# Firm Liquidity and the Transmission of Monetary Policy*

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We study the impact of firms' cash balances on the supply of bank credit and on the transmission of monetary policy through the bank lending channel. We show that banks supply cheaper credit to more liquid firms, in line with the pledgeability of cash and with its role in the loan negotiation process. Furthermore, we provide evidence that the transmission of monetary policy is weakened by firms' liquidity balances. A monetary policy impulse alters the slope of the risk-free yield curve, which in turn changes the opportunity cost of holding cash-like assets. This leads firms to decrease their liquidity holdings after a steepening, or, alternatively, to increase them after a flattening. As a result, firms' negotiation power declines after a policy rate cut, allowing banks to dampen the pass-through of the easing. Similarly, firms end up with larger cash balances after a tightening and are able to negotiate a lower pass-through.

JEL Codes: E51, E52.

*We are grateful to Piergiorgio Alessandri, Matteo Bugamelli, Paolo Del Giovane, Davide Dottori, Giuseppe Ferrero, Gabriele Galati, Marco Gallo, Paul Hubert, Vasso Ioannidou, Andrea Lamorgese, Giacinto Micucci, Stefano Neri, Nicola Pavanini, Alessandro Secchi, Enrico Sette, Federico Signoretti, Marco Taboga, Andrea Tiseno, Razvan Vlahu, and Christopher J. Waller for the helpful comments and discussions; to Leandro D'Aurizio and Domenico Depalo for data sharing; as well as to participants in the Nederlandsche Bank Seminar Series, the 2023 Banque de France Empirical Corporate Finance Workshop—Corporate Finance in a Context of Persistent Inflation and Rising Interest Rates: Diagnosis, Risks and Challenges, the 2nd workstream 1 workshop of the ESCB Network on "Challenges for Monetary Policy Transmission in a Changing World (ChaMP)," and the 2024 IJCB Conference on the Transmission of Monetary Policy in the Post-Pandemic World. Authors' contacts: Margherita Bottero, margherita.bottero@bancaditalia.it; Stefano Schiaffi: stefano.schiaffi@bancaditalia.it.

## 1. Introduction

Firm liquidity has been on the rise globally over the last two decades. This phenomenon, which is associated with the extended period of low long-term real interest rates, high corporate profits and stagnating or declining investment in physical capital, is unlikely to revert anytime soon (Dao and Maggi 2018).[1] In light of the growing significance of liquidity on firm balance sheets, this paper aims at empirically assessing its effect on the cost of credit and on the transmission mechanism of monetary policy via the bank lending channel.

From a theoretical perspective, liquidity holdings reflect several factors, including risk preferences, perceived continuation value, and exposure to shocks (Keynes 1936; Miller and Orr 1966; Myers and Majluf 1984; Jensen 1986).[2] Liquidity may thus inform investors—and intermediaries—about a firm's fundamentals (Gamba and Triantis 2008). However, the direction of the signaling impact of corporate liquidity on credit conditions is a priori ambiguous.

On the one hand, a firm with a large cash balance may be perceived as more vulnerable to aggregate shocks, which could potentially lead to unfavorable treatment by financial intermediaries when seeking financing (*negative signaling*). This signal stems from the consideration that when a firm holds large amounts of cash in expectation of possible investment opportunities, it must have been denied access to more flexible credit lines by previous lenders (Acharya, Almeida, and Campello 2013). Prospective lenders internalize this information and respond by reining in supply conditions.

On the other hand, cash may serve as an indicator of a firm's heightened profitability (*positive signaling*). With financing

[1] More recently, the outbreak of the COVID-19 pandemic has brought about an additional, sharp increase in corporates' liquid holdings. The uncertainty about the evolution of the pandemic, the emergence of bottlenecks, and disrupted global value chains all induced companies to hoard liquidity and postpone fixed investment, resulting in firms stocking up large deposits amidst very accommodative monetary policy and supporting public programs.

[2] According to Keynes (1936, p. 196), cash is held "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 fixed in terms of money." Besides precautionary motives, Keynes mentions transaction costs and speculative motives as driving the demand for money.

constraints, firms lacking sufficient cash reserves may become illiquid and be compelled to default while still solvent. As firms with higher profitability expect a greater continuation value, they hold greater cash reserves to circumvent negative liquidity shocks that could otherwise lead to default (Gryglewicz 2011; Campello et al. 2011). Higher cash balances, then, are linked to more favorable credit conditions, reflecting the firm's higher profitability and more prudent liquidity management.

In addition, besides signaling on firms' fundamentals, cash holdings may act as a *negotiation tool* between banks and firms.[3] More precisely, liquidity eases the bank-firm match in two ways. First, cash is easier for the creditor to seize compared to other assets, soothing the various moral hazard issues surrounding the credit relationship. Second, it supports the firm's claim to be able to undertake the project independently, even in the absence of external funds, should the credit agreement not be finalized (Rocheteau, Wright, and Zhang 2018). If liquidity holdings do, in fact, facilitate negotiations between banks and firms, it is reasonable to expect that intermediaries would offer more favorable credit terms to cash-rich firms.

To discriminate empirically between these alternatives, we look at a panel of bank-firm matched data over the period 2006–18 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 amount of cash (the average cash-to-assets ratio in our sample is 9.5 percent). 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 percent). Third, we can draw on the very detailed credit data available via the Bank of Italy's Central Credit Register, which cover volumes, cost, and characteristics of loans granted, matching this information with bank and firm balance sheet characteristics.

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 other bank characteristics that affect lending to more liquid firms.

[3]While this mechanism is stronger when a firm applies for a new loan with the bank where it has its deposits, it holds more generally, as cash is more easily and transparently sizable than other collateralized fixed assets.

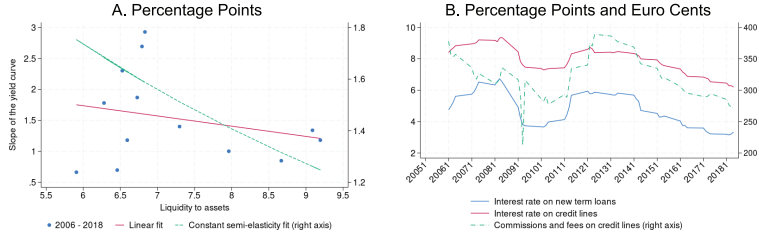
To do so, we include in all regressions bank*year fixed effects (FEs) and an array of firm-level variables, including their credit score.[4] To better net out confounding firm demand dynamics, we also control for firm and industry*year FEs to capture time-varying demand confounders at the firm or industry level (e.g., industry-specific liquidity needs that are linked to the business cycle; Shi 2015). The richness of the data also allows us to include firm*bank FEs, which nets out the specificities of the lender-borrower match.

We find that liquidity holdings are associated with more favorable credit supply conditions, supporting both the positive signaling and the negotiation tool views of liquidity. According to our estimates, a one-standard-deviation increase in cash and deposits as a share of total assets (13 percent) is associated with lower interest rates on term loans and credit lines (by up to 38 and 20 basis points, respectively). These results are robust to the inclusion of the controls and fixed effects described above, pointing toward a robust *positive signaling* role of cash holdings.

To expand on the these results, we exploit a quasi-natural experiment that resulted in some Italian firms enjoying an unexpected liquidity increase as a result of the repayment of past credits they had with the Italian Public Administration. In practice, we compare credit conditions offered to firms that received the payments with those offered to firms that did not, which allows us to verify our findings in a cross-sectional difference-in-difference (D-in-D) framework. The positive link between cash holdings and credit conditions is confirmed, with a similar economic size and magnitude to that in the fixed-effect approach. After the change in regulation, the cost of credit for firms that benefited from the cash injection decreased by roughly 30 basis points for term loans and by approximately 15 basis points for credit lines. For interest rates on new term loans, the effect is significant two and three quarters after the entry into force of the law. The effect on interest rates on credit lines, by contrast, is significant right after the liquidity shock. Moreover, as these repayments are exogenous with respect to firms' cash management decisions, the results lend direct support to the negotiation role of liquidity, while not necessarily rejecting its positive signaling role.

