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FIRM LIQUIDITY AND THE TRANSMISSION OF MONETARY POLICY

by Margherita Bottero* and Stefano Schiaffi*

Abstract

We study how firms' cash balances affect the supply of bank credit and the transmission of monetary policy via the bank-lending channel in Italy using bank- and firm-level data. From a theoretical perspective, there is no agreement on whether, for a given level of credit demand, cash-rich companies enjoy better access to credit, as an abundance of cash may reveal both positive and negative information about the firm. According to our analysis, based on a sample of 430,000 Italian non-financial corporations over the period 2006-2018, banks view firm liquidity favourably since it is associated, on average, with cheaper bank funding and with a credit composition tilted towards term loans, at all maturities and non-collateralized. We also show that firms reallocate their liquidity in and out of their deposits following changes in the slope of the yield curve, which proxies the opportunity cost of cash. For this reason, changes in monetary policy that alter the slope of the term structure impact the cost of credit not only via the traditional channels but also indirectly, as they prompt a reallocation of firm liquidity that banks anticipate and price into the credit contracts they offer.

JEL Classification: E51, E52.
Keywords: firm liquidity, bank financing, monetary policy transmission.
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1. Introduction[1]

Firm liquidity has been on the rise globally over the last two decades. This phenomenon, which is associated with the prolonged period of low real interest rates, high corporate profits and stagnating or declining investment in physical capital, is unlikely to revert anytime soon (Dao and Maggi, 2018). More recently, the outbreak of the Covid-19 pandemic has brought about an additional, sharp increase in corporates' liquid holdings. As the restrictions put in place to contain the spread of the virus were halting the flow of firms' revenues, the uncertainty about the evolution of the pandemic induced companies to postpone fixed investment, resulting in firms stocking up large deposits, amidst very accommodative monetary policy and supporting public programs.

Given the increasing importance of liquidity on firm balance sheets, this paper sets out to empirically estimate the effect of Italian firms' corporate liquidity on credit conditions (interest rates, volumes, maturity and collateralization) and on the transmission mechanism of monetary policy via the bank-lending channel (focussing on the pass-through of changes in key ECB's policy rates to the cost of credit).

From a broad theoretical point of view, several factors, including risk preferences, perceived continuation value and exposure to shocks, concur to explain why firms hold a positive and time-varying amount of cash (Keynes 1936; Whalen 1996; Miller and Orr 1966; Myers and Majluf 1984; Jensen 1986). Thus cash informs investors - and intermediaries - about these fundamentals about a firm, influencing its access to capital markets and bank credit (Gamba and Triantis, 2008).[2,3] However, the direction of the effect of corporate liquidity, broadly intended as cash, deposits and short-term liquid assets, on credit conditions is a priori ambiguous.

On the one hand, large amounts of cash may signal that a firm is more exposed to aggregate shocks, and thus be an unappealing borrower for intermediaries to finance.[4] The reasoning is as follows: firms

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[2] According to Keynes (1936) cash is held to "to provide for contingencies requiring sudden expenditure and for unforeseen opportunities of advantageous purchases, and also to hold an asset of which the value is fixed in terms of money to meet a subsequent liability in terms of money" (General theory of money and prices, p 196). Besides precautionary motives, Keynes mentions transaction costs and speculative motives as driving the demand for money.

[3] In a frictionless market, cash and credit lines should be substitute, but in presence of frictions the two are not (see survey in Lins, Servaes, and Tufano 2010).

[4] In this theoretical framework, exposure to idiosyncratic shock is less problematic for lenders, as they can "insure" against this type of risk by diversifying their portfolio. As aggregate risk is by its nature uninsurable, banks view unfavorably lending to borrowers exposed to it, and tend to discourage them by charging them worse contractual conditions (or declining to lend at all).

in general prefer to finance their projects when these arise drawing on flexible credit lines rather than holding liquidity in expectation of possible investment opportunities. Thus, if they do hold large cash balances, it is likely to be because previous lenders have found them too risky and charged them unfavourable contractual conditions – or denied credit tout-court – tilting their funding mix toward internal sources of finance (Acharya et al. 2013). In this view, a borrower's high liquidity signals that previous intermediaries have not satisfied his credit demand: perspective lenders internalize this information and respond by charging unfavorable contractual terms.

On the other hand, cash may be an indicator of a firm's higher profitability. In presence of financing constraints, in fact, firms without sufficient cash reserves may become illiquid and be forced into default while still solvent. As firms that are more profitable have a higher continuation value, they accumulate more cash to avoid negative liquidity shocks that would force them into default (Gryglewicz, 2011; Campello et al. 2011). It follows that higher cash balances lead to more favourable credit conditions, reflecting the firm's higher profitability and more prudent liquidity management.[5]

To the extent that banks take firm liquidity into account in their lending choices, the pass-through of changes in monetary policy rates to the cost of credit may also be affected by cash holdings. This is because changes in the slope of the yield curve impact the opportunity cost of holding cash assets, prompting firms to adjust their holdings (or cash-like liquid assets). For instance, a steepening in the yield curve is associated with a reduction in liquid holdings, as firms find it more profitable to reallocate the funds from their accounts to more remunerative assets/projects. As intermediaries value firm liquidity in their lending choices, this adjustment is priced in by banks *simultaneously* to the pass-through of the monetary action. Indeed, in our dataset, which covers credit developments for a representative sample of Italian firms between 2006q1 and 2018q4, firms' liquid holdings and the slope of the yield curve co-move negatively (Figure 1). Quantitatively, the correlation between the two variables stands at -0.4** for the whole sample; the effect is larger in magnitude in the years after 2014 (-0.1, not significant for the subsample). The effect of having lower cash balances - induced by the steepening of the curve - brings about an effect on credit conditions (with the direction of the effect determined by which theory of the above prevails), additional to that induced by monetary policy and the ensuing effects on the yield curve.

[5] Finally, cash holdings may also play a role in shaping firms' demand, by acting as a negotiation tool allowing firms to credibly claim their intention to undertake the project even without external funds. To the extent that this signals the projects' quality, the intermediaries may respond by conceding credit at a better rate (Rocheteau et al. 2018).

Here we address these two questions (i.e. the effect of firm liquidity on bank credit supply and the effect of firm liquidity in altering the transmission of changes in the official rates on the cost of credit) using a panel of bank-firm matched data for Italy, which is an ideal setup for the following reasons. First, Italian firms are largely bank-dependent and hold in their balance sheets a substantial and increasing amount of cash (Figure 1, panel a, blue solid line). Second, there is considerable variation in the amount of liquid holdings as a percentage of total assets in our sample (the coefficient of variation is equal to 137%). Third, we can draw on the very detailed, bank-firm matched credit data available via the Bank of Italy Credit Register. Our dataset includes firms' balance sheet characteristics, the specificities of their bank financing (volumes, cost and characteristics of loans granted). We can track this data for over ten years spanning two financial crises. Lastly, the advantage of focusing on Italy is that monetary policy in this country is to some extent exogenous, as it is decided at the euro area level. This allows us to disentangle the impact of the policy action from contemporaneous changes in the macroeconomic environment (Jimenez et al., 2014, Peydro et al., 2017).

Econometrically, to isolate the role of cash on bank supply conditions we should minimize the concerns about the endogeneity of firm liquidity to credit outcomes and, at the same time, control for all bank characteristics that affect lending to more liquid firms (beyond their evaluation of the liquidity position). In line of principle, we would like to compare lending from the same bank to two firms identical in everything but their level of cash – thus controlling for all other drivers of credit supply and demand. To approximate this ideal setting, we include in all regressions bank*quarter fixed effects and an array of firm-level variables, including their credit score.[6] To better net out confounding firm demand dynamics, we also control for firm*year and/or industry*quarter fixed effects to capture time-varying demand confounders at the firm or industry level (e.g. industry-specific liquidity needs that are linked to the business cycle; Shi, 2015). This approach, which builds on Khwaja and Mian (2008), compares credit conditions applied by the same bank to two firms that differ in their liquidity level, controlling extensively for a wide range of other observable traits that may affect their credit demand. This methodology allows us to establish causality using the whole time series of the dataset, but has unavoidable limitations (Amiti and Weinstein, 2018). To robustify our results, we also exploit an episode that resulted in some firms enjoying an unexpected liquidity

[6] The inclusion of firms' credit score controls for the risk-taking channel of monetary policy (Borio and Zhu, 2012; Adrian and Shin, 2011).

increase owing to the repayment of debt with the Italian Public Administration. This allows us to verify our findings in a cross-sectional difference-in-difference framework.

The empirical analysis documents the existence of a positive relationship between liquidity holdings and credit conditions. In particular, we find that more liquid firms obtain lower interest rates on new term loans and on credit lines (, as well as lower fees and commissions on credit lines. Firms also obtain higher volumes of term loans, at all maturities, and they reduce credit lines accordingly. Finally, they are able to scale down collateralized term loans.

Next, we address the issue of the transmission of monetary policy impulses. We show that firms respond to changes in the term structure coherently with the notion that the steepness of the curve approximates the opportunity cost of holding liquidity. A steepening in the yield curve prompts firms to reduce their cash balances (to allocate them into more remunerative projects); a flattening, instead, is associated with an increase in cash balances, as the opportunity cost of holding them is lower. Crucially, an established result in the corporate finance literature states that firms with higher liquidity exhibit a stronger cashflow sensitivity of cash (Gryglewicz, 2011) because of the positive interplay of firms' solvency and demand for cash: liquid firms display higher solvency, which in turn increases their demand for cash as a form of insurance in an incomplete markets framework. This in turn increases their solvency, thus driving up their demand for cash. Therefore, any shock to the opportunity cost of liquidity (e.g. a flattening of the yield curve) implies greater changes in the cash balances of ex ante more liquid firms. As banks view favorably increases in firms' liquid holdings, a correlation emerges between a flattening in the yield curve, firms' cash balances and the application of more favorable conditions (and vice-versa for steepening).

Because of these results, firm liquidity indeed interacts with monetary policy. Depending on the nature of impulse that the central bank wants to transmit with its action, this may dampen or accelerate the transmission. In particular, in positive territory, a (expansionary) rate cut steepens the curve, prompting more liquid firms get rid of larger amounts of cash. As intermediaries assign value to firms' liquidity, they view this reallocation unfavorably, and thus charge relatively higher rates on their loans, reversing in part the easing effect intended by the initial rate. The reverse happens following an increase in policy rates that prompts a flattening of the yield curve. Thus, in positive territory, firm liquidity acts as a "dampener" of the initial monetary policy stimulus, both in the case of steepening and of flattening of the yield curve. Interestingly, in negative territory, rate cuts prompt

a flattening of the yield curve. Thus, contrary to standard cuts, the easing effect of cuts in negative territory is enhanced by firm liquidity.

To the best of our knowledge, our paper is the first to provide a unified assessment of the impact of firm cash balances on the cost of bank credit and on the transmission of monetary policy, highlighting the role of movements in the whole slope of the yield curve in shaping this heterogeneity. This consideration adds to the growing literature that urges to reconsider the workings of monetary policy in light of the fact that agents respond to movements in the whole term structure a new hue to the vast literature that studies how bank and firm characteristics affect credit dynamics.

Literature overview. The studies on the role of liquidity in shaping firms' funding and investment decisions are abundant. Hubbard (1998) is the classical reference for a survey of the works that show that a firm's financial mix impacts its investment choices. Seminal work is Fazzari, Hubbard and Petersen (1998). Since then, however, the literature has questioned whether liquidity truly matters for investment choices, and results are still mixed (for instance Mercatanti et al., 2017, and Buono and Formai, 2019). Focusing on Italy, Dottori and Micucci (2018) assess the role of liquidity determinants at the firm level, relating them to different motives for holding cash, such as precautionary reasons, transaction costs, and the effects of information asymmetries in financial markets. Rocheteau et al. (2018) propose a general equilibrium model where the pass-through of monetary policy to lending rates and to investment depends on market microstructure, policy, bank and firm characteristics. In particular, the authors stress the role of corporate liquidity as a bargaining tool vis à vis banks: in an incomplete information setting, large liquid holdings act as an implicit threat of using internal funds instead of bank credit to pursue investment, thus lowering the equilibrium lending rates of cash-rich firms. A number of papers put forward the same approach in simplified settings. Lagos and Rocheteau (2009) and Duffie, Garleanu, and Pedersen (2005) study the determination of the loan size and lending rate adopting the theory of intermediation premia (bid-ask spreads) in OTC financial markets. Their approach is also linked to the literature on pledgeability (Kiyotaki and Moore, 1997; Holmström and Tirole, 1998; 2011; Tirole, 2006).

