(0.0261)	(0.0237)	(0.0258)	(0.0343)	(0.0215)	(0.0255)
R^2	0.2482	0.1982	0.2645	0.2516	0.153	0.2701	0.2013
N	158	158	158	158	158	158	158

The table shows the regression results for log-returns of credit spreads using an indicator function for credit demand in the baseline setting. Standard errors are provided in brackets. The symbols *, ** and *** indicate significance at the 10%, 5% and 1% levels.