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

**Figure 1. Firm Liquidity, Monetary Policy Indicators, and the Cost of Credit**




**Note:** Panel A shows a scatter plot of yearly firm liquidity to total assets and of the slope of the euro area yield curve, measured as the difference between the 10-year EURIRS and the EONIA, as well the fitted values of a linear and a constant semi-elasticity model. Panel B reports the evolution of our main cost variables, i.e., the interest rate applied to new term loans, the interest rate applied to credit lines, and fees and commissions applied to credit lines. Source: Cerved®; ECB Statistical DataWarehouse; Bank of Italy Credit Register; authors' calculations.

In addition to directly influencing banks' lending decisions, firm liquidity also affects the transmission of monetary policy rates to the cost of credit. This occurs via the following mechanism. A reduction in the policy rate prompts a steepening of the yield curve, which in turn affects the opportunity cost of holding liquid assets, typically priced at the shorter end of the risk-free yield curve. In response to this, firms reallocate their liquidity to more remunerative financial assets or investment projects. This reallocation results in firms holding less liquidity, which consequently reduces their bargaining power. Figure 1A displays the clear negative relationship between liquidity and the slope of the yield curve in our data. Banks then offer comparatively tighter credit conditions, thereby weakening the transmission of the easing stimulus. Similarly, the reallocation of firms' assets into liquid instruments triggered by an increase in policy rates attenuates the transmission of a monetary tightening to credit conditions.

Our data set on the Italian credit market is an appropriate setup to address these questions, as monetary policy is to a large extent exogenous to the country-specific macro outlook, as it is decided at the euro-area level. This allows us to better disentangle the impact of the policy action from contemporaneous changes in the macroeconomic environment (Jiménez et al. 2014; Peydró, Polo, and Sette

2017). According to our estimates, the effect of a 1 percentage point change in the overnight unsecured borrowing costs of euro-area banks (EONIA) on the cost of term loans and of credit lines is up to 33 percent weaker for firms that have one standard deviation of additional liquidity. In the context of the 2022–23 tightening cycle in the euro area, this implies that the transmission of the 450 basis point hike might have been up to 150 basis points weaker for more liquid firms.

To the best of our knowledge, our paper is the first to provide a unified assessment of the effect of firm cash balances on the cost of bank credit and on the transmission of monetary policy, highlighting the role of movements in the slope of the yield curve in shaping this heterogeneity. This consideration adds to the literature that focuses on how monetary policy transmission via bank lending depends on movements in the whole term structure, not only in short-term rates (Adrian and Shin 2011; Dell'Ariccia, Laeven, and Marquez 2014).

**Literature Review.** Our work relates to the theoretical literature on optimal cash management by firms. Various theoretical models have been put forward to explain why corporates keep a positive level of cash, even when this yields less than comparable options (Myers 1984; Myers and Majluf 1984; Bolton, Chen, and Wang 2011, 2013; Almeida et al. 2014). When taking the perspective of the lending bank, these models can be grouped in two categories: those that imply that liquidity is held in response to underlying external financing frictions (such as in Acharya, Almeida, and Campello 2013) and those that see it as a precautionary buffer to insure against cash flow volatility in the context of high expected future profitability (such as in Gryglewicz 2011).

In addition, some papers have explored the relevance of cash from the more narrow perspective of the relationship between banks and firms when they meet for a credit match. Cash and liquid assets have a pledgeability advantage compared to other assets in facilitating the bank's decision to fund the firm (Kiyotaki and Moore 1997; Holmström and Tirole 1998, 2011; Tirole 2006; Diamond, Hu, and Rajan 2022). In addition, corporate liquidity may be viewed 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 (Duffie, Garleanu, and

Pedersen 2005; Lagos and Rocheteau 2009; Rocheteau, Wright, and Zhang 2018).

Our paper is also linked to the literature on the transmission of monetary policy through the financial system. According to Drechsler, Savov, and Schnabl (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, exploiting their market power, decrease the spread between the policy rate and the interest they pay on deposits. Savers optimally respond by withdrawing a fraction of their deposits, which in turn causes banks' leverage to reduce and lending to contract. With respect to this seminal paper, we highlight a different role for deposits in the transmission of monetary policy by focusing on how their outflows/inflows following firms' liquidity management decisions in response to a policy rate change affect banks' willingness to supply credit.

Finally, our paper is implicitly related to the literature on the relationship between firms' liquidity and investment, to the extent that liquidity, as a facilitator of firms' access to bank credit, prompts investments. Hubbard (1998) and Fazzari, Hubbard, and Petersen (1998) are classical reference works on how a firm's financial mix impacts its investment choices. Since then, however, the literature has questioned whether liquidity truly matters for investment choices, and results are still mixed (for instance, Mercatanti, Makinen, and Silvestrini 2017, and Buono and Formai 2019). More recently, Jeenas (2023) studies the role of firms' balance sheet liquidity in the transmission of monetary policy to investment, finding that higher liquidity makes firms less likely to issue new debt, shielding them from temporary changes in rates on new borrowing and weakening monetary transmission.

Our contribution to these strands of literature is twofold. First, we provide empirical evidence on the ex ante ambiguous role of firm liquidity in determining credit conditions. We show that intermediaries value a borrower's liquid holdings positively and offer more favorable contractual terms to cash-rich firms. This result also supports the negotiation role of liquidity holdings, by which more liquid firms negotiate better credit conditions as banks look upon liquidity as a form of collateral. Second, building on this result, we relate the established connection between changes in the yield

curve—prompted by monetary policy—and firm liquidity holdings to the strength of the transmission. Here, we highlight how firms' liquidity reallocation following such changes eventually results in a dampening 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. Data

Our data set draws on four data sources to track the credit relations of a random sample of 900,000 Italian firms[5] over the period 2006–18 at yearly frequency, merging them with their own balance sheet and that of their lenders.[6] In this section, we describe each data source and the variables used in the analysis.

**Firm Liquidity.** The main independent variable is firm liquidity, which we measure as the end-of-year ratio of cash balances to total assets (see Table 1). Cash balances include deposits, cash, and checks, besides short-term credit with financial intermediaries. We choose not to include in the definition of liquidity other relatively liquid financial assets—e.g., 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 we will study how firms' liquidity position affects the transmission of the 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 helps us isolate movements in liquidity related to changes in

[5]Firms are randomly selected from the Cerved® group database, which pools yearly figures from individual balance sheets that companies submit compulsorily to the Italian Chamber of Commerce for the universe of 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 observations for the quantities.

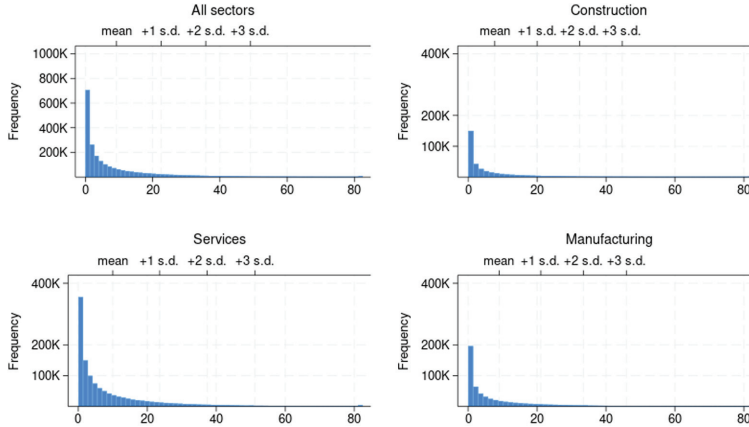
[6]We stop in 2018 since, after that, the Bank of Italy, in accordance with the Eurosystem, implemented a major change in the recording of data on the cost of credit, launching the AnaCredit harmonized data collection framework.