Our paper is also linked to the literature on the transmission of monetary policy through the financial system. In recent years, there has been a resurgence of research on the topic and the findings have revolved around the fact that monetary policy appears to impact risk premia and liquidity premia in stock and bond prices, thus affecting the whole term structure of interest rates and the prices of wide class of assets. Bernanke and Kuttner (2005) show that surprise increases in the short interest rate

have a strong negative impact on stock returns and estimate that this effect is due almost entirely to an increase in the equity risk premium. Gertler and Karadi (2015) find that surprise rate hikes are also associated with a widening of credit spreads on risky bonds. Finally, Hanson and Stein (2015) show that surprise short rate increases induce substantial increases in long-term (e.g., 10-year) nominal and real forward rates. Drechsler et al. (2018) show that monetary policy's influence on the liquidity premium causes it to impact the risk premium in the economy. Since banks hold liquidity to guard against runs on deposits, by influencing the liquidity premium monetary policy controls the cost of holding this buffer and hence the cost of taking leverage for banks. A higher liquidity premium makes taking leverage more costly, which leads to less risk taking, higher risk premia, lower asset prices, and less investment.

According to Drechsler et al. (2017) changes in the liquidity premium affect the pass-through of monetary policy through bank market power on the deposit supply: policy rate hikes cause deposit funding to contract because banks exploit the lower opportunity cost of liquidity to exert their market power and decrease the spread between the policy rate and the interest they pay on deposits. Households optimally respond by withdrawing a fraction of their deposits and this causes banks' leverage to reduce and lending to contract. With respect to this seminal paper, we propose a different role for deposits in the transmission of monetary policy by focusing on firms and on the role of their liquidity as a signal of hidden characteristics relevant for intermediaries in an asymmetric information framework. Moreover, we stress the role of the stock of firm liquidity as an accelerator or a dampener of monetary policy under different conditions.

Finally, there is ample literature on the interplay between the slope of the yield curve and banks' attitude towards risk. According to "reach-for-yield" models (Adrian and Shin, 2010), a flattening brings about a decrease in banks' profitability due to the maturity mismatch between banks' assets and liabilities, a reduction in bank capital and a consequent contraction of credit, especially to riskier borrowers. On the other hand, a reduction of banks' profitability might weaken the incentives to screen and monitor new loans and, as a consequence, bank risk-taking could increase (Allen et al., 2011; Dell'Ariccia et al., 2014). Moreover, commitment on target returns and managers' compensation schemes may induce financial institutions to increase risk-taking when profitability declines (Rajan, 2005). Using loan-level data from Italy, Ferrero et al. (2019) find that ex ante risk-taking by banks is negatively related to the short end of the yield curve but positively related to the long end, thus finding a positive and significant relationship between the slope of the yield curve and

banks' risk-taking and corroborating the reach-for-yield view that a decrease in banks' profitability is associated with a decrease in the average riskiness of their lending portfolio.

Overall, we build upon these strands of the literature by providing the novel insight that monetary policy's effect on the yield curve and the liquidity premium coupled with banks' preference for liquid firms makes the aggregate stock of firm liquidity an important determinant of the pass through of monetary policy to lending rates.

The rest of the paper is organized as follows. Section 2 describes the data, while Section 3 details the empirical strategy. Section 4 contains the results of the estimations, with further discussion in Section 5. Section 6 concludes.

2. The Data

Our dataset draws on four data sources that span the period 2006:q1-2018:q4. After that, the Bank of Italy in accordance with the Eurosytem implemented a major change in the recording of data on the cost of credit, which creates a strong discontinuity that we preferred to avoid.[7] We collect firm-level variables from the Cerved® group database, which pools yearly figures from individual balance sheets that companies submit compulsorily to the Italian Chamber of Commerce. Our dataset includes the universe of Italian joint stock as well as private and public limited liability companies (about 1,800,000 firms). Due to computational limitations our analysis is based on a random sample of half of these firms, for a total of about 10 million observations for the cost variables and more than 20 million observation for the quantities.

Firm liquidity.

The main independent variable is firm liquidity, which we measure as the end-of-year ratio of cash balances to total assets (Table 1, panel a). Cash balances include deposits, cash and cheques, besides short-term credit with financial intermediaries. We choose not to include in the definition of liquidity other relatively liquid financial assets like government bonds for two reasons. First, these assets are characterized by a certain degree of time-varying liquidity and credit risk. Second, later in the paper

[7] In 2011 the European System of Central Banks promoted the construction of a dataset containing detailed information on individual bank loans in the euro area, harmonised across all Member States; data collection started in September 2018.

we are interested in how firms' liquidity position affects the transmission of risk-free rate. A key part of our reasoning rests on the claim that firms change their liquidity holdings in response to changes in the risk free rate, which is their opportunity cost. Excluding financial assets allows us to be sure that liquidity is moving only in response to changes in the risk-free rate, and not because of other, contemporaneous, changes in term or credit premia.

The average cash-to-assets ratio in our sample is 9.5%; this figure however masks a large heterogeneity both in the time series (see Figure 1, panel 1, continuous blue line) and in the cross-section, as suggested by the large standard deviation (equal to 13.3, Figure 2, panel a).

Between 2006 and 2011, average liquidity amounted to 8.4%; afterwards, this value increased dramatically, reaching 13.1% in 2018. Smaller companies – in the first quartile of assets distribution, computed on a yearly basis – retain the larger share of cash in their balance sheet. Average liquidity holdings amount to 13, 9, 8 and 6% respectively for firms in the 1st to the 4th quartile of assets distribution. The increase over time mentioned above was widespread across firms of all sizes; however, it was largest for firms in the fourth quartile (+110% from 2012 to the end of the sample) and smallest for those in the first quartile (+41 %).[8]

Across sectors, liquidity holdings are larger among firms operating in services (mean 9.9%), followed by those in manufacturing (8.7%) and in construction (7.7%; in all cases the sd. continues to be large, at about 12%; Figure 3). While we do not investigate in this paper what drives the infra-sector differences, intuition suggests that relatively higher holdings of cash-like assets in the services sector reflects a less structured production-sales cycle and the typical absence of machineries or other fixed assets. Both features would warrant larger holdings of liquidity to buffer longer time spans between sales or immediate needs to meet unexpected obligations.

The cost and volumes of credit

Using the Bank of Italy Credit Register, we reconstruct each firm's network of banks, associating to each bank-firm match the interest rate applied to outstanding exposures, the amount of credit granted as well as its characteristics, which are our main dependent variables (Table 1, panel b). More precisely, we measure the cost of credit for firms with the annual percentage rate of charge (APRC)

[8] Dottori and Micucci (2018) thoroughly investigate the determinants of liquidity's dynamics using the same data as we do, for a partly overlapping period of time (2002-2015). They conclude that the main driver has been the lower opportunity cost of money observed in conjunction with declining policy rate.

on new term loans and with the interest rate as well as fees and commissions on credit lines. The evolution over time of these variable is plotted in Chart 2 (panel b). As for quantities, we look at the volumes of term credit and of credit lines; in addition, for term credit, we separate loans with shorter maturities (less than 1 year at origination) from those with longer durations, as well as collateralized from uncollateralized loans.[9]

Other firm controls

As firm controls, we consider a number of variables that the literature identifies as determinants of cash holdings (see Dottori and Micucci, 2018 and references therein for a thorough discussion of these controls, drawn from the same data source). These are (i) firm size, computed as the log of total assets; (ii) the share of bank financing to total assets and (iii) leverage, computed as the ratio between financial debts and the sum of financial debt and net worth; all typically relate negatively to cash holdings. The ratio of net working capital to assets (iv) proxies of firms' availability of means of internal financing alternative to cash, and thus negatively relates to it. We also include (v) the volatility of the cash flow, computed as the volatility of the cash-flow over the three preceding years, which captures the need for precautionary savings and the firms' exposure to shocks. Finally, we include (vi) a dummy for whether the firm has distributed its dividend in the previous year, as firms that do so are typically safe and more reliant on external finance.

In addition to this, we control for firms' productivity and profitability, that may affect the demand for credit, by looking at (vii) cash-flow to assets, (viii) ROA (ix), the investment rate, (x) the log growth of value added, (xi) the rate of fixed assets to value added and (xii) the growth in labor cost. Lastly, we include firms' credit score – i.e. its Z-score – measured by Altman (1968) which is an indicator that ranges from 1 – best rating – to 9 and captures comprehensively the observable characteristics of the firm. Due to its construction, the rating includes the effect of many other key firm controls.

Bank controls

Exploiting the banks' identifier, we employ the Supervisory records to access information on their balance sheet and income statement, aggregated at the consolidated level (Table 1, panel c). Overall,

[9] Here and elsewhere in the paper, "credit lines" only cover revocable credit loans; we excluded trade receivables.

we have about 700 financial institutions. We consider banks' capital ratio (Tier 1 capital to total assets), log of total assets, liquidity ratio (securities over total assets), retail funding and the share of non-performing loans to total assets.

Monetary and macroeconomic controls

Finally, our preferred measures of the monetary policy stance are the quarterly averages of the Eonia rate and 10-year Eurirs rate, which capture respectively the short and the long end of the yield curve (Table 1, panel d).[10] Alternatively, we proxy the short-term rate with the 3-month Euribor. These are typically considered the key reference rates for banks' pricing policies and lending decisions in the Euro area (Darracq et al., 2014). However, in the period we consider, these two rates have been close to zero for many months before breaking through and may not be fully informative. To account for this, we robustify our results considering two additional measures (the yield on 2-year Italian Treasuries and a measure of the shadow rate) that address the issue of measuring monetary policy around the lower bound. First, we follow Gertler and Karadi (2015) and use the yield on 2-year Italian Treasuries. This longer-term rate has the advantage to inform both on the current short-term stance and on the forward guidance approach, which may prove useful in a period of low interest rates. On the downside, the yield on this longer maturity is likely to include a risk premium component, which in the case of Italy in the period considered may be non-trivial. However, in the empirical methodology we control for a number of factors that may move the risk premium independently from monetary policy (such as GDP and employment). Importantly, the presence of time-varying quarterly fixed effects is likely to absorb many such shocks. Second, we consider a measure of the shadow rate (Pericoli and Taboga, 2015). The shadow rate allows us to account, albeit indirectly, for the various non-conventional measures adopted by the ECB to overcome the effective lower bound to the policy rates. At the same time, the quantification of the shadow rate is econometrically difficult, so that rather than providing an effective measure of the policy rate that would prevail in the absence of the zero bound, the variable is interpreted as indicating the "distance" from the lift-off date, i.e. the date in which the policy rates will be raised. In this interpretation, the farther away is the lift-off date, the more "accommodative" the monetary stance is. To control for the macroeconomic outlook, we include the growth of real GDP and the change, the level of employment and firms' expectations on

[10] The 10-year Eurirs is the 10-year Euro Interest Rate Swap (10-year EURIRS, afterwards), a risk-free long-term interest rate.

selling prices, employment and production using survey data from the Joint Harmonized EU Industry Survey conducted by the European Commission[11] and the 10y BTP-Bund spread (Table 1, panel d).

Merging the data sources.

Firm-level information are annual, Credit Register data are monthly, key monetary policy rates are in the continuous time, GDP is quarterly and employment is monthly. To discipline the data, we construct our dependent variables (the cost of credit and the changes in credit granted, along with their various specifications) at a quarterly frequency, and we compute the Eonia, the 3-month Euribor, the yield on 2-year Italian treasuries and the shadow rate as quarterly means. The rationale for keeping the dataset quarterly is to retain some of the infra-year variation in the monetary policy variables, which would be of interest for the second part of the paper. To this quarterly dataset, we merge annual firm-level information. More precisely, we associate to the quarterly values of our dependent variables observed in year T, q_3 (i.e, the cost of and changes in credit) the firm-level variables realized in T-1, q_4 (yearly), and the controls in T-1, q_2. This carries the implicit assumptions that firm variables for year T are publicly known by the lenders in the first quarter of T+1. While we are aware that typically a lag of several quarters separates the realization of these data and their public availability, we justify our assumption with the consideration that borrowers are likely to pass all the available data on their financial situation to the lenders as soon as they have it, even informally. To control for the fact that the same annual value of liquidity (and other firm variables) is repeated for four quarters, we cluster the estimates' errors at a firm*year level. To be completely on the safe side, we have run all the analysis on the dataset collapsed at the year level. In this exercise, all values that varied at a frequency higher than the annual have been computed as yearly means. The fixed effects have been recast as bank/sector*year (rather than *quarter) and errors have been clustered at the firm level. Results have been confirmed with minor discrepancies in terms of statistical significance (see Appendix).

[11] Following Alessandri and Bottero (2020) we compute this indicator as the simple mean of the replies to questions 5, 6 and 7 of the survey, where firms express their expectations on selling prices, employment and productionover the following three months.

3. The effect of firm liquidity on the cost and volumes of credit

We begin discussing the role played by liquidity levels at time *t-1* in determining the cost of credit at *t*. To this end, we regress the three measures of the cost of credit described above (interest rates on new term loans and on credit lines, fees and commissions on credit lines) as well as the growth rate of new term loans (broken down into short and long-term, collateralized and non-collateralized) and of credit lines on cash balances at *t-1*. As cash holdings are correlated with many important firm characteristics that jointly determine the financing needs and outcomes, we include the lagged firm credit score (Altman 1968) as well as a large number of lagged firm covariates in the regressions (see Section 2 for details). We control for bank supply determinants by including the lagged values for bank size, funding, liquidity, share of impaired loans and regulatory (Tier 1) capital. Finally, we account for the general environment via the following macroeconomic variables: a measure of the monetary policy stance, real GDP growth and changes in employment level in Italy. In this specification and in the following ones we cluster standard errors at the firm*year level.[12]

As shown in Table 2, firm liquidity reduces the annual percentage rate of charge (APRC) on new term loans, as well as the interest rate and commissions and fees on credit lines (column 1, panel a-c).[13] This means that firms with higher (pre-determined) liquidity enjoy on average a lower cost of credit. These results are consistent with the theories that argue that cash proxies a prudent management or a high firm value and with the bargaining role, while they do not support the view that banks weigh cash balances unfavourably.[14]

We strengthen the identification using bank*quarter fixed effects to further control for supply dynamics, adapting to our setup the identification strategy of Khwaja and Mian (2008) to control for supply rather than for demand developments. The bank*quarter fixed effects capture all observable and unobservable bank-specific, possibly time-varying, confounding supply dynamics that would favour more liquid firms over less liquid ones. On the bank side, given the large number of firms that a single bank entertains relations with, the identification should work even more smoothly than in the Kwhaja Mian case of a single firm connected with few banks. This is because the fixed effects will

[12] All estimates are robust to clustering at the firm level only.
[13] Results are shown controlling for the short-term rates with eonia, but are unchanged if this is substituted with the other short term rate indicators discussed in Section 2.
[14] Note that the estimation sample is visibly lower than the values reported for the dependent variables in the Summary statistics table. This owes to the fact that several of the explanatory variables from Cerved are oftentimes not reported by the firm, causing the corresponding observation to be missing. In particular, the information for bank and non bank debt to total assets is reported for about 900K observations only.

net each bank-firm outcome by the average of that outcome across all firm relations entertained by the bank. Due to the large number of these relations, the average value is closer to the actual average, which would take into account the weight of each firm in the banks' lending portfolio (Amiti and Weinstein, 2018). On the firm side, beside the yearly firm level variables, we add firm fixed effects to control for time-invariant characteristics of the firm that may influence both their cash balances and their credit conditions (e.g. their business model and their industry). Results are broadly unchanged (columns 2 and 3), indicating that the estimates are not confounding the role of firm liquidity with other bank characteristics (which would arise, for instance, if larger or better funded banks were systematically more linked to liquid firms).

To further control for time-varying demand confounders at the industry level, such time-varying industry-specific liquidity needs that are linked to the business cycle (Shi, 2015), we include industry*time fixed effects. As with any fixed effect identification, the point estimates are only valid in the estimation sample, so usually better identification comes at the cost of lower external validity. However, this issue is not particularly relevant in the present context as even in these most saturated specifications the sample size does not drop excessively compared to the full sample (by about 4% in the regression on the cost of credit and by about 3% in those on quantities). The negative relationship between liquidity and the cost of credit is again stable, except for fees and commissions where the coefficient becomes insignificant (column 4).

Looking at the economic magnitude of the results, the estimates suggest that a 10 percentage point increase in cash holdings – as a share of total assets – lowers the APRC on new term loans by 30 basis points, the rate on credit lines by 17 basis points, and – depending on the specification – the fees and commissions on credit lines by approximately 18 euros per year. While the effect on fees and commissions is not particularly large, the one on interest rates is economically significant when compared to their historical and cross-sectional means (4.8% for new term loans and 8.1% for credit lines).

Unreported analyses – available upon request – inform us on the impact of other firm characteristics and of the interaction between some of these and firm liquidity on the cost of credit. Considering both the results on the interest rate on new term loans and on credit lines, the cost of credit is: (i) negatively related to a firm's creditworthiness, (ii) negatively related to its size, leverage, amount of bank financing and working capital (the latter two scaled by assets); (iii) negatively related to cash-flow – although positively to cash-flow volatility – growth in value added and productivity. Moreover, the

negative effect of liquidity is larger for larger firms, while leverage and industry don't seem to be a relevant interaction factor. Fees and commissions are instead positively related to firm's size, leverage, cash-flow volatility and net working capital. Fees and commission may move in opposite direction with respect to the cost of credit for a number of reasons. First, banks may offer contractually binding low interest rates and then later increase the fees, which can be unilaterally adjusted even when the contract is signed. Second, fees may cover a range of services that is wider than a specific loan contract and that may include general services provided by the bank to the client.

In an additional robustness check, we account for the fact that past credit conditions may influence past investment decisions, firm profitability and cash hoardings. For example, Ippolito et al. (2018) show that monetary policy-induced changes to floating interest rates on firms' bank loans affect the liquidity, balance sheet strength, and investment of financially constrained firms. As long as interest rates are persistent, the estimation of static models may lead to biased estimates. In unreported regressions, we include one lag of the dependent variable in a model with cross-sectional (firm*bank) and quarter fixed effects, as well as firm and bank controls. In order to account for the Nickell (1981) bias, we estimate the model using one-step system GMM, where all explanatory variables are considered predetermined (except the time fixed effects) and instrumented accordingly with their own lags. We obtain virtually the same results.

We now turn to assessing if firms' cash holdings affect the quantity, type, maturity and collateralization of bank loans. Tables 3 and 4 shows that liquid firms are able to secure greater volumes of term loans, while there is no effect on credit lines. The effect on term credit emerges both at shorter and longer maturities (i.e. separating financing with maturity of 1 year or less – at origination – and above 1 year). Interestingly, firms with higher cash balances are able to borrow greater amounts of uncollateralized loans and make less use of collateralized credit.

Taken together, these results suggest that more liquid firms can secure on average better access to credit: not only they rely more on the cheaper and more "secure" term credit – compared to credit lines – , but they also can pledge lower level of collateral[15].

[15] Given the yearly frequency of data on firm characteristics, as a robustness check we estimate the regressions in Tables 2, 3, and 4 using annual data (Tables A1, A2 and A3, respectively). We obtain virtually the same results.

These findings speak to all those models that view liquidity as a strength for firms when bargaining credit conditions with the lenders. For instance, in the theoretical model put forward in Gryglewicz (2011), cash holdings proxy firms' expected profitability:[16] then it follows that perceived more profitable firms are likely to have more leverage in claiming more favorable terms for their credit contracts. Similarly, Rocheteau et al (2018) demonstrate that in an incomplete information setting, large liquid holdings act as a negotiation tool for the firms that can credibly declare to be willing to wake away from the bank and undertake the project with own funds unless an agreement is made on the contractual terms. Because of this this, intermediaries view more favorably companies with ampler liquidity buffers, and are willing to disburse larger volumes of credit, besides applying more favorable cost terms (see above). While it is self-explanatory why firms would prefer to reduce their collateralized credit, the repositioning towards term credit at the expenses of more flexible credit lines may appear more puzzling. However, consider the following. First, term loans are cheaper. Second, the "insurance" and "precautionary savings" roles[17] typically ascribed to credit lines (Demiroglu and James 2012), and not easily transferrable to term credit, are, in the case of high-liquidity firms, carried out by the internal cash holdings. Third, on top of the cost motive, credit lines may not necessarily available when most needed. Underperformance from part of the firm, which is likely is the company becomes illiquid, may trigger a covenant violation, allowing the bank to unilaterally cut the committed amount (Sufi 2009). Moreover, if the financial difficulty is shared by the intermediary, this may decide not honor their obligations and cut the credit line (Ivashina and Scharfstein, 2009)

3.1 Validating the causal effect of liquidity: a difference-in-difference exercise

One issue that might complicate the interpretation of the results is to what extent we are controlling for the endogeneity of firm liquidity to credit outcomes, which can be due to omitted variables or simultaneity bias. We have already discussed the empirical techniques that we use to control for this problem in the regressions. Here we take a different perspective, and resort to an episode of unexpected increase in firm liquidity to provide evidence that such increase is associated with a lower cost of credit in the future.

[16] As the continuation value of a company increases, the more profitable it becomes to hedge temporary liquidity shocks, thus the larger the liquidity buffer held.

[17] By "insurance role" we mean the fact that holding liquidity allows to fund unexpected contractual obligations without incurring in situation of illiquidity. The "precautionary savings role" refers to the ability of firms to take up unused liquidity to finance unexpected investment opportunities.

Following D'Aurizio and Depalo (2016), we look at a government bill that was passed in Italy in April 2013 (henceforth "repayment act") that addressed the issue of overdue payments from the Public Administration (PA). At the time of the repayment act the PA had accumulated large debts vis à vis Italian firms for years, mainly because of severe financial constraints but also owing to trade debts being excluded from European accounts of national debt levels: at the end of 2012 the trade debt of the general government in Italy reached 6% of GDP[18]. According to a survey conducted by Intrum Justitia, the average payment delay in Italy was 90 days, compared to 10 in Germany and 19 in France. These large and relatively long-lasting credits vis à vis the PA had severe negative effects on firms' liquidity balance, eventually hindering investment and, given uncertainty over payment delays, affecting, at least to some extent, firms' solvency. The 2013 repayment act allotted an unprecedented amount of funds to the payment of PA debts (40 billion euros, later expanded to 47) to Italian firms by the end of 2014 and simplified the related bureaucracy. Crucially, the eligibility criteria had to be met by firms at a much earlier stage than that of law enforcement, eliminating concerns of self-selection in the policy. We consider this episode as an instance in which liquidity increased unexpectedly and sizeably for some corporations but not for others, allowing us to observe whether this change affected the credit terms on new loans differentially for affected and unaffected firms.[19]

We collected information on the PA payments via the Bank of Italy Business Outlook Survey (Sondtel).[20] The survey is carried out yearly on a representative sample of firms of more than 20 employees. The 2013 wave asked participants whether they had outstanding trade credit with the PA by the end of 2012 and, if so, if it were repaid in the first half of 2013. The survey only follows up the repayment situation faced by firms in August of the same year, meaning that firms classified as eligible, but not yet paid, may have received their payments in the following months. In our preferred specification, we assign all firms that were eligible to a repayment in 2013 or 2014 to the treatment group, regardless of whether they received the money by the time the survey was conducted[21]. These firms were treated with a positive liquidity shock, either because they actually received a repayment from the PA or because they had a credible claim to it. The control group is composed of all other

[18] Bank of Italy Annual Report for 2012.
[19] For a detailed discussion on the exogeneity of the shock and how it "surprised" borrowers and lenders, see D'Aurizio and Depalo (2016).
[20] We thank Domenico Depalo for data sharing.
[21] In robustness exercises we restrict the treatment group to firms that were actually repaid by the end of august 2013. The results are available upon request.

firms that took the survey. The outcome variables are the interest rates on new term loans and on credit lines, as well as fees and commissions on credit lines.

Figure 4 plots the outcome variables for the treated and the control group in a 2-year window around the treatment quarter, which we take to be 2013:Q2 in line with the passing date of the repayment act (April 2013). The evolution of the two groups are parallel before the treatment while they diverge afterwards (except for fees and commissions). We take these plots as evidence that our design satisfies the parallel trends assumption. We proceed to estimate a difference in difference model specified as follows:

$$y_{b,f,t} = \beta_1(T_f P_t) + \beta_2 T_f + FE_{ind} + FE_{prov} + FE_{b,t} + \gamma' X_{f,t} + \varepsilon_{b,f,t}$$

$y_{b,f,t}$ is the interest rate on new term loans, the interest rate on credit lines or fees and commissions on credit lines. β_1 is the parameter of interest, as T_f is a dummy equal to one for treated firms and P_t is a dummy equal to one for all quarters after and including 2013:Q2; $FE_{ind}, FE_{prov}, FE_{b,t}$ are industry, province and bank-time fixed effects, respectively; $X_{f,t}$ is a vector of firm-level controls[22]. Notice that firm balance-sheet controls date back to December 2011 in order to avoid reverse causality with the treatment. Industry and province fixed effects are particularly relevant to this setting because different industries may have stronger business relationships with the PA and local PAs may have responded more or less strongly to the policy because of financial and bureaucratic constraints. Finally, we cluster standard errors at the firm level.

Table 5 shows the estimation results. Columns (1)-(4) contain the results using an increasingly larger sample, starting from one quarter before and after the enactment of the law (April 2013) and reaching a total of two years before and after. There is a sizeable and significant difference between treated and untreated firms before and after the treatment (DiD effect): after the change in regulation, the cost of credit for more liquid firms decreased by roughly 30 bps for term loans and by approximately 15 bps for credit lines. For interest rates on new term loans the effect is significant two and three quarters after the coming into force of the law. The effect on interest rates on credit lines, instead, is significant right after the liquidity shock. We found no effect of the policy on fees and commissions. All in all, the results of this difference in difference exercise provide additional evidence that firm

[22] We include the same firm-level controls used in the regressions of the previous section and taken from the determinants of firm-liquidity in Dottori and Micucci (2018).

liquidity has a positive, causal effect on credit supply conditions, in line with that stream of literature that highlights firm liquidity as a positive signal for banks.