**Table 1. Summary Statistics: Firm Liquidity and Other Firm Characteristics**

| | **Cash to Assets (%)** | **Firm Size (log(assets))** | **Rating** | **Volatility** | **Cash Flow to Assets (%)** | **Net Working Capital to Assets (%)** | **Dividends Distributed (Dummy)** |
|---|---|---|---|---|---|---|---|
| Mean | 9.24 | 6.94 | 4.99 | 9.54 | 27.94 | 34.16 | 0.22 |
| sd | 13.30 | 1.50 | 2.01 | 13.08 | 32.16 | 36.43 | 0.41 |
| p25 | 1 | 5.92 | 4.00 | 2.34 | 8.23 | 11.88 | 0 |
| p50 | 4 | 7 | 5 | 5.22 | 21.28 | 37 | 0 |
| p75 | 12 | 8 | 7 | 11.13 | 40.0 | 59 | 0 |
| N | 2,211,287 | 2,415,497 | 2,784,912 | 2,179,922 | 2,397,181 | 2,410,042 | 2,861,873 |
| | **Bank Financing (% Total Assets)** | **Leverage (%)** | **ROA (%)** | **Investment Rate (%)** | **Log Growth Value-Added (%)** | **Lab Cost Growth (%)** | |
| Mean | 19.92 | 17.61 | 2.43 | 24.62 | 1.56 | 1.57 | |
| sd | 19.25 | 36.07 | 16.07 | 140.77 | 59.36 | 49.82 | |
| p25 | 5.72 | 2.79 | 0.60 | –14.29 | –16.18 | –9 | |
| p50 | 13 | 6 | 3.60 | –1.97 | 2 | 3 | |
| p75 | 28 | 14 | 7.50 | 10.6 | 21 | 15 | |
| N | 991,416 | 1,599,763 | 2,394,136 | 2,401,252 | 2,318,676 | 2,131,377 | |

**Note:** Yearly values; all variables have been winsorized at the (1,99) percentile. Source: Cerved®.

**Figure 2. The Distribution of Liquidity**




**Note:** The panels display the distribution of firm liquidity, as a percentage of assets, for the whole sample in the analysis (2006–18) and by sector of firm activity. The upper horizontal axis reports the mean and the mean + 1,2,3 s.d. Source: Cerved®.

the risk-free rate, and not to other, contemporaneous changes in term or credit premia. The average cash-to-assets ratio in our sample is 9.5 percent; this figure, however, masks a large heterogeneity both in the time series and in the cross section, as suggested by the large standard deviation (equal to 13.3, Figure 2). Between 2006 and 2011, average liquidity amounted to 8.4 percent; afterward, this value increased dramatically, reaching 13.1 percent in 2018. Smaller companies—in the first quartile of the 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 percent respectively for firms in the first to the fourth quartile of asset 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 percent from 2012 to the end of the sample) and smallest for those in the first quartile (+41 percent).[7] Across

[7]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 (2002–15). They conclude that the main driver has been the lower opportunity cost of money observed in conjunction with a declining policy rate.

sectors, liquidity holdings are larger among firms operating in services (mean 9.9 percent), followed by those in manufacturing (8.7 percent), and in construction (7.7 percent; in all cases the standard deviation continues to be large, at about 12 percent). 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 machinery 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.

**Credit Variables.** Using the Bank of Italy's Central Credit Register, we reconstruct each firm's network of banks, associating to each bank-firm match the interest rate applied to outstanding exposures, which is our main dependent variable (see Table 2). More precisely, we measure the cost of credit for firms with the annual percentage rate of charge (APRC) on new term loans and with the interest rate as well as fees and commissions on credit lines. The evolution over time of these variables is plotted in Figure 1B. We also investigate the effect on credit quantities, looking at the volumes of term credit and of credit lines (revocable credit loans). In addition, for term credit, we separate loans with shorter maturities (less than one year at origination) from those with longer duration.

**Bank Controls.** Exploiting the banks' identifiers, we employ the Bank of Italy's Supervisory Records to access information on their balance sheets and income statements, aggregated at the consolidated level (see Table 3). Overall, we have about 700 financial institutions.[8] In the regressions, we follow the classical literature on the bank lending channel and include 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 nonperforming loans to total assets to control for confounding supply dynamics.

**Monetary and Macroeconomic Controls.** Finally, our preferred measures of the monetary policy stance are the yearly averages of the euro overnight index average (EONIA) rate and 10-year euro

[8]Note however, that the number of intermediaries in the estimation will vary depending on the availability of their borrowers' balance sheet data.

## Table 2. Summary Statistics: Cost, Quantities, and Characteristics of Credit

| | Rate on Term Loans (%) | Rate on Credit Lines (%) | Fees and Commissions (Euro) | 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 | 4.85 | 8.13 | 293.01 | –1.08 | –5.91 | –0.26 | –7.10 | –7.32 | –2.34 | –1.17 |
| sd | 2.23 | 3.35 | 493.81 | 13.50 | 23.86 | 11.60 | 40.11 | 21.06 | 12.02 | 14.34 |
| p25 | 3.20 | 5.73 | 23.78 | –3.39 | –9.71 | 0 | –10.45 | –10.61 | –3.35 | –3.06 |
| p50 | 4.78 | 7.95 | 118.75 | 0 | –3.42 | 0 | 0 | –4.90 | –1.45 | 0 |
| p75 | 6.24 | 10.53 | 339.29 | 0 | 0.0 | 0 | 0 | –0.93 | 0.0 | 0 |
| N | 1,030,950 | 3,672,234 | 3,672,234 | 6,403,717 | 3,725,950 | 4,978,478 | 1,160,520 | 3,043,190 | 57,907 | 5,821,884 |

**Note:** Quarterly data winsorized at the (1,99) level. The average rate is computed as the weighted average of all types of credit (including commercial credits). Source: Bank of Italy Central Credit Register.

**Table 3. Summary Statistics: Bank Characteristics**

| | Log (Total Assets) (%) | Retail Funding to Total Assets (%) | Cash and Government Bonds to Total Assets (Liquidity Ratio) (%) | Impaired Loans to Total Assets (%) | Tier 1 Assets to Total Assets (%) |
|---|---|---|---|---|---|
| Mean | 6.46 | 59.27 | 20.71 | 3.46 | 9.37 |
| sd | 1.45 | 23.22 | 11.88 | 3.14 | 3.22 |
| p25 | 5 | 52.12 | 12.33 | 1.04 | 6.95 |
| p50 | 6 | 65 | 21.15 | 2.56 | 9 |
| p75 | 7 | 74 | 29.61 | 5.0 | 12 |
| N | 7,515 | 7,515 | 7,515 | 7,515 | 6,842 |

**Note:** Yearly averages of monthly values; all variables have been winsorized at the (1,99) percentile. Source: Supervisory Reports.

interest rate swap (EURIRS) rate, which capture, respectively, the short and the long end of the yield curve (see Table 4). These are typically considered the key reference rates for banks' pricing policies and lending decisions in the euro area (Darracq Pariès, Maurin, and Moccero 2014). However, in the period we consider, these two rates had been close to zero for many months before breaking through and may not be fully informative. To account for this, we resort to a "pure" monetary policy shock measure, building on Jarociński and Karadi (2020). The shocks are constructed using a high-frequency identification approach in the spirit of Gürkaynak, Sack, and Swanson (2005) and Gertler and Karadi (2015). In a first step, a series of policy announcement surprises is obtained by extracting information from the changes in the three-month EONIA swap rate within a fixed intraday window around monetary policy meetings. In a second step, the surprises are used to identify a series of pure monetary policy shocks as opposed to information shocks. The series of shocks is obtained using the so-called "poor man's" sign-restriction procedure that considers a policy announcement surprise as a pure monetary policy shock only when there is a negative comovement with the equity price index.

To control for the macroeconomic outlook, we include the growth of real GDP and the change in the level of employment, as well as firms' expectations on selling prices, employment, and production

**Table 4. Summary Statistics: Monetary Policy and Macro Indicators**

| | EONIA (p.p.) | 3m EURIBOR (p.p.) | 10Y EURIRS (p.p.) | Real GDP Growth (Quarterly Changes) | Unemployment (Quarterly Changes) | Firms' Expectations (Quarterly Changes) |
|---|---|---|---|---|---|---|
| Mean | 0.91 | 1.19 | 2.44 | –0.03 | 0.06 | 3.23 |
| sd | 1.55 | 1.72 | 1.47 | 0.51 | 0.25 | 8.27 |
| p25 | 0 | –0.02 | 0.98 | –0.28 | 0.10 | 1.43 |
| p50 | 0 | 1 | 2 | –0.01 | 0.07 | 3 |
| p75 | 1 | 1 | 4 | 0.32 | 0.2 | 10 |
| N | 13 | 13 | 13 | 13 | 13 | 13 |

**Note**: Yearly averages of daily values. Monetary rates in percentage points, macro variables as quarterly changes, and firm expectations as index. Source: Istat; European Commission; ECB Statistical Datawarehouse.

using survey data from the Joint Harmonised EU Industry Survey conducted by the European Commission.[9]

**Merging the Data Sources.** Firm-level data are annual; Credit Register data are monthly; key monetary policy rates are in continuous time; GDP is quarterly; and employment is monthly. To discipline the data, we recast all our variables as yearly means, in accordance with the frequency of variation of firm liquidity.

We resort to a quarterly data set, in which variables are computed as quarterly means, in two cases. First, when carrying out the difference-in-difference exercise in Section 3.1, as we are not constrained by firm liquidity. Second, in a robustness test in Section 4.2, where we look at the effect of firm liquidity on transmission proxying monetary policy with the Jarociński and Karadi (2020) shocks. In that case, we take the cumulative sum of the shocks (Coibion 2012; Nelson, Pinter, and Theodoridis 2018; Cucic and Gorea 2024) at the quarterly frequency to improve the variation.

[9]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 production over the following three months (see also Alessandri and Bottero 2020).

## 3. Firm Liquidity and the Cost of Credit

We begin discussing the relationship between liquidity and the cost of bank credit to shed light on the alternatives described in the Introduction (*positive signaling role*, *negative signaling role*, and *bargaining role*). To this end, we regress the three measures of the cost of credit described in the previous section (interest rates on new term loans and on credit lines, fees and commissions on credit lines) on firms' previous-year liquidity. As cash holdings are correlated with many important firm characteristics that jointly determine their 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 capital (Tier 1). Finally, we account for the economic outlook via the following macroeconomic variables: a lagged measure of the monetary policy stance, lagged real GDP growth and changes in employment level, and lagged firms' expectations about economic activity in Italy. In this and in the following specifications we cluster standard errors at the firm level.

As shown in Table 5, firm liquidity is associated with a significant reduction in the APRC on new term loans, as well as the interest rate and fees and commissions on credit lines (column 1, panels A–C).[10] This means that firms with higher (predetermined) liquidity enjoy on average a lower cost of credit. These results are consistent with the theories that argue that cash proxies prudent management or a high firm value and with those that assign a bargaining role to liquidity, while they do not support the view that banks weigh cash balances unfavorably.[11]

[10]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.

[11]Note that the estimation sample is visibly lower than the values reported for the dependent variables in the summary statistics tables. This is due 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 nonbank debt to total assets is reported for about 900,000 observations only.

## Table 5. Impact of Firm Liquidity on the Cost of Credit

| *Dep. Variable Is:* | **A. Interest Rate on New Term Loans** | | | | |
|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) |
| Liquidity $t-1$ | –0.0283*** | –0.0263*** | –0.0183*** | –0.0171*** | –0.0152*** |
| | (0.001) | (0.001) | (0.001) | (0.001) | (0.001) |
| Obs. | 374,692 | 375,677 | 349,985 | 349,621 | 283,747 |
| $R^2$ | 0.348 | 0.435 | 0.679 | 0.685 | 0.792 |
| | **B. Interest Rate on Credit Lines** | | | | |
| Liquidity $t-1$ | –0.0151*** | –0.0143*** | –0.0126*** | –0.0126*** | –0.0109*** |
| | (0.001) | (0.001) | (0.001) | (0.001) | (0.001) |
| Obs. | 1,125,368 | 1,127,278 | 1,107,425 | 1,106,069 | 1,000,745 |
| $R^2$ | 0.123 | 0.171 | 0.485 | 0.487 | 0.743 |
| | **C. Fees and Commissions** | | | | |
| Liquidity $t-1$ | –1.6483*** | –1.6008*** | 0.0621 | 0.1156 | 0.1787 |
| | (0.170) | (0.168) | (0.157) | (0.154) | (0.151) |
| Obs. | 1,125,368 | 1,127,278 | 1,107,425 | 1,106,069 | 1,000,745 |
| $R^2$ | 0.068 | 0.118 | 0.404 | 0.407 | 0.724 |
| *Firm Controls* | *yes* | *yes* | *yes* | *yes* | *yes* |
| *Bank Controls* | *yes* | - | - | - | - |
| *Macro Controls* | *yes* | - | - | - | - |
| *Bank*Year FEs* | *no* | *yes* | *yes* | *yes* | *yes* |
| *Firm FEs* | *no* | *no* | *yes* | *yes* | *yes* |
| *Industry*Year FEs* | *no* | *no* | *no* | *yes* | *yes* |
| *Bank*Firm FEs* | *no* | *no* | *no* | *no* | *yes* |

**Note**: This table presents estimates of the relation between liquidity and 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 nonperforming 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 bank financing to total debt, ROA, investment rate, the log growth of value-added, and the log growth of labor cost. 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 to 2018. Errors are clustered at the firm level. Standard errors in parentheses. ***$p < 0.01$, **$p < 0.05$, *$p < 0.1$.

We strengthen the identification using bank*year FEs to control for confounding supply dynamics.[12] These effects capture all observable and unobservable bank-specific, possibly time-varying, confounding supply dynamics that would favor more liquid firms over less liquid ones. Results are broadly unchanged (column 2), 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).

On the firm side, beside the yearly firm-level variables, we add firm FEs to control for time-invariant characteristics that may influence both their cash balances and their credit conditions (e.g., business model and industry; column 3).[13] In addition, to control for time-varying demand confounders at the industry level, such as time-varying industry-specific liquidity needs that are linked to the business cycle (Shi 2015), we include industry*year FEs (column 4).[14] As with any FE identification, 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 estimation sample in column 1. The negative relationship between liquidity and the cost of credit is stable across these specifications, except for fees and commissions, where the coefficient becomes insignificant. Finally, in column 5 we include bank*firm FEs: neither the size nor the statistical significance of the coefficient change much.[15]

Looking at the economic magnitude of the results, the estimates suggest that a one-standard-deviation increase in cash holdings as a share of total assets (s.d. 13.3 percent) lowers the APRC on new term loans by up to 30 basis points, the rate on credit lines by up to 15 basis points, and the fees and commissions on credit lines by up to 16 euros per year, depending on the specifications. While the

[12] We have around 1,200 bank*year FEs.

[13] Firm FEs amount to about 50,000 FEs.

[14] This inclusion results in an addition of about 2,000 FEs.