4. The transmission of monetary policy through firm liquidity

In the second part of the analysis, we build on the relationship between firm liquidity and credit supply conditions to assess the impact of firms' cash balances on the transmission of the monetary policy stance to the cost of bank credit.

Liquidity holdings and the slope of the yield curve

The yield curve is a central element in the transmission of monetary policy (Drechsler et al., 2018). Standard and non-standard monetary policy instruments affect the whole of the term structure, which in turn is a key determinant of asset prices in the economy (Diebold et al., 2005; Hanson and Stein, 2015). When monetary policy instruments change the slope of the yield curve, they also change the opportunity-cost of holding short-term assets like bank deposits. For instance, an increase in short-term rates makes deposits and cash more attractive for firms, while an increase in long-term rates makes them relatively more costly because firms might want to invest their liquid balances in longer-term assets with higher yields.

The existence of a positive relation between movements in the yield curve and liquidity holdings is a key precondition to analyse the heterogeneity that liquidity creates in the transmission of monetary policy impulses via the bank lending channel. The logic is as follows. Monetary policy moves trigger modifications in the term structure, which in turn prompt liquidity adjustments by firms. Banks anticipate these adjustments, and, preferring more over less liquid firms – as established in Section 3 –, they pass a different stimulus to those firms that they know will end up increasing their cash balances.

To empirically detect this pass-through heterogeneity, we need i) that firm liquidity indeed varies with changes in the term structure and ii) that the liquidity adjustment operated by firms in response to a yield curve shift are heterogeneous depending on the firms' initial liquidity holdings. If this latter condition were not true, i.e. if all firms adjusted liquidity by the same amount in response of a shift

in the term structure, their ex post liquidity distribution would remain unchanged, and intermediaries would pass the stimulus equally to all firms.

To test these conditions, we regress firms' liquid holdings on lagged indicators of the inverse of the yield curve's slope (which we dub "flattening", i.e. the difference between short and long rate; this will help interpreting the coefficient, as an increase in this variable sums up to a flattening of the yield curve) with the lagged level of firms' cash balances. In our preferred specification, we use the Eonia as a proxy for short-term interest rates and the 10-year Eurirs rate as a proxy for the long end of the curve[23]. The yield curve is generally a good approximation of the monetary policy stance, however it reflects also beliefs about future monetary policy and risk premia. In turn, these depend on a host of factors which determine the inflation or growth outlook of market participants. In order to isolate monetary policy effects on the yield curve, in this and in the following set of regressions, we include controls – where not absorbed by the fixed effects – for firms' expectation on selling prices, employment and production. Table 6 shows the results using increasingly saturated specifications (firm, industry, time and industry*time fixed effects). As we control in the regression for the past values of liquidity, which varies annually, we momentarily collapse the dataset at that frequency, taking yearly averages of the other variables.

According to the estimates, liquidity levels in a given period are positively correlated with those in the next period, i.e. more liquid firms have a higher propensity to save cash from cash flow increases. This is consistent with the notion that more liquid firms are also those more profitable, so that they want to hold larger liquidity buffers to minimize illiquidity and insolvency risks (Gryglewicz, 2011). A flattening (steepening) of the yield curve is associated with an increase (decrease) in firms' cash balances due to a higher (lower) opportunity cost of holding liquidity. This result is consistent with Drechsler et al. (2017) who show that policy rate hikes cause deposits to contract. Finally, the effect of a flattening indeed turns out to be stronger for firms with ex ante higher cash balances, as evidenced by the coefficients of the interaction between firm liquidity and the inverse of the slope of the curve.[24] Therefore, we confirm that both liquid holdings respond to changes in the yield curve (increasing

[23] In alternative specifications, we take the 3-month Euribor, the 2-year rate on Italian Treasuries and a measure of the shadow rate as proxies for the short end of the yield curve.

[24] We have also estimated a specification in which firm liquidity is regressed on eonia, Eurirs20y, liquidity at t-1 and liquidity at t-1 squared. We find that previous period liquidity has a positive effect on current liquidity, and the squared terms is small but positive, indicating increasing returns (results available upon request).

when the curve flattens, and vice versa) and that such response is stronger the higher the liquidity level.

To get a more complete picture, in Table 6a we substitute the slope variable with the short- and the long-term rates separately. This test allows us to observe if the results just discussed are driven only by one end of the curved (that is, if it is only movements in the short – or long – rates that guide the reallocation of liquidity). Consistent with our narrative, irrespective of whether it is caused by an increase in the short-term rates or by a decrease in the long-term rates, a flattening in the yield curve is associated with an increase in the liquidity held by firms, the more so the larger the firms' cash balances.

The takeaway from this analysis is that the response of firms to changes in the risk-free rate varies with the amount of liquidity they already hold. This creates the premises for firm liquidity to interact with the transmission of monetary policy, in the way that we describe below.

Liquidity holdings and the transmission of monetary policy

Relying on the insights and empirical results just discussed, we can now study if and how firm liquidity interacts with the transmission of monetary policy through the slope of the yield curve. To do so, we include interactions between firms' cash balances and the inverse of the yield curve's slope (i.e. the "flattening" variable introduced in the previous subsection, computed as the difference between short and long rate; this will help interpreting the coefficient, as an increase in this variable sums up to a flattening of the yield curve).

Results are displayed in Table 7. Coherently with the first part of the analysis, liquidity retains its direct negative effects on the cost of credit. The flattening variable, which measures the inverse of the slope of the yield curve, is instead positively related to it. This is consistent with the notion that a flattening in the yield curve (brought about by increases in the short-end of the curve or by cuts in the long-end) transmits a tighter monetary policy stance in normal times. Finally, in all the specifications we consider, the positive impact of a flattening on the rates and fees applied is lower for more liquid firms. This is coherent with our hypotheses, i.e. a flattening in the yield curve prompts an increase in liquid holdings from part of firms, which is larger for ex ante more liquid firms (Table 6); banks anticipate this and respond by offering more favourable rates (i.e. by passing less of the increase in

rates) to more liquid firms. Thus, when there is a flattening of the yield curve, average rates on loans increases, but they increase less so for more liquid firms.

According to the estimates, when we compare two firms one standard deviation apart in terms of cash balances (s.d. 13.3%), we find that the pass-through to the APRC on term loans of a 100 bps flattening in the yield curve – which results for the average firm in an increase of the interest rates – is 15 bps lower for the more liquid firm.[25] The pass-through of a similar flattening on the interest rates and the fees and commission on credit lines is 2 bp and 2 euros lower for the more liquid firm, respectively[26].

The results hold symmetrically in case of an increase in the slope of the yield curve (i.e. a steepening). When there is a steepening, average rates decreases for the average firm, but less so for more liquid firms. Also in this case, liquidity "smooths" the average impact on cost: the idea is that, faced with higher returns, firms reallocate their liquidity to more remunerative assets, decreasing the cash and deposits stock that is appreciated by intermediaries. Banks, anticipating this, pass less of the decrease to more liquid firms, knowing that these companies will be pursuing the reallocation more actively (cfr. results in Table 6).

It is important however to stress that the pass-through of changes in the term structure of interest rates is higher for liquid firms but that liquid firms still obtain, on average, cheaper credit than other firms with smaller cash balances. Figure 5 provides a qualitative description of our results: it shows the relationship between the slope of the yield curve on the x-axis and the cost of credit for firms on the y-axis for a hypothetical decrease in the yield curve's slope from S_0 to S_1 (i.e. a flattening, however the intuition is symmetric for a steepening). Firms with higher liquidity are able to obtain cheaper credit regardless of the monetary policy stance, hence for any term structure of interest rates. However, a decrease (increase) in the slope of the curve results in a smaller change in the cost of credit for more liquid firms.

We investigate further our results by substituting the slope variable with the short and the long rates separately. This approach allows us to test if our findings are driven exclusively by one of the two rates. This information allows to draw more precise policy implication and recommendations (consider for instance how decision on short-term rates are "conventional" monetary tools, while the

[25] Both the liquidity and the flattening variables are in pp. Average liquidity is 9%, s.d. is 13.3%. According to column (1), Table 7, the impact of a 1% increase in the flattening for the average firm is: 0.46% = (0.57- (0.012*9)). For a firm 1 sd away from the mean, this effect is 0.30% = (0.57-(0.012*(22))). The difference between these two delivers the result.
[26] We also run the same regression using yearly data for robustness. We obtain virtually the same results (Table A4).

long end of the yield curve is more affected by non conventional tools, such as QE). Results are displayed in Table 7a.

As expected, liquidity retains its direct negative effect on the APRC charged on term loans, as well as on the interest rate and fees and commissions on credit lines (Table 7a, columns 1, 4, 7). The Eonia rate has a positive and significant effect on the cost of credit, in line with the traditional bank lending channel; the 10-year Eurirs has a negative but small effect on the interest rate on term loans, consistently with the fact that bank loan rates for firms are mostly priced off shorter maturities (Darracq Paries et al., 2014), as well as a very small effect on credit lines due to their shorter maturity. Thus, a flattening of the curve – independently of whether it is prompted by higher short-term rates or lower long-term rates – brings about a decrease of the cost of new term loans and of credit lines, both in terms of interest rates and in terms of commissions and fees.[27]

According to the estimates, when we compare two firms one standard deviation apart in terms of cash balances (s.d. 10.44%), we find that the pass-through to the APRC on term loans of a flattening due to a 100 basis points increase in Eonia – which results for the average firm in an increase of the interest rates – is 5 bp lower for the more liquid firm. The pass-through of a similar flattening on the interest rates and the fees and commission on credit lines is 2 bp and 2 euros lower for the more liquid firm, respectively. The effect of a steepening due to an increase in the long end of the curve on the APRC on term loans (which causes rates to decrease for the average firm), interest rates and fees and commissions on credit lines is 20 bp, 7 bp and 5 euros higher (in absolute value) for the more liquid firm, respectively.

5. Discussion: is firm liquidity a financial accelerator?

The previous section showed that the effect of changes in the monetary policy rates on firm loan rates depends on the interplay between the resulting movement in the yield curve and the ex ante level of firm liquidity. A steepening in the yield curve prompts firms to reduce their cash balances (to allocate them into more remunerative projects); a flattening, instead, is associated with an increase in cash

[27] This is because in all specification, the interaction eonia*liquidity is negative while eurirs10y*liquidity is positive. This means when short-term rate increase (eonia goes up), the cost of credit goes down. Similarly, as the regression coefficients are symmetric, when the long-term rate decreases (eurirs10y goes down), the cost of credit goes down (as the interaction is positive). Thus, whenever the yield curve flattens, irrespectively of the flattening being caused by an increase in the short term rates or by a decrease in the long term rates ones, it prompts a reduction in the cost of loans and their fees

balances, as the opportunity cost of holding them is lower (cfr. Table 6 and discussion in the Introduction). As banks view favorably increases in firms' liquid holdings, a correlation emerges between a flattening in the yield curve (usually associated with an increase in the cost of credit for the average firm; see previous section) and the application of more favorable conditions to more liquid firms (that are charged a lower increase in the cost of credit). Similarly, a steepening, usually associated with a decrease in the cost of credit for the average firm, is associated with less favorable financing conditions for firm (that enjoy less of the reduction in cost).

Thus, in positive territory, when rates cuts are associated with a steepening of the curve and rate hikes with a flattening, firm liquidity acts as a "dampener" of the initial monetary policy stimulus (that is, intended rate increases are less strong and intended rate reductions are less strong for more liquid firms).

However, the association rate cuts (hikes) /steepening (flattening) of the yield curve became more blurred after 2014, when, following the deployment of negative interest rates and forward guidance, alongside with the prosecution of the asset purchase programmes, rate cuts below zero have prompted a series of flattening, not steepening, of the yield curve (Grisse et al.,2017; Christensen, 2019). This effect was due to cuts being often accompanied by communication that the ECB was willing to lower the negative rate even further (Ruge-Murcia, 2006); moreover, the negative interest rate policy also reinforced the ECB's targeted long-term refinancing operations (TLTROs) by providing an even stronger commitment to an accommodative stance. Thus, contrary to cuts in positive territory, cuts "below zero" have been accompanied by a flattening in the yield curve.

Our narrative would then suggest that in this period liquidity acted as an *accelerator* of monetary policy. This is because the below-zero cuts continued to have the easing intent of their counterparts in positive territory, but now the associated flattening of the yield curve prompted firms to *increase* their liquidity holdings (rather than decreasing them as they would have done in case the cut prompted a steepening of the curve). In line with the reasoning discussed in Section 4, as more liquid firms increased liquidity by more after the cut they should have obtained relatively better credit conditions (i.e. a larger credit cut).

We test this hypothesis in Table 8, where we replicate the analysis for the sub-period 2014q3-2018q4, only for the specification that allows us to estimate all the coefficients of interest (liquidity, flattening and their interaction). We find that in this sub-period the flattening variable takes up a negative sign

(consistently with the fact that the flattening results from a number of accommodative monetary policy decisions) and the interaction between flattening and liquidity remains negative and significant in two out of three cases. This evidence suggests that the easing was stronger for more liquid firms, i.e. that liquidity has an accelerating effect for the monetary policy stance.