[15] This is the most demanding estimation, which includes an additional 80,000 FEs, totaling up at about 120,000 FEs.

effect on fees and commissions is not particularly large, the effect on interest rates is economically significant when compared to their historical and cross-sectional means (4.8 percent for new term loans and 8.1 percent 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 the results on the interest rate on both new term loans and 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); and (iii) negatively related to cash flow—although positively to cash flow volatility—and growth in value-added. Moreover, the negative effect of liquidity is larger for larger firms, while leverage and industry do not seem to be relevant interaction factors. Fees and commissions are negatively related to creditworthiness and share of bank financing, while they increase in relation to firm size, cash flow, and cash flow volatility. Fees and commissions may move in the opposite direction 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 hoarding. For example, Ippolito, Ozdagli, and Perez-Orive (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 year FEs, as well as firm and bank controls. In order to account for the Nickell (1981) bias, we estimate the model using a one-step system GMM, where all explanatory variables are considered predetermined (except the time FEs) and instrumented accordingly with their own lags. We obtain virtually the same results.

We have also investigated how cash holdings affect the quantity, type, and maturity of bank loans (Table 6). According to our results, higher firm liquidity is associated with more term credit at all maturities, controlling for firm time-varying characteristics and bank time-varying FEs (columns 1, 2). At the same time, firms that are more liquid compared to their structural level (as captured by the cross-sectional average) tend to display lower levels of bank funding, possibly indicating a substitution between external and internal funds which underscores the bargaining role of liquidity (column 3).

### *3.1 Validating the Causal Effect of Liquidity: A Difference-in-Difference Exercise*

One issue that might complicate the interpretation of the results is the extent to which 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 soothe the 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 an increase is associated with a lower cost of credit in the future. This exercise also allows us to shed further light on the distinct signaling and bargaining roles of liquidity.

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 percent of GDP.[16] 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

[16]See Bank of Italy (2012).

## Table 6. Impact of Firm Liquidity on the Volumes of Credit

| *Dep. Variable Is:* | **Delta Log (Term Credit)** | | | **Delta Log (Credit Lines)** | | |
|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) |
| Liquidity $t-1$ | 0.0151*** | 0.0146*** | –0.0357*** | –0.0047*** | –0.0052*** | –0.0059** |
| | (0.004) | (0.003) | (0.006) | (0.001) | (0.001) | (0.002) |
| Obs. | 1,259,836 | 1,286,628 | 1,260,592 | 1,527,327 | 1,530,998 | 1,510,822 |
| $R^2$ | 0.015 | 0.027 | 0.141 | 0.004 | 0.018 | 0.104 |
| | **Delta Log (Term Credit with Maturity <= 1 year)** | | | **Delta Log (Term Credit with Maturity > 1 year)** | | |
| Liquidity $t-1$ | 0.0919*** | 0.1022*** | –0.0498*** | 0.0073** | 0.0065* | –0.0150*** |
| | (0.011) | (0.011) | (0.017) | (0.003) | (0.003) | (0.006) |
| Obs. | 437,961 | 440,309 | 420,797 | 1,056,597 | 1,081,602 | 1,054,044 |
| $R^2$ | 0.031 | 0.061 | 0.225 | 0.022 | 0.034 | 0.155 |
| *Firm Controls* | *yes* | *yes* | *yes* | *yes* | *yes* | *yes* |
| *Bank Controls* | *yes* | - | - | *yes* | - | - |
| *Macro Controls* | *yes* | - | - | *yes* | - | - |
| *Bank*Year FEs* | *no* | *yes* | *yes* | *no* | *yes* | *yes* |
| *Firm FEs* | *no* | *no* | *yes* | *no* | *no* | *yes* |

**Note**: This table presents estimates of the relation between liquidity and the yearly growth rate of the quantity of credit (term credit and credit lines), as well as, for term credit, with various credit maturities (short and long). 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 nonperforming 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 bank financing to total debt, ROA, investment rate, the log growth of value-added, and the log growth of labor cost. 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 to 2018. Errors are clustered at the firm level. Standard errors in parentheses. ***$p < 0.01$, **$p < 0.05$, *$p < 0.1$.

and, given uncertainty over payment delays, affecting firms' solvency, at least to some extent. The 2013 repayment act allotted an unprecedented amount of funds (40 billion euros, later expanded to 47 billion) to the payment of PA debts 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 sizably for some corporations but not for others, allowing us to observe whether this change affected the credit terms on new loans differently for affected and unaffected firms.[17]

We retrieve information on the PA payments via the Bank of Italy Business Outlook Survey (Sondtel).[18] 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 had been 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 for a repayment in 2013 or 2014 to the treatment group, regardless of whether they received the money by the time the survey was conducted.[19] 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 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.

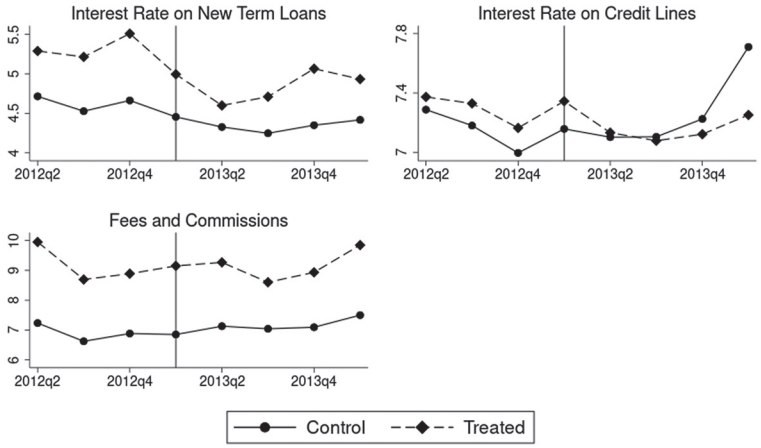
Figure 3 plots the outcome variables for the treated and the control group in a two-year window around the treatment quarter, which we take to be 2013:Q2 in line with the enactment date of the repayment act (April 2013). The evolution of the outcome variables

[17]For a detailed discussion on the exogeneity of the shock and how it "surprised" borrowers and lenders, see D'Aurizio and Depalo (2016).

[18]We thank Leandro D'Aurizio and Domenico Depalo for data sharing.

[19]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.

**Figure 3. 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 Noneligible Firms (Control Group)**




**Note:** 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 noneligible firms. It shows that 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 broadly parallel before the policy enactment, and they diverged afterward. This is less evident for fees and commissions on credit lines. Fees and commissions are in hundreds of euros. Source: CR-Taxia; Sondtel; Cerved®; authors' calculations. We thank Leandro D'Aurizio and Domenico Depalo for sharing data and codes on the repayments from the PA.

of the two groups is 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:

$$y_{f,b,t} = \beta_1(T_f P_t) + \beta_2(T_f) + FE_{ind} + FE_{prov} + FE_t + \beta_3 X_f + \beta_4 X_{b,t} + \varepsilon_{f,b,t}. \quad (1)$$

$y_{f,b,t}$ is the interest rate on new term loans (or the interest rate on credit lines or fees and commissions on credit lines) from bank $b$

to firm $f$ in quarter $t$. In this exercise we exploit our data set at the quarterly frequency, instead of annual, as we are no longer constrained by the yearly frequency of the firm liquidity variable. $\beta_1$ 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; $FE_{ind}$, $FE_{prov}$, and $FE_t$ are industry, province, and quarter FEs, respectively; $X_f$ is a vector of firm-level controls dating back to December 2011 in order to avoid reverse causality with the treatment.[20] $X_{b,t}$ are bank-level time-varying controls. While quarterly dummies soak up all macroeconomic variation at that frequency, industry and province FEs 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 7 shows the estimation results. Columns 1–3, 4–6, and 7–9 present the results using an increasingly longer sample for interest rates on new term loans, interest rates on credit lines, and fees and commissions, considering first one quarter before and after the enactment of the law (April 2013) to progressively encompass one year before and after it. There is a sizable and significant difference between treated and untreated firms before and after the treatment (D-in-D effect): after the change in regulation, the cost of credit for more liquid firms decreased by roughly 30 basis points for term loans and by approximately 15 basis points for credit lines. For interest rates on new term loans, the effect is significant two and three quarters after the entry into force of the law. The effect on interest rates on credit lines, by contrast, 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 liquidity has a positive effect on credit supply conditions. Moreover, the fact that the cash windfall was largely exogenous to firms implies that, in this context, firm liquidity cannot be taken by banks as a signal of other firm

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

## Table 7. Difference-in-Difference Estimates of the Effect of Firm Liquidity on the Cost of Credit

| *Dep. Variable Is:* | **Interest Rate on New Term Loans** | | | **Interest Rate on Credit Lines** | | | **Fees & Commissions** | | |
|---|---|---|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) |
| Quarters around the treatment date (2013:Q1) | ±2quart. | ±3quart. | ±4quart. | ±2quart. | ±3quart. | ±4quart. | ±2quart. | ±3quart. | ±4quart. |
| D-in-D effect: treatment*post | –0.3496* | –0.2815* | –0.2328 | 0.1664** | –0.1425** | –0.1336 | –19.5841 | –51.4085 | –73.5064 |
| | (0.1864) | (0.1526) | (0.1475) | (0.0759) | (0.0722) | (0.0000) | (33.6097) | (43.0959) | (0.0000) |
| Obs. | 7,762 | 11,642 | 15,284 | 28,499 | 42,659 | 56,820 | 28,499 | 42,659 | 56,896 |
| $R^2$ | 0.4072 | 0.4007 | 0.3840 | 0.2103 | 0.2032 | 0.2066 | 0.1265 | 0.1221 | 0.1145 |
| *Treatment Dummy* | *yes* | *yes* | *yes* | *yes* | *yes* | *yes* | *yes* | *yes* | *yes* |
| *Quarter Dummies* | *yes* | *yes* | *yes* | *yes* | *yes* | *yes* | *yes* | *yes* | *yes* |
| *Province Dummies* | *yes* | *yes* | *yes* | *yes* | *yes* | *yes* | *yes* | *yes* | *yes* |
| *Industry Dummies* | *yes* | *yes* | *yes* | *yes* | *yes* | *yes* | *yes* | *yes* | *yes* |
| *Firm Controls (2011)* | *yes* | *yes* | *yes* | *yes* | *yes* | *yes* | *yes* | *yes* | *yes* |
| *Bank Controls* | *yes* | *yes* | *yes* | *yes* | *yes* | *yes* | *yes* | *yes* | *yes* |

**Note**: 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, leverage, and ROA as of 2011. The sample period is 2006:Q1 to 2018:Q1. Errors are clustered at the firm level. Standard errors in parentheses. ***$p < 0.01$, **$p < 0.05$, *$p < 0.1$.

characteristics. Therefore, the results of these exercises support the bargaining/pledgeability role of liquidity (while not necessarily hindering its positive signaling role). Firms that received the exogenous cash windfall may have been able to negotiate better credit conditions with banks, either because they could credibly claim to be able to finance their investment with internal finance or because banks valued greater liquidity in the form of deposits as a form of partial collateral.

## 4. The Transmission of Monetary Policy through Firm Liquidity

In the second part of the analysis, we build on the positive relation of firm liquidity and the cost of credit to assess how this extends to the transmission of monetary policy.

### *4.1 Liquidity Holdings and the Slope of the Yield Curve*

The yield curve is a central element in the transmission of monetary policy (Drechsler, Savov, and Schnabl 2018). Standard and nonstandard monetary policy instruments affect the whole of the term structure, which in turn is a key determinant of asset prices in the economy (Diebold, Piazzesi, and Rudebusch 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. This adjustment leaves firms with with more or less bargaining power—as emerges from the findings in Section 3—which banks exploit to pass

on a different stimulus from that originally inputted by the central bank's action.

To empirically detect this pass-through heterogeneity, we need the following conditions to be true: i) that firm liquidity indeed varies with changes in the term structure; and ii) that the liquidity adjustments operated by firms in response to a yield curve shift are heterogeneous depending on their initial liquidity holdings. If this latter condition were not true, i.e., if all firms adjusted liquidity by the same amount in response to 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 their past values and on lagged indicators of the short- and long-term risk-free rates, which jointly determine the slope 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. The yield curve is generally a good approximation of the monetary policy stance; however, its longer end typically also reflects 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' expectations on selling prices, employment, and production. Table 8 shows the results using increasingly saturated specifications (firm, industry, year, and industry*year FEs).[21]

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 more profitable, so they want to hold larger liquidity buffers to minimize illiquidity and insolvency risks (Gryglewicz 2011). In addition, an increase in the EONIA rate (which would prompt a flattening of the yield curve) is associated with an increase in firms' cash balances due to a lower opportunity cost of holding liquidity.

[21]Regressions are progressively saturated with around 50,000 dummies, of which about 1,200 bank*year FEs, 50,000 firm FEs, 2,000 sector*year FEs.

**Table 8. Evolution of Firm Liquidity**

| *Dep. Variable Is:* | **Liquidity $t+1$** | | | |
|---|---|---|---|---|
| | (1) | (2) | (3) | (4) |
| Liquidity $t$ | 0.3478*** | 0.3478*** | 0.3464*** | 0.3417*** |
| | (0.006) | (0.006) | (0.006) | (0.006) |
| EONIA $t$ | 0.1806*** | 0.1762*** | | |
| | (0.018) | (0.018) | | |
| Liquidity $t$*EONIA $t$ | 0.0255*** | 0.0262*** | 0.0264*** | 0.0267*** |
| | (0.003) | (0.003) | (0.003) | (0.003) |
| EURIRS10Y $t$ | –0.4979*** | –0.4947*** | | |
| | (0.017) | (0.017) | | |
| Liquidity $t$*EURIRS10Y $t$ | –0.0345*** | –0.0353*** | –0.0350*** | –0.0342*** |
| | (0.003) | (0.003) | (0.003) | (0.003) |
| Obs. | 1,809,747 | 1,807,017 | 1,807,017 | 1,807,006 |
| $R^2$ | 0.760 | 0.759 | 0.759 | 0.761 |
| *Macro Controls* | *yes* | *yes* | *yes* | *yes* |
| *Firm Controls* | *yes* | *yes* | *yes* | *yes* |
| *Firm FEs* | *yes* | *yes* | *yes* | *yes* |
| *Industry FEs* | - | *yes* | *yes* | *yes* |
| *Year FEs* | - | - | *yes* | *yes* |
| *Industry*Year FEs* | - | - | - | *yes* |

**Note**: 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 data set collapsed at the yearly level; variables at other frequencies are computed 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 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 bank financing to total debt, ROA, investment rate, the log growth of value-added, and labor cost growth. Macro controls include yearly growth of real GDP, year-on-year change in the level of employment and firms' expectations. Sample period is 2006 to 2018. Errors are clustered at the firm*year level. Standard errors in parentheses. ***$p < 0.01$, **$p < 0.05$, *$p < 0.1$.

Conversely, an increase in the 10-year EURIRS is associated with a reduction in liquidity holdings. Finally, both effects are stronger for firms with ex ante higher cash balances, as evidenced by the coefficients of the interaction between the two risk-free rates and firm liquidity.[22] Therefore, the empirical results are consistent with the

[22]We have also estimated a specification in which firm liquidity is regressed on EONIA, 10-year EURIRS, liquidity at $t$–1 and liquidity at $t$–1 squared. We

following notions: (i) that liquidity holdings respond to changes in policy rates in line with the opportunity-cost motive (i.e., increasing when the curve flattens, and vice versa); and (ii) that such responses are stronger the higher the liquidity level. These findings create the premise for firm liquidity to interact with the transmission of monetary policy, in the way that we describe below.