These preliminary analysis appears to indicate that whether liquidity accelerates or dampen the impact of monetary policy depends on the intentions underlying the movements of the yield curve. More liquid firms are always viewed more favorably by banks after a flattening of the curve, in virtue of their liquidity-hoarding responded to lower returns on long-term assets. However, a flattening may results both from a tighter stance ("normal" times) and from an easing stance ("negative territory" times). In the former case, firm liquidity will act as a dampener (i.e. more liquid firms will suffer a lower increase in the cost of credit). In the second case, firm liquidity will be an accelerator (i.e. more liquid firms will benefit from a larger decrease in the cost of credit).

6. Conclusions

Cash-rich companies may enjoy either better or worse access to credit, as abundance of cash may reveal both positive and negative information about the firm. The econometric analysis shows that liquidity helps firms to obtain cheaper bank funding and greater volumes of term credit at all maturities, as well as to lower their use of collateralized loans. Moreover, the paper shows that the stock of firm liquidity can either dampen or amplify the transmission of different monetary policy tools to lending rates, depending on the effects of the latter on the slope of the yield curve and on the liquidity premium.

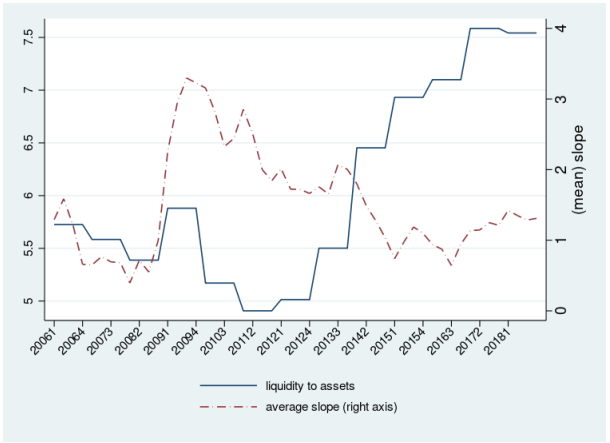
At a point in time when firm liquidity has risen sharply, well above a rising long-run trend, our results offer quantitatively relevant insights on the capacity of firms to obtain bank loans to fund investment after the Covid-19 crisis, as well as for the management of monetary policy both during and after the crisis. In light of the extraordinary fiscal measures in support of firms' liquidity undertaken by governments during the pandemic, this paper also suggests a novel synergy between fiscal and monetary policy in extraordinary times. By sustaining firm liquidity – which banks view favourably when setting credit conditions – fiscal policy has helped to reinforce the accommodative impulse from the ECB.

FIGURES AND TABLES

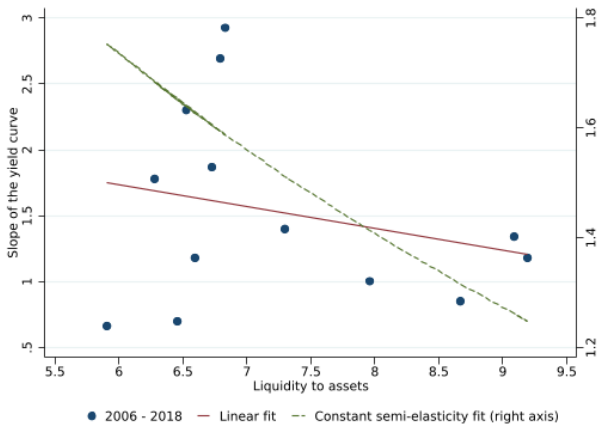
Figure 1 – Evolution of Italian firms' liquidity and of the slope of the Euro area yield curve

(p.p.)

a)



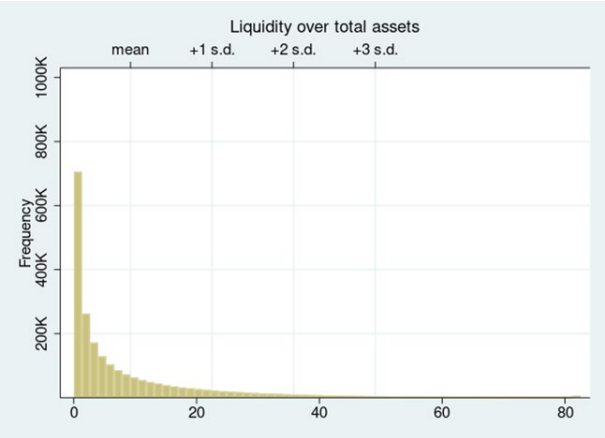
b)



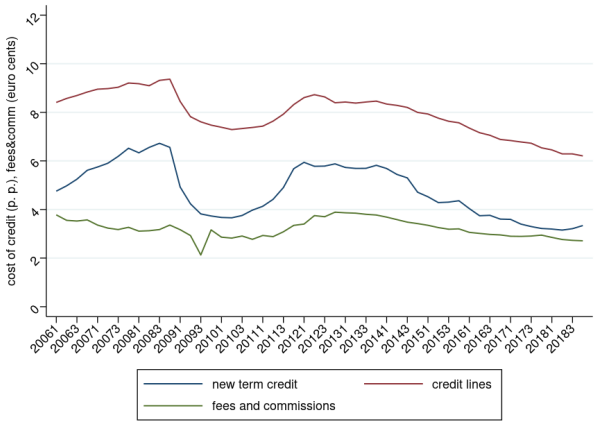
Notes: the charts display how firm liquidity comoves negatively with the slope of the yield curve, coherently with the notion that the term structure of interest rates acts as the opportunity cost of firms' cash and deposits. Panel a) plots the evolution of firm liquidity against that of the slope of the Euro area yield curve, measured by the difference between the 10-year eurirs and the eonia. Panel b) imposes more structure on this relation, by showing the fitted values of a linear and a constant semi-elasticity model. *Sources*: Cerved, SDW, Supervisory records and authors' calculations.

Figure 2 – Distribution of liquidity and evolution of the cost of credit

a) The distribution of liquidity

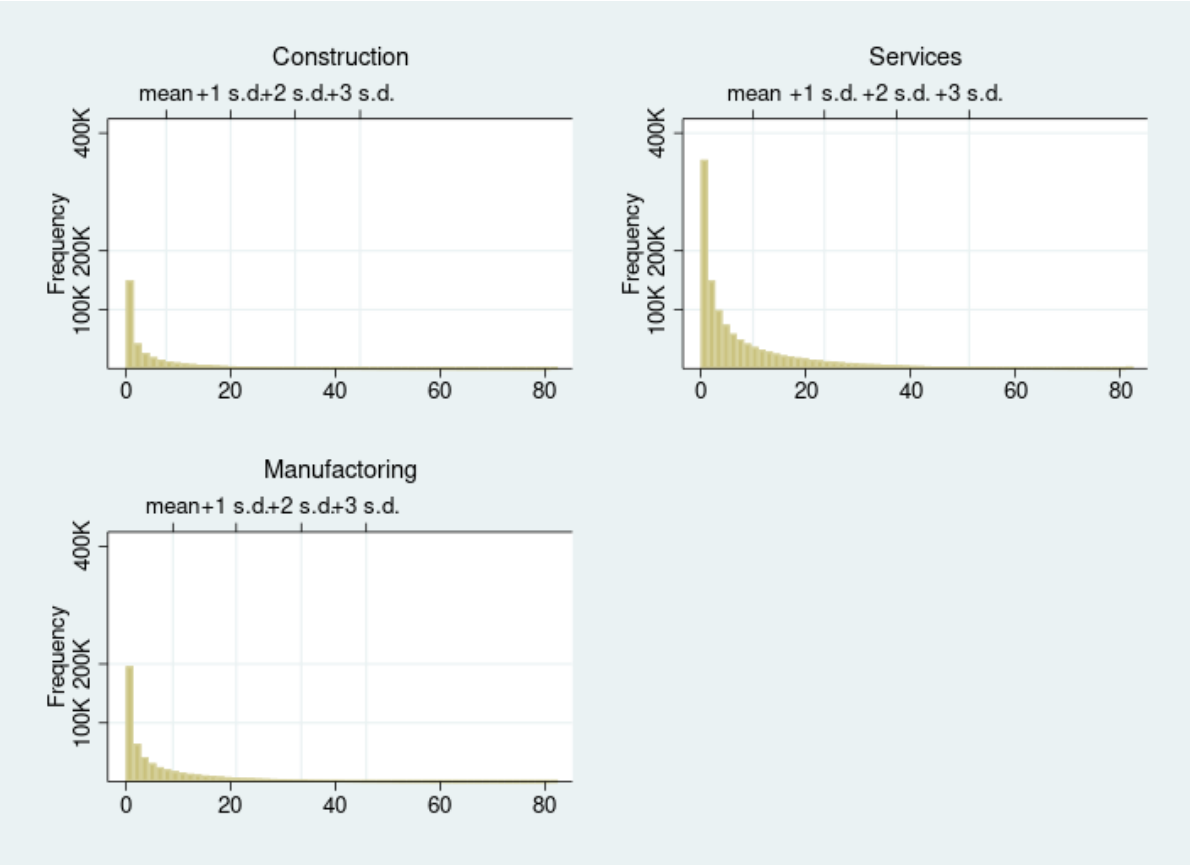


b) The evolution of the cost of credit (p.p.)



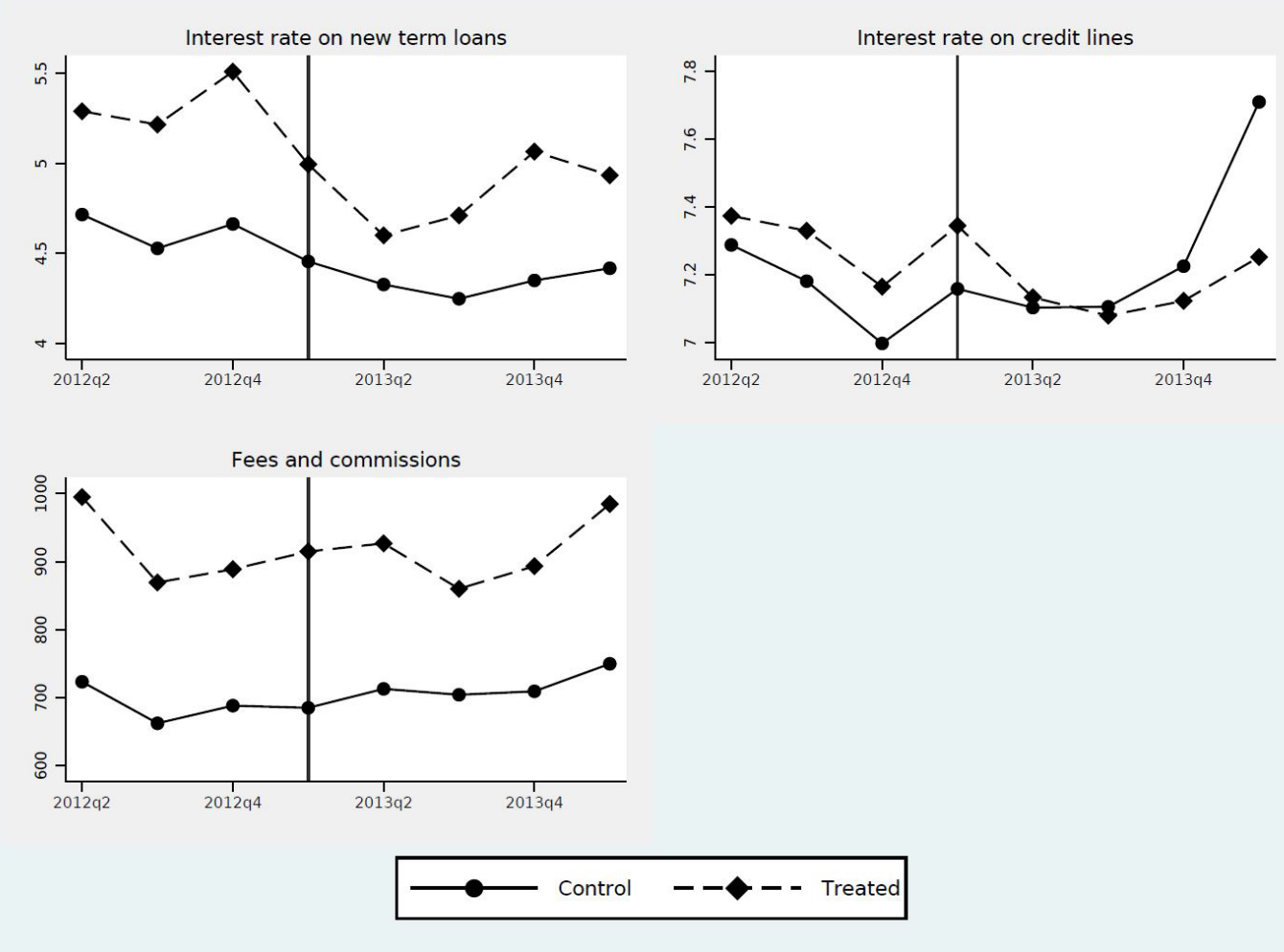
Notes: panel a displays the distribution of firm liquidity, in percentage of assets, for the whole sample (2006-2018). On the upper x-axis the mean, and the mean + 1,2,3 s.d. are reported. Panel b reports the evolution of our main cost variables, i.e. the rate applied to new term loans, the rate applied to credit lines, fees and commissions applied to credit lines.

Figure 3 – The distribution of liquidity: by sector of activity



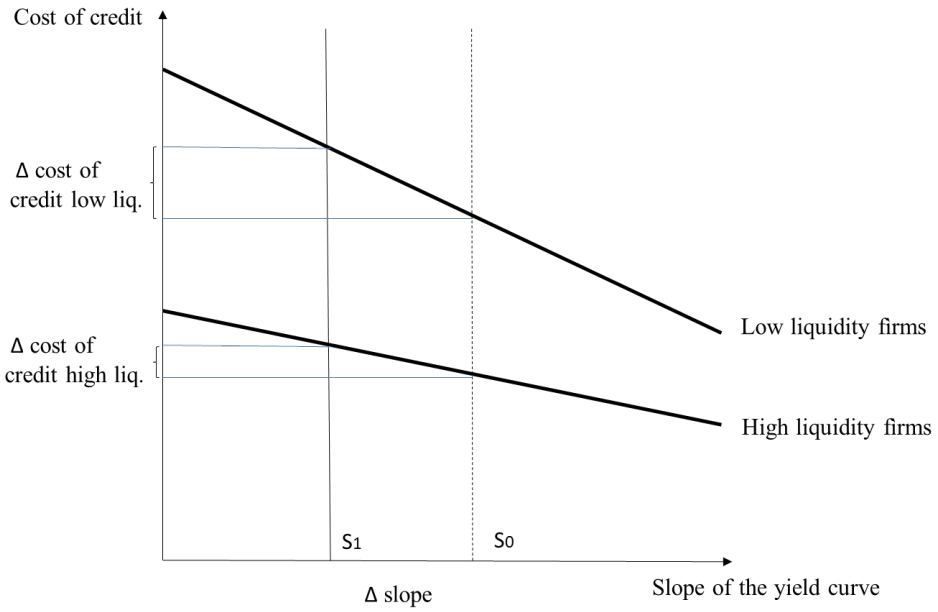
Notes: the panels display the distribution of firm liquidity, in percentage of assets, for the whole sample (2006-2018) by sector of firm activity. On the upper x-axis the mean, and the mean + 1,2,3 s.d. are reported.

Figure 4 – Pre and post-treatment dynamics for firms eligible for a repayment of debt vis à vis the PA under the Repayment Act (treated group) and non-eligible firms (control group)



Notes: this chart plots the evolution of interest rates on new term loans, interest rates on credit lines and fees and commissions on credit lines around the implementation of a government bill (April 2013) that speeded up the repayment of outstanding debt from the PA for a treatment group composed of firms eligible for the repayment under the bill and for a control group composed of non-eligible firms. It shows that before the policy enactment, the dynamics of the interest rates obtained on new term loans and on credit lines by firms in the control and the treated group were parallel until the enactment of the law and they diverged afterwards. This is less evident for fees and commissions on credit lines. *Source*: CR-Taxia, Sondtel, Cerved® and authors' calculations. We thank Domenico Depalo for sharing data and codes on the repayments from the PA.

Figure 5 – The impact of firm liquidity on the cost of credit and on the transmission of monetary policy: preview of the main findings



Notes: the chart presents the relationship between the cost of credit, the slope of the yield curve and firm liquidity as it is modelled in the paper and exemplifying it graphically for the discrete case of two firms, respectively with high (LIQ^H) and low liquidity (LIQ^L). For any level of the slope, high-liquidity firms obtain cheaper credit than low-liquidity firms. However, a steepening of the curve exerts a heterogeneous downward pressure on the cost of credit which is stronger for high-liquidity firms. In general, changes in the slope (in both directions) are amplified by firm liquidity.

Table 1. Summary statistics

Panel a): Firm liquidity and other firm characteristics

	cash to assets *%*	firm size *(ln(assets))*	rating	volatility	cashflow to assets *(%)*	net working capital to assets *(%)*	dividends distirbuted *(dummy)*
mean	9.24	6.94	5	9.54	27.94	34.16	0
sd	13.30	1.50	2	13.08	32.16	36.43	0
p25	0.83	5.92	4	2.34	8.23	11.88	0
p50	3.65	6.82	5.00	5.22	21.28	36.59	0.00
p75	12.07	7.84	7.00	11.13	40.04	59.37	0.00
N	2211287	2415497	2784912	2179922	2397181	2410042	2861873

Notes: yearly values; all variables have been wisorzed at the (1,99) percentile. Source: Cerved.

	bank financing *(% of assets)*	leverage *(%)*	roa *(%)*	investment rate *(%)*	log growth value added *(%)*	lab cost growth *(%)*	material investments *(% of value added)*
p25	19.92	17.61	2.43	24.62	1.56	1.57	23.01
p50	19.25	36.07	16.07	140.77	59.36	49.82	76.17
p75	5.72	2.79	0.60	-14.29	-16.18	-9.28	1.58
mean	13.41	5.86	3.60	-1.97	2.34	2.77	5.41
sd	27.82	14.37	7.50	10.61	20.80	15.18	17.56
N	991416	1599763	2394136	2401252	2318676	2131377	1630894

Notes: yearly values; all variables have been wisorzed at the (1,99) percentile. Source: Cerved.

Panel b): Cost and quantities of credit

	rate on term loans *(%)*	rate on credit lines *(%)*	fees and commissions *(euro)*
mean	4.82	8.10	323.62
sd	2.27	3.38	559.38
p25	3.13	5.68	19.94
p50	4.75	7.89	124.57
p75	6.22	10.54	373.97
N	*1642672*	*11200000*	*11200000*

Notes: quarterly data winsorized at the (1,99) level. The average rate is computed as the weighted average of all types of credit (including commerical credits).

Panel b) (continued) Volumes and characteristics of granted credit

	delta log (total credit)	delta log (term loans)	delta log (credit lines)	delta log (short-term loans)	delta log (long-term loans)	delta log (collateralized loans)	delta log (uncollateralized loans)
	(%)	*(%)*	*(%)*	*(%)*	*(%)*	*(%)*	*(%)*
mean	-0.95	-4.76	-0.20	-3.97	-6.34	-2.36	-0.96
sd	20.77	34.37	19.91	54.60	28.14	15.90	22.23
p25	-2.81	-10.14	0.00	-3.99	-10.85	-3.02	-2.36
p50	0.00	-3.50	0.00	0.00	-5.07	-1.00	0.00
p75	0.00	0.00	0.00	0.00	-0.75	0.00	0.00
N	*22500000*	*12300000*	*17500000*	*3282928*	*9873950*	*182005*	*20300000*

Notes: quarterly data. Delta log growth is winsorized at the (1,99) level. Observation slightly increase with the other two measures as the opening of the credit line is captured. Source: Bank of Italy Credit Register.

Panel c) Bank characteristics

	ln(assets)	liquidit ratio	retail funding	NPLS	Tier 1	ROA	ROE	NIM	market share	leverage
			(% of assets)	*(% of assets)*	*(% of assets)*	*(%)*	*(%)*	*(%)*	*(%)*	
mean	6.45	20.83	59.34	3.44	9.39	0.07	0.75	0.57	0.24	15.26
sd	1.44	12.01	23.43	3.14	3.24	0.28	2.47	0.31	2.25	32.90
p25	5.22	12.25	51.27	1.03	6.97	0.00	0.00	0.39	0.00	3.26
p50	6.06	21.16	65.22	2.52	9.09	0.09	0.76	0.54	0.00	6.06
p75	7.05	29.80	74.29	4.95	12.12	0.19	1.76	0.73	0.01	11.87
N	*29377*	*29377*	*29377*	*29377*	*26803*	*29290*	*28918*	*29290*	*29377*	*19840*

Notes: quarterly averages of monthly values; all variables have been wisorzed at the (1,99) percentile. Source: Suvervisory Reports.

Panel d): Monetary policy and macro indicators

	eonia	3month euribor	shadow rate	yield on 2year BTP	10year Eurirs	real GDP growth	unemployment	firms' expectations
	(p.p)	*(p.p)*	*(p.p)*	*(p.p)*	*(p.p)*	*(quarterly changes)*	*(quarterly changes)*	*(index)*
mean	0.91	1.19	-0.93	2.23	2.44	0.91	1.19	3.08
sd	1.52	1.69	2.92	1.62	1.44	1.52	1.69	8.77
p25	-0.14	-0.06	-3.29	0.51	0.97	-0.14	-0.06	0.16
p50	0.26	0.51	-1.83	2.28	2.14	0.26	0.51	2.81
p75	1.21	1.79	1.17	3.69	3.67	1.21	1.79	10.01
N	*56*	*56*	*56*	*56*	*56*	*56*	*56*	*56*

Table 2. Impact of firm liquidity on the cost of credit

Notes: this table presents estimates of the impact of liquidity on the cost of credit (rate on new term loans, rate on credit lines and fees and commissions on credit lines). Liquid assets are the ratio of cash to total assets. Bank controls include capital ratio (Tier 1 capital to total assets), log of total assets, liquidity ratio (securities over total assets), retail funding and share of non-performing loans to total assets. Firm controls include the z-score, size (log of total assets), leverage, volatility of the cash flow, ratio of cashflow to assets, net working capital to assets, a dummy for whether the firm has distributed its dividend in the previous year, the share of banks financing to total debt, roa, investment rate, the log growth of value added, and ratio of material investment to value added. Macro controls include a measure of the monetary policy stance (quarterly average of the Eonia rate), a measure of the long end of the yield curve (the 10-year eurirs), quarterly growth of real GDP, quarter-on-quarter change in the level of employment and firms' expectations. Sample period is 2006:q1 to 2018:q4. Errors are clustered at the firm*year level. Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

dep. variable is:	interest rate on new term loans			
	(1)	(2)	(3)	(4)
$liquidity_{t-1}$	-0.0335***	-0.0315***	-0.0269***	-0.0253***
	(0.0007)	(0.0007)	(0.0009)	(0.0008)
Obs.	657354	661173	635479	634678
R2	0.3844	0.4496	0.6847	0.6928
	interest rate on credit lines			
$liquidity_{t-1}$	-0.0176***	-0.0168***	-0.0170***	-0.0169***
	(0.0007)	(0.0007)	(0.0007)	(0.0007)
Obs.	3408962	3426859	3420382	3416366
R2	0.1299	0.1733	0.4666	0.4692
	fees and commissions			
$liquidity_{t-1}$	-1.8413***	-1.7879***	0.0870	0.1042
	(0.1138)	(0.1119)	(0.1217)	(0.1190)
Obs.	3408964	3426861	3420384	3416368
R2	0.0617	0.1139	0.3646	0.3687
firm controls	*yes*	*yes*	*yes*	*yes*
bank controls	*yes*	-	-	-
macro controls	*yes*	*yes*	*yes*	*yes*
*bank*quarter FE*	*no*	*yes*	*yes*	*yes*
firm FE	*no*	*no*	*yes*	*yes*
*industry*quarter FE*	*no*	*no*	*no*	*yes*

Table 3. Impact of firm liquidity on the volumes of credit

Notes: this table presents estimates of the impact of liquidity on the quarterly growth rate of the quantity of credit (term credit and credit lines). Liquid assets are the ratio of cash to total assets. Bank controls include capital ratio (Tier 1 capital to total assets), log of total assets, liquidity ratio (securities over total assets), retail funding and share of non-performing loans to total assets. Firm controls include the z-score, size (log of total assets), leverage, volatility of the cash flow, ratio of cashflow to assets, net working capital to assets, a dummy for whether the firm has distributed its dividend in the previous year, the share of banks financing to total debt, roa, investment rate, the log growth of value added, and ratio of material investment to value added. Macro controls include a measure of the monetary policy stance (quarterly average of the Eonia rate), a measure of the long end of the yield curve (the 10-year eurirs), quarterly growth of real GDP, quarter-on-quarter change in the level of employment and firms' expectations. Sample period is 2006:q1 to 2018:q4. Errors are clustered at the firm*year level. Standard error s in parentheses. *** p<0.01, ** p<0.05, * p<0.1

dep. variable is:	delta log(term credit)			
	(1)	(2)	(3)	(4)
liquidity$_{t-1}$	0.0391***	0.0383***	0.0547***	0.0551***
	(0.0025)	(0.0025)	(0.0042)	(0.0042)
Obs.	4138905	4246697	4242131	4235984
R2	0.0053	0.0172	0.0466	0.0490
	delta log(credit lines)			
liquidity$_{t-1}$	-0.0051***	-0.0056***	-0.0006	-0.0014
	(0.0011)	(0.0011)	(0.0019)	(0.0019)
Obs.	5363295	5392643	5389771	5382046
R2	0.0009	0.0119	0.0294	0.0317
firm controls	*yes*	*yes*	*yes*	*yes*
bank controls	*yes*	-	-	-
macro controls	*yes*	*yes*	*yes*	*yes*
*bank*quarter FE*	*no*	*yes*	*yes*	*yes*
firm FE	*no*	*no*	*yes*	*yes*
*industry*quarter FE*	*no*	*no*	*no*	*yes*