### *4.2 Liquidity Holdings and the Transmission of Monetary Policy*

Relying on the insights and empirical results just discussed, we can now study whether 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 both short and long risk-free rates.[23]

Results are displayed in Table 9, which displays the estimation results for progressively tighter models.[24] Coherently with the first part of the analysis, liquidity retains its direct negative effect on the APRC charged on term loans (columns 1–4), as well as on the interest rate on credit lines (columns 5–8). 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, consistent with the fact that bank loan rates for firms are mostly priced off shorter maturities (Darracq Pariès, Maurin, and Moccero 2014), as well as a very small effect on credit lines due to their shorter maturity. The interaction EONIA*liquidity is negative and significant in practically all specifications. This means that when short-term rates increase (causing an increase in the cost of borrowing), the effect on the cost of credit is lower for more liquid firms. This is coherent with

find that previous-period liquidity has a positive effect on current liquidity, and the squared terms are small but positive, indicating decreasing returns (results available upon request).

[23]In this part of the analysis we look at the contemporaneous impact of short- and long-term risk-free rates on lending rates, while keeping all the remaining variables (including firm liquidity) lagged.

[24]The specifications include a wide range of FEs. In columns 2 and 6, there are approximately 140 bank FEs and about 50,000 firm FEs. In columns 3 and 7, around 1,200 bank*year FEs are added alongside the firm FEs. In columns 4 and 8, an additional 2,000 FEs capture variation at the industry*year level.

## Table 9. Impact of Firm Liquidity on the Transmission of Monetary Policy to the Cost of Credit

| *Dep. Variable Is:* | **Interest Rate on New Term Loans** | | | | **Interest Rate on Credit Lines** | | | |
|---|---|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
| Liquidity $t-1$ | –0.0410*** | –0.0363*** | –0.0354*** | –0.0347*** | –0.0239*** | –0.0315*** | –0.0303*** | –0.0296*** |
| | (0.001) | (0.001) | (0.001) | (0.001) | (0.002) | (0.001) | (0.001) | (0.001) |
| EONIA | 0.1356*** | 0.1294*** | | | 0.5821*** | 0.5650*** | | |
| | (0.019) | (0.015) | | | (0.019) | (0.012) | | |
| Liquidity | –0.0016** | –0.0027*** | –0.0027*** | –0.0022*** | 0.0000 | –0.0027*** | –0.0024*** | –0.0021*** |
| $t-1$*EONIA | (0.001) | (0.001) | (0.001) | (0.001) | (0.001) | (0.001) | (0.001) | (0.001) |
| EURIRS10Y | –0.1127*** | –0.3332*** | | | –0.0804*** | –0.3345*** | | |
| | (0.009) | (0.009) | | | (0.010) | (0.009) | | |
| Liquidity | 0.0080*** | 0.0100*** | 0.0100*** | 0.0101*** | 0.0041*** | 0.0090*** | 0.0085*** | 0.0081*** |
| $t-1$*EURIRS10Y | (0.001) | (0.001) | (0.001) | (0.001) | (0.001) | (0.001) | (0.001) | (0.001) |
| Obs. | 374,692 | 348,999 | 348,968 | 348,604 | 1,125,368 | 1,105,511 | 1,105,504 | 1,104,149 |
| $R^2$ | 0.400 | 0.664 | 0.680 | 0.685 | 0.134 | 0.474 | 0.485 | 0.487 |
| *Firm Controls* | *yes* | *yes* | *yes* | *yes* | *yes* | *yes* | *yes* | *yes* |
| *Bank Controls* | *yes* | *yes* | - | - | *yes* | *yes* | - | - |
| *Macro Controls* | *yes* | *yes* | - | - | *yes* | *yes* | - | - |
| *Bank FEs* | *no* | *yes* | - | - | *no* | *yes* | - | - |
| *Firm FEs* | *no* | *yes* | *yes* | *yes* | *no* | *yes* | *yes* | *yes* |
| *Bank*Year FEs* | *no* | *no* | *yes* | *yes* | *no* | *no* | *yes* | *yes* |
| *Industry*Year FEs* | *no* | *no* | *no* | *yes* | *no* | *no* | *no* | *yes* |

**Note**: This table presents estimates of the impact of changes in the short- and long-term reference rate on the cost of credit (rate on new term loans, rate 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 nonperforming 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 bank financing to total debt, ROA, investment rate, the log growth of value-added, and the log growth of labor cost. Macro controls include yearly growth of real GDP, yearly change in the level of employment, and firms' expectations. Sample period is 2006 to 2018. Errors are clustered at the firm level. Standard errors in parentheses. ***$p < 0.01$, **$p < 0.05$, *$p < 0.1$.

our hypothesis, i.e., that an increase in short-term rates, which flattens the yield curve and thus reduces liquidity's opportunity cost, prompts firms to increase their cash holdings, the more so the more liquid they are (Table 8); banks anticipate this liquidity increase, and respond by offering more favorable rates (i.e., by passing on less of the increase in rates) to more liquid firms. Thus, when short-term rates increase (and there is a flattening of the yield curve), average rates on loans increase, but they do so less 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 percent), we find that the pass-through to the APRC on term loans of a 100 basis point increase in EONIA is up to 4 basis points lower for the more liquid firm, compared to an average impact of EONIA on lending rates on term loans of about 11 basis points. In other words, the impact of EONIA on lending rates is about 33 percent weaker for the more liquid firm than for the less liquid one, i.e., one standard deviation apart. The pass-through on the interest rates on credit lines is also up to 4 basis points lower for the more liquid firm. In the context of the 2022–23 tightening cycle in the euro area, this implies that the transmission of the 450 basis point hike on term loans might have been up to 150 basis points weaker for more liquid firms.

The results hold symmetrically in case of a decrease in short-term rates, in which case average lending rates decrease 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 valued 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.

The results are confirmed overall when looking at the three-month EURIBOR as an alternative measure of short-term rates (see Table 10).

In an additional robustness check, we rely on the monetary policy shocks proposed by Jarociński and Karadi (2020), aggregated at quarterly frequency (see Section 2 for the construction of the quarterly data set). Results are displayed in Table 11. The Jarociński and Karadi (2020) monetary policy shocks are constructed in such a way that positive values represent a monetary policy easing and negative