Table 4. Impact of firm liquidity on the composition of credit

Notes: this table presents estimates of the impact of liquidity on the quarterly growth rate of the volumes of new term loans, broken down by maturity (less than 1 year and more than 1 year) and by the presence of collateral. Liquid assets are the ratio of cash to total assets. Bank controls include capital ratio (Tier 1 capital to total assets), log of total assets, liquidity ratio (securities over total assets), retail funding and share of non-performing loans to total assets. Firm controls include the z-score, size (log of total assets), leverage, volatility of the cash flow, ratio of cash-flow to assets, net working capital to assets, a dummy for whether the firm has distributed its dividend in the previous year, the share of banks financing to total debt, ROA, investment rate, the log growth of value added, and ratio of material investment to value added. Macro controls include a measure of the monetary policy stance (quarterly average of the Eonia rate), a measure of the long end of the yield curve (the 10-year eurirs), quarterly growth of real GDP, quarter-on-quarter change in the level of employment and firms' expectations. Sample period is 2006:q1 to 2018:q4. Errors are clustered at the firm*year level. Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

dep. variable is:	delta log(term credit with maturity < = 1yr)			
	(1)	(2)	(3)	(4)
liquidity$_{t-1}$	0.0844***	0.0861***	0.0152	0.0102
	(0.0069)	(0.0068)	(0.0115)	(0.0116)
Obs.	1251169	1260973	1253423	1252292
R2	0.0052	0.0259	0.0713	0.0788
	delta log(term credit with maturity > 1yr)			
liquidity$_{t-1}$	0.0238***	0.0233***	0.0515***	0.0520***
	(0.0024)	(0.0024)	(0.0042)	(0.0042)
Obs.	3369810	3467807	3462639	3457127
R2	0.0113	0.0247	0.0640	0.0666
	delta log(term credit, collateralized)			
liquidity$_{t-1}$	-0.0312**	-0.0365**	-0.0685**	-0.0730**
	(0.0150)	(0.0169)	(0.0319)	(0.0366)
Obs.	48865	45387	44845	43317
R2	0.0150	0.1130	0.2302	0.3560
	delta log(term credit, uncollateralized)			
liquidity$_{t-1}$	-0.0133***	-0.0144***	0.0120***	0.0136***
	(0.0014)	(0.0014)	(0.0024)	(0.0024)
Obs.	6244982	6363472	6360770	6351498
R2	0.0033	0.0164	0.0398	0.0418
firm controls	*yes*	*yes*	*yes*	*yes*
bank controls	*yes*	-	-	-
macro controls	*yes*	*yes*	*yes*	*yes*
*bank*quarter FE*	*no*	*yes*	*yes*	*yes*
firm FE	*no*	*no*	*yes*	*yes*
*industry*quarter FE*	*no*	*no*	*no*	*yes*

Table 5. Difference-in-difference estimates of the effect of firm liquidity on the cost of credit

Notes: this table presents difference-in-difference estimates of the impact of liquidity on interest rates on new term loans, interest rates on credit lines and fees and commissions on credit lines, using the passing of a law for the repayment of debt vis à vis the PA in April 2013 as an exogenous treatment. Firm controls include the z-score, size (log of total assets), leverage, volatility of the cash flow, ratio of cash-flow to assets, net working capital to assets, a dummy for whether the firm has distributed its dividend in the previous year, the share of banks financing to total debt, ROA, investment rate, the log growth of value added, and ratio of material investment to value added. The sample period is 2006:q1 to 2018:q4. Errors are clustered at the firm level. Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

dep. variable is:	interest rate on new term loans			
	(1)	(2)	(3)	(4)
Quarters around the treatment date	± 1	± 2	± 3	± 4
Dff. in diff. effect	-0.1701	-0.3496*	-0.2815*	-0.2328
	(0.2018)	(0.1864)	(0.1526)	(0.1475)
Obs.	3845	7762	11642	15284
R2	0.3911	0.4072	0.4007	0.3840
	interest rate on credit lines			
Quarters around the treatment date	± 1	± 2	± 3	± 4
Diff. in diff. effect	-0.1663**	-0.1664**	-0.1425**	-0.1336
	(0.0842)	(0.0759)	(0.0722)	(0.0000)
Obs.	14387	28499	42659	56820
R2	0.2260	0.2103	0.2032	0.2066
	fees and commissions			
Quarters around the treatment date	± 1	± 2	± 3	± 4
Diff. in diff. effect	25.9366	-19.5841	-51.4085	-69.8823
	(52.0205)	(33.6097)	(43.0959)	(0.0000)
Obs.	14387	28499	42659	56820
R2	0.1303	0.1265	0.1221	0.1177
treatment dummy	*yes*	*yes*	*yes*	*yes*
firm controls (2011)	*yes*	*yes*	*yes*	*yes*
province fixed effects	*yes*	*yes*	*yes*	*yes*
industry fixed effects	*yes*	*yes*	*yes*	*yes*
bank-time fixed effects	*yes*	*yes*	*yes*	*yes*

Table 6. Evolution of firm liquidity

Notes: this table presents estimates of the impact of changes in the inverse of the slope of the yield curve (short term – long term rates)on future liquid holdings. It is run on a dataset collapsed at the yearly level; variables at other frequencies are computes as yearly averages. Liquid assets are the ratio of cash to total assets. Firm controls include the z-score, size (log of total assets), leverage, volatility of the cash flow, ratio of cashflow to assets, net working capital to assets, a dummy for whether the firm has distributed its dividend in the previous year, the share of banks financing to total debt, roa, investment rate, the log growth of value added, and ratio of material investment to value added. Macro controls include quarterly growth of real GDP, quarter-on-quarter change in the level of employment and firms' expectations. Sample period is 2006:q1 to 2018:q4. Errors are clustered at the firm*year level. Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

dep. variable is:	$liquidity_{t+1}$			
	(1)	(2)	(3)	(4)
$liquidity_t$	0.3116***	0.3112***	0.3095***	0.3079***
	(0.0054)	(0.0055)	(0.0055)	(0.0055)
$flattening_t$	0.4884***	0.4845***		
	(0.0192)	(0.0192)		
$liquidity_t$*$flattening_t$	0.0280***	0.0287***	0.0285***	0.0287***
	(0.0026)	(0.0026)	(0.0026)	(0.0026)
Obs.	429470	428532	428532	428492
R2	0.7723	0.7711	0.7718	0.7736
macro controls	*yes*	*yes*	*yes*	*yes*
firm controls	*yes*	*yes*	*yes*	*yes*
firm FE	*yes*	*yes*	*yes*	*yes*
industry FE	-	*yes*	*yes*	*yes*
quarter FE	-	-	*yes*	*yes*
*industry*quarter FE*	-	-	-	yes

Table 6a. Evolution of firm liquidity

Notes: this table presents estimates of the impact of changes in the short and long ends of the yield curve on future liquid holdings. It is run on a dataset collapsed at the yearly level; variables at other frequencies are computes as yearly averages. Liquid assets are the ratio of cash to total assets. Firm controls include the z-score, size (log of total assets), leverage, volatility of the cash flow, ratio of cashflow to assets, net working capital to assets, a dummy for whether the firm has distributed its dividend in the previous year, the share of banks financing to total debt, roa, investment rate, the log growth of value added, and ratio of material investment to value added. Macro controls include quarterly growth of real GDP, quarter-on-quarter change in the level of employment and firms' expectations. Sample period is 2006:q1 to 2018:q4. Errors are clustered at the firm*year level. Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

dep. variable is:	liquidity$_{t+1}$			
	(1)	(2)	(3)	(4)
liquidity$_t$	0.3225***	0.3225***	0.3216***	0.3187***
	(0.0059)	(0.0060)	(0.0060)	(0.0060)
eonia$_t$	0.1997***	0.1960***		
	(0.0221)	(0.0221)		
liquidity$_t$*eonia$_t$	0.0231***	0.0239***	0.0243***	0.0249***
	(0.0027)	(0.0027)	(0.0027)	(0.0027)
Eurirs10Y$_t$	-0.5031***	-0.4988***		
	(0.0196)	(0.0197)		
liquidity$_t$*Eurirs10$_t$	-0.0322***	-0.0331***	-0.0331***	-0.0328***
	(0.0027)	(0.0027)	(0.0027)	(0.0028)
Obs.	429470	428532	428532	428492
R2	0.7730	0.7718	0.7719	0.7737
macro controls	*yes*	*yes*	*yes*	*yes*
firm controls	*yes*	*yes*	*yes*	*yes*
firm FE	*yes*	*yes*	*yes*	*yes*
industry FE	-	*yes*	*yes*	*yes*
quarter FE	-	-	*yes*	*yes*
*industry*quarter FE*	-	-	-	yes

Table 7. Impact of firm liquidity on the transmission of monetary policy to the cost of credit

Notes: this table presents estimates of the impact of changes in the inverse of the slope of yield curve on the cost of credit (rate on new term loans, rate on credit lines and fees and commissions on credit lines). Liquid assets are the ratio of cash to total assets. Bank controls include capital ratio (Tier 1 capital to total assets), log of total assets, liquidity ratio (securities over total assets), retail funding and share of non-performing loans to total assets. Firm controls include the z-score, size (log of total assets), leverage, volatility of the cash flow, ratio of cashflow to assets, net working capital to assets, a dummy for whether the firm has distributed its dividend in the previous year, the share of banks financing to total debt, roa, investment rate, the log growth of value added, and ratio of material investment to value added. Macro controls include quarterly growth of real GDP, quarter-on-quarter change in the level of employment and firms' expectations. Sample period is 2006:q1 to 2018:q4. Errors are clustered at the firm*year level. Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

dep. variable is:	interest rate on new term loans			interest rate on credit lines			fees and commissions		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(7)
liquidity$_{t-1}$	-0.0453***			-0.0118***			-3.6123***		
	(0.0009)			(0.0006)			(0.0989)		
flattening$_t$	0.5687***			0.4580***			14.6337***		
	(0.0062)			(0.0042)			(0.6572)		
liquidity$_{t-1}$*flattening$_t$	-0.0127***	-0.0023***	-0.0020***	-0.0014***	-0.0021***	-0.0022***	0.1890***	-0.2687***	-0.2642***
	(0.0005)	(0.0007)	(0.0007)	(0.0004)	(0.0003)	(0.0004)	(0.0528)	(0.0620)	(0.0630)
Obs.	1307681	1052969	1051846	8642101	8748971	8733379	8642107	8748977	8733385
R2	0.0918	0.8042	0.8057	0.0445	0.6262	0.6263	0.0103	0.5031	0.5032
firm controls	*yes*	*yes*	*yes*	*yes*	*yes*	*yes*	*yes*	*yes*	*yes*
bank controls	*yes*	-	-	*yes*	-	-	*yes*	-	-
macro controls	*yes*	*yes*	*yes*	*yes*	*yes*	*yes*	*yes*	*yes*	*yes*
*bank*quarter FE*	*no*	*yes*	*yes*	*no*	*yes*	*yes*	*no*	*yes*	*yes*
firm FE	*no*	*yes*	*yes*	*no*	*yes*	*yes*	*no*	*yes*	*yes*
*industry*quarter FE*	*no*	*no*	*yes*	*no*	*no*	*yes*	*no*	*no*	*yes*

Table 7a. Impact of firm liquidity on the transmission of monetary policy to the cost of credit

Notes: this table presents estimates of the impact of changes in the short and long end of the yield curve on the cost of credit (rate on new term loans, rate on credit lines and fees and commissions on credit lines). Liquid assets are the ratio of cash to total assets. Bank controls include capital ratio (Tier 1 capital to total assets), log of total assets, liquidity ratio (securities over total assets), retail funding and share of non-performing loans to total assets. Firm controls include the z-score, size (log of total assets), leverage, volatility of the cash flow, ratio of cashflow to assets, net working capital to assets, a dummy for whether the firm has distributed its dividend in the previous year, the share of banks financing to total debt, roa, investment rate, the log growth of value added, and ratio of material investment to value added. Macro controls include quarterly growth of real GDP, quarter-on-quarter change in the level of employment and firms' expectations. Sample period is 2006:q1 to 2018:q4. Errors are clustered at the firm*year level. Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

dep. variable is:	interest rate on new term loans			interest rate on credit lines			fees and commissions		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(7)
liquidity$_{t-1}$	-0.0461***			-0.0251***			-2.7388***		
	(0.0010)			(0.0009)			(0.1281)		
eonia	0.7018***			0.5486***			30.2549***		
	(0.0058)			(0.0043)			(0.7630)		
liquidity$_{t-1}$*eonia	-0.0043***	-0.0003	0.0003	-0.0015***	-0.0019***	-0.0019***	0.1739***	-0.1708**	-0.1453*
	(0.0004)	(0.0008)	(0.0008)	(0.0004)	(0.0004)	(0.0004)	(0.0530)	(0.0805)	(0.0812)
Eurirs10	-0.0813***			-0.0073			17.8285***		
	(0.0065)			(0.0048)			(0.7340)		
liquidity$_{t-1}$*Eurirs10	0.0140***	0.0039***	0.0038***	0.0065***	0.0024***	0.0025***	-0.4678***	0.3887***	0.4119***
	(0.0005)	(0.0009)	(0.0009)	(0.0004)	(0.0005)	(0.0005)	(0.0588)	(0.0681)	(0.0694)
Obs.	1307681	1052969	1051846	8642101	8748971	8733379	8642107	8748977	8733385
R2	0.2209	0.8042	0.8057	0.0783	0.6262	0.6263	0.0146	0.5031	0.5032
firm controls	*yes*	*yes*	*yes*	*yes*	*yes*	*yes*	*yes*	*yes*	*yes*
bank controls	*yes*	-	-	*yes*	-	-	*yes*	-	-
macro controls	*yes*	*yes*	*yes*	*yes*	*yes*	*yes*	*yes*	*yes*	*yes*
*bank*quarter FE*	*no*	*yes*	*yes*	*no*	*yes*	*yes*	*no*	*yes*	*yes*
firm FE	*no*	*yes*	*yes*	*no*	*yes*	*yes*	*no*	*yes*	*yes*
*industry*quarter FE*	*no*	*no*	*yes*	*no*	*no*	*yes*	*no*	*no*	*yes*

Table 8. Impact of firm liquidity on the transmission of monetary policy to the cost of credit during negative interest rates

Notes: this table presents estimates of the impact of changes in the inverse of the slope of yield curve on the cost of credit (rate on new term loans, rate on credit lines and fees and commissions on credit lines) for the period 2014q3-2018q4. Liquid assets are the ratio of cash to total assets. Bank controls include capital ratio (Tier 1 capital to total assets), log of total assets, liquidity ratio (securities over total assets), retail funding and share of non-performing loans to total assets. Firm controls include the z-score, size (log of total assets), leverage, volatility of the cash flow, ratio of cashflow to assets, net working capital to assets, a dummy for whether the firm has distributed its dividend in the previous year, the share of banks financing to total debt, roa, investment rate, the log growth of value added, and ratio of material investment to value added. Macro controls include quarterly growth of real GDP, quarter-on-quarter change in the level of employment and firms' expectations. Sample period is 2006:q1 to 2018:q4. Errors are clustered at the firm*year level. Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

dep. variable is:	int. rate on new term loans	int. rate on credit lines	fees and commissions
	(1)	(2)	(3)
$liquidity_{t-1}$	-0.0320***	-0.0328***	-3.6465***
	(0.0029)	(0.0030)	(0.3981)
$flattening_t$	-1.1650***	-0.8202***	-15.6204***
	(0.0403)	(0.0269)	(3.8368)
$liquidity_{t-1}$*$flattening_t$	0.0015	-0.0138***	-0.8476**
	(0.0026)	(0.0026)	(0.3560)
Obs.	454280	2050103	2050108
R2	0.0776	0.0534	0.0108
firm controls	*yes*	*yes*	*yes*
bank controls	*yes*	*yes*	*yes*
macro controls	*yes*	*yes*	*yes*
*bank*quarter FE*	*no*	*no*	*no*
firm FE	*no*	*no*	*no*
*industry*quarter FE*	*no*	*no*	*no*

APPENDIX

Table A1. Impact of firm liquidity on the cost of credit; yearly data

Notes: this table presents estimates of the impact of liquidity on the cost of credit (rate on new term loans, rate on credit lines and fees and commissions on credit lines). Liquid assets are the ratio of cash to total assets. Bank controls include capital ratio (Tier 1 capital to total assets), log of total assets, liquidity ratio (securities over total assets), retail funding and share of non-performing loans to total assets. Firm controls include the z-score, size (log of total assets), leverage, volatility of the cash flow, ratio of cashflow to assets, net working capital to assets, a dummy for whether the firm has distributed its dividend in the previous year, the share of banks financing to total debt, roa, investment rate, the log growth of value added, and ratio of material investment to value added. Macro controls include a measure of the monetary policy stance (yearly average of the Eonia rate), a measure of the long end of the yield curve (the 10-year eurirs), yearly growth of real GDP, yearly change in the level of employment and firms' expectations. Sample period is 2006:q1 to 2018:q4. Errors are clustered at the firm*year level. Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

dep. variable is:	interest rate on new term loans			
	(1)	(2)	(3)	(4)
$liquidity_{t-1}$	-0.0331***	-0.0306***	-0.0259***	-0.0248***
	(0.0013)	(0.0012)	(0.0017)	(0.0017)
Obs.	164815	165591	141423	141214
R2	0.3570	0.4262	0.6893	0.6977
	interest rate on credit lines			
$liquidity_{t-1}$	-0.0179***	-0.0167***	-0.0179***	-0.0178***
	(0.0013)	(0.0012)	(0.0012)	(0.0012)
Obs.	164815	165591	141423	141214
R2	0.3570	0.4262	0.6893	0.6977
	fees and commissions			
$liquidity_{t-1}$	-1.7872***	-1.7175***	0.0688	0.0893
	(0.1893)	(0.1859)	(0.1915)	(0.1871)
Obs.	164815	165591	141423	141214
R2	0.3570	0.4262	0.6893	0.6977
firm controls	*yes*	*yes*	*yes*	*yes*
bank controls	*yes*	-	-	-
macro controls	*yes*	*yes*	*yes*	*yes*
*bank*year FE*	*no*	*yes*	*yes*	*yes*
firm FE	*no*	*no*	*yes*	*yes*
*industry*year FE*	*no*	*no*	*no*	*yes*

Table A2. Impact of firm liquidity on the volumes of credit; yearly data

Notes: this table presents estimates of the impact of liquidity on the quarterly growth rate of the quantity of credit (term credit and credit lines). Liquid assets are the ratio of cash to total assets. Bank controls include capital ratio (Tier 1 capital to total assets), log of total assets, liquidity ratio (securities over total assets), retail funding and share of non-performing loans to total assets. Firm controls include the z-score, size (log of total assets), leverage, volatility of the cash flow, ratio of cashflow to assets, net working capital to assets, a dummy for whether the firm has distributed its dividend in the previous year, the share of banks financing to total debt, roa, investment rate, the log growth of value added, and ratio of material investment to value added. Macro controls include a measure of the monetary policy stance (yearly average of the Eonia rate), a measure of the long end of the yield curve (the 10-year eurirs), yearly growth of real GDP, yearly change in the level of employment and firms' expectations. Sample period is 2006:q1 to 2018:q4. Errors are clustered at the firm*year level. Standard error s in parentheses. *** p<0.01, ** p<0.05, * p<0.1

dep. variable is:	delta log(term credit)			
	(1)	(2)	(3)	(4)
liquidity$_{t-1}$	0.0382***	0.0355***	0.0496***	0.0512***
	(0.0053)	(0.0052)	(0.0096)	(0.0096)
Obs.	1045392	1076566	1049143	1047548
R2	0.0054	0.0114	0.1079	0.1099
	delta log(credit lines)			
liquidity$_{t-1}$	-0.0043*	-0.0054**	-0.0014	-0.0024
	(0.0025)	(0.0025)	(0.0046)	(0.0047)
Obs.	1374164	1379831	1359561	1357577
R2	0.0008	0.0057	0.0873	0.0892
firm controls	*yes*	*yes*	*yes*	*yes*
bank controls	*yes*	-	-	-
macro controls	*yes*	*yes*	*yes*	*yes*
*bank*year FE*	*no*	*yes*	*yes*	*yes*
firm FE	*no*	*no*	*yes*	*yes*
*industry*year FE*	*no*	*no*	*no*	*yes*

Table A3. Impact of firm liquidity on the composition of credit; yearly data

Notes: this table presents estimates of the impact of liquidity on the quarterly growth rate of the volumes of new term loans, broken down by maturity (less than 1 year and more than 1 year) and by the presence of collateral. Liquid assets are the ratio of cash to total assets. Bank controls include capital ratio (Tier 1 capital to total assets), log of total assets, liquidity ratio (securities over total assets), retail funding and share of non-performing loans to total assets. Firm controls include the z-score, size (log of total assets), leverage, volatility of the cash flow, ratio of cash-flow to assets, net working capital to assets, a dummy for whether the firm has distributed its dividend in the previous year, the share of banks financing to total debt, ROA, investment rate, the log growth of value added, and ratio of material investment to value added. Macro controls include a measure of the monetary policy stance (yearly average of the Eonia rate), a measure of the long end of the yield curve (the 10-year eurirs), yearly growth of real GDP, yearly change in the level of employment and firms' expectations. Sample period is 2006:q1 to 2018:q4. Errors are clustered at the firm*year level. Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

dep. variable is:	delta log(term credit with maturity < = 1yr)			
	(1)	(2)	(3)	(4)
$liquidity_{t-1}$	0.0889***	0.0910***	0.0605**	0.0640**
	(0.0161)	(0.0161)	(0.0305)	(0.0309)
Obs.	311443	313866	295624	295355
R2	0.0055	0.0180	0.1684	0.1755
	delta log(term credit with maturity > 1yr)			
$liquidity_{t-1}$	0.0219***	0.0191***	0.0355***	0.0370***
	(0.0048)	(0.0047)	(0.0090)	(0.0091)
Obs.	850469	879254	850325	848890
R2	0.0112	0.0189	0.1309	0.1334
	delta log(term credit, collateralized)			
$liquidity_{t-1}$	0.0298	0.0306	-0.1229	-0.1242
	(0.0311)	(0.0369)	(0.0916)	(0.0944)
Obs.	11828	10892	9056	8554
R2	0.0190	0.1137	0.3902	0.5232
	delta log(term credit, uncollateralized)			
$liquidity_{t-1}$	-0.0157***	-0.0176***	0.0094*	0.0110**
	(0.0029)	(0.0028)	(0.0053)	(0.0053)
Obs.	1600631	1633417	1613229	1610821
R2	0.0034	0.0103	0.0891	0.0908
firm controls	*yes*	*yes*	*yes*	*yes*
bank controls	*yes*	-	-	-
macro controls	*yes*	*yes*	*yes*	*yes*
*bank*year FE*	*no*	*yes*	*yes*	*yes*
firm FE	*no*	*no*	*yes*	*yes*
*industry*year FE*	*no*	*no*	*no*	*yes*

Table A4. Impact of firm liquidity on the transmission of monetary policy to the cost of credit; yearly data

Notes: this table presents estimates of the impact of changes in the inverse of the slope of yield curve on the cost of credit (rate on new term loans, rate on credit lines and fees and commissions on credit lines). Liquid assets are the ratio of cash to total assets. Bank controls include capital ratio (Tier 1 capital to total assets), log of total assets, liquidity ratio (securities over total assets), retail funding and share of non-performing loans to total assets. Firm controls include the z-score, size (log of total assets), leverage, volatility of the cash flow, ratio of cashflow to assets, net working capital to assets, a dummy for whether the firm has distributed its dividend in the previous year, the share of banks financing to total debt, roa, investment rate, the log growth of value added, and ratio of material investment to value added. Macro controls include yearly growth of real GDP, yearly change in the level of employment and firms' expectations. Sample period is 2006:q1 to 2018:q4. Errors are clustered at the firm*year level. Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

dep. variable is:	interest rate on new term loans			interest rate on credit lines			fees and commissions		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(7)
liquidity$_{t-1}$	-0.0380***			-0.0085***			-3.3057***		
	(0.0014)			(0.0009)			(0.1280)		
flattening$_t$	0.4855***			0.3560***			33.8251***		
	(0.0093)			(0.0056)			(0.8742)		
liquidity$_{t-1}$*flattening$_t$	-0.0110***	-0.0140*	-0.0140*	-0.0007	-0.0074*	-0.0077*	0.2329***	-0.8489	-0.8689
	(0.0007)	(0.0077)	(0.0078)	(0.0005)	(0.0042)	(0.0043)	(0.0668)	(0.6108)	(0.6249)
Obs.	344448	152227	152125	2320122	1739053	1736777	2320126	1739057	1736781
R2	0.1022	0.7830	0.7830	0.0289	0.6012	0.6011	0.0045	0.4848	0.4847
firm controls	*yes*	*yes*	*yes*	*yes*	*yes*	*yes*	*yes*	*yes*	*yes*
bank controls	*yes*	-	-	*yes*	-	-	*yes*	-	-
macro controls	*yes*	*yes*	*yes*	*yes*	*yes*	*yes*	*yes*	*yes*	*yes*
*bank*year FE*	*no*	*yes*	*yes*	*no*	*yes*	*yes*	*no*	*yes*	*yes*
firm FE	*no*	*yes*	*yes*	*no*	*yes*	*yes*	*no*	*yes*	*yes*
*industry*year FE*	*no*	*no*	*yes*	*no*	*no*	*yes*	*no*	*no*	*yes*

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