## Table 10. Impact of Firm Liquidity on the Transmission of Monetary Policy to the Cost of Credit: 3m EURIBOR

| *Dep. Variable Is*: | **Interest Rate on New Term Loans** | | | | **Interest Rate on Credit Lines** | | | |
|---|---|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
| Liquidity $t-1$ | –0.0409*** | –0.0361*** | –0.0352*** | –0.0344*** | –0.0238*** | –0.0313*** | –0.0300*** | –0.0294*** |
| | (0.001) | (0.001) | (0.001) | (0.001) | (0.002) | (0.001) | (0.001) | (0.001) |
| EURIBOR3m | 0.1226*** | 0.1124*** | | | 0.5340*** | 0.5041*** | | |
| | (0.018) | (0.014) | | | (0.017) | (0.011) | | |
| Liquidity | –0.0013** | –0.0023*** | –0.0022*** | –0.0018** | 0.0001 | –0.0023*** | –0.0020*** | –0.0017*** |
| $t-1$*EURIBOR3m | (0.001) | (0.001) | (0.001) | (0.001) | (0.001) | (0.001) | (0.001) | (0.001) |
| EURIRS10Y | –0.1352*** | –0.3525*** | | | –0.1840*** | –0.4283** | | |
| | (0.010) | (0.010) | | | (0.011) | (0.009) | | |
| Liquidity | 0.0081*** | 0.0101*** | 0.0100*** | 0.0102*** | 0.0040*** | 0.0091*** | 0.0085*** | 0.0082*** |
| $t-1$*EURIRS10Y | (0.001) | (0.001) | (0.001) | (0.001) | (0.001) | (0.001) | (0.001) | (0.001) |
| Obs. | 374,692 | 348,999 | 348,968 | 348,604 | 1,125,368 | 1,105,511 | 1,105,504 | 1,104,149 |
| $R^2$ | 0.400 | 0.664 | 0.680 | 0.685 | 0.134 | 0.474 | 0.485 | 0.487 |
| *Firm Controls* | *yes* | *yes* | *yes* | *yes* | *yes* | *yes* | *yes* | *yes* |
| *Bank Controls* | *yes* | *yes* | - | - | *yes* | *yes* | - | - |
| *Macro Controls* | *yes* | *yes* | - | - | *yes* | *yes* | - | - |
| *Bank FEs* | *no* | *yes* | - | - | *no* | *yes* | - | - |
| *Firm FEs* | *no* | *yes* | *yes* | *yes* | *no* | *yes* | *yes* | *yes* |
| *Bank*Year FEs* | *no* | *no* | *yes* | *yes* | *no* | *no* | *yes* | *yes* |
| *Industry*Year FEs* | *no* | *no* | *no* | *yes* | *no* | *no* | *no* | *yes* |

**Note**: This table presents estimates of the impact of changes in the short- and long-term reference rate on the cost of credit (rate on new term loans, rate 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 nonperforming 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 bank financing to total debt, ROA, investment rate, the log growth of value-added, and the log growth of labor cost. Macro controls include yearly growth of real GDP, yearly change in the level of employment, and firms' expectations. Sample period is 2006 to 2018. Errors are clustered at the firm level. Standard errors in parentheses. ***$p < 0.01$, **$p < 0.05$, *$p < 0.1$.

## Table 11. Impact of Firm Liquidity on the Transmission of Monetary Policy to the Cost of Credit: Jarociński and Karadi Shocks

| *Dep. Variable Is:* | **Interest Rate on New Term Loans** | | | | **Interest Rate on Credit Lines** | | | |
|---|---|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
| Liquidity $t-1$ | –0.0341*** | –0.0283*** | –0.0269*** | –0.0253*** | –0.0173*** | –0.0180*** | –0.0172*** | –0.0171*** |
| | (0.001) | (0.001) | (0.001) | (0.001) | (0.001) | (0.001) | (0.001) | (0.001) |
| MP Shock | –1.4133*** | –1.0295*** | | | –0.5652*** | –0.5090*** | | |
| | (0.052) | (0.046) | | | (0.035) | (0.021) | | |
| Liquidity $t-1$*MP Shock | 0.0409*** | 0.0233*** | 0.0279*** | 0.0282*** | 0.0247*** | 0.0180*** | 0.0198*** | 0.0194*** |
| | (0.007) | (0.006) | (0.006) | (0.006) | (0.005) | (0.003) | (0.003) | (0.003) |
| Obs. | 657,354 | 631,718 | 631,405 | 630,886 | 3,408,962 | 3,402,486 | 3,402,460 | 3,398,536 |
| $R^2$ | 0.326 | 0.604 | 0.684 | 0.690 | 0.114 | 0.435 | 0.467 | 0.468 |
| *Firm Controls* | *yes* | *yes* | *yes* | *yes* | *yes* | *yes* | *yes* | *yes* |
| *Bank Controls* | *yes* | *yes* | - | - | *yes* | *yes* | - | - |
| *Macro Controls* | *yes* | *yes* | - | - | *yes* | *yes* | - | - |
| *Bank FEs* | *no* | *yes* | - | - | *no* | *yes* | - | - |
| *Firm FEs* | *no* | *yes* | *yes* | *yes* | *no* | *yes* | *yes* | *yes* |
| *Bank*Year FEs* | *no* | *no* | *yes* | *yes* | *no* | *no* | *yes* | *yes* |
| *Industry*Year FEs* | *no* | *no* | *no* | *yes* | *no* | *no* | *no* | *yes* |

**Note**: This table presents estimates of the impact of monetary policy shocks on the cost of credit (rate on new term loans, rate on credit lines). The monetary policy shocks are Jarociński and Karadi (2020) poor man's monetary policy shocks aggregated at quarterly frequency. 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 nonperforming 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 bank financing to total debt, ROA, investment rate, the log growth of value-added, and the log growth of labor cost. Macro controls include yearly growth of real GDP, yearly change in the level of employment, and firms' expectations. Sample period is 2006 to 2018. Errors are clustered at the firm level. Standard errors in parentheses. ***$p < 0.01$, **$p < 0.05$, *$p < 0.1$.

values indicate a tightening. Accordingly, the coefficient on the shock is negative and significant throughout all the columns, indicating that easing shocks negatively relate to the cost of credit. Liquidity continues to have a negative and significant effect on the dependent variable. The interaction between the two variables is positive, indicating that the negative relation between a positive shock and the cost of credit is more muted for high-liquidity firms, as these tend to reallocate liquidity away from their balances as monetary policy is eased (and the curve steepens). In terms of economic magnitude, a one-standard-deviation easing shock decreases the interest rate on term loans and on credit lines by 7 and 3 basis points, respectively. The effects on the cost of term loans and of credit lines are up to 3 and 2 basis points weaker, respectively, for firms that have one standard deviation of additional liquidity.

## 5. Discussion

The previous section shows that the relation between changes in the monetary policy rate and firm loan rates depends also 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, by contrast, is associated with an increase in cash balances, as the opportunity cost of holding them is lower (cf. Table 8 and discussion in the Introduction). As banks view increases in firms' liquid holdings favorably, a correlation emerges between a flattening of 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 firms (that enjoy less of the reduction in cost). Thus, in positive territory, when rate 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 between rate cuts (hikes) and steepening (flattening) of the yield curve became more blurred after 2014, when, following the deployment of negative interest rates and forward guidance, along with the implementation of the asset purchase programs, rate cuts below zero prompted a series of flattenings, not steepenings, of the yield curve (Grisse, Krogstrup, and Schumacher 2017; Christensen 2019). This effect was due to cuts often being 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 at this point the associated flattening of the yield curve prompted firms to increase their liquidity holdings (rather than decreasing them as they would have done if the cut had prompted a steepening of the curve). In line with the reasoning discussed in Section 4, as liquid firms increased liquidity after the cut, they should have obtained relatively better credit conditions (i.e., a larger decrease in the cost of credit).

To test this hypothesis, we replicate the analysis in the previous subsection for the subperiod 2014:Q3–2018:Q4 (results available upon request), interacting liquidity with a "flattening" variable, computed as the inverse of the slope of the yield curve (i.e., EONIA minus 10-year EURIBOR). We find that in this subperiod the flattening variable takes up a negative sign (consistent 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 impulse transmitted by the flattening was stronger for more liquid firms, i.e., that liquidity has an accelerating effect for the monetary policy stance. This result uncovers a novel synergy between fiscal and monetary policy that played out during the COVID-19 pandemic. By sustaining firm liquidity with the extraordinary measures deployed to support businesses'

activities, fiscal policy helped reinforce the accommodative impulse from the ECB.

Concluding, our analysis suggests that firms are viewed more favorably by banks after a flattening of the curve, by virtue of their liquidity hoarding prompted by the lower returns on long-term assets. However, a flattening may result from a tightening stance ("normal" times) or 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 latter case, firm liquidity will be an accelerator (i.e., more liquid firms will benefit from a larger decrease in the cost of credit). Similarly, a steepening of the yield curve, for instance caused by a reduction in the central bank's asset portfolio, will prompt firms to reduce their liquidity, which is viewed negatively by banks. This effect will amplify the transmission of short-term policy rate hikes, but dampen that of policy rate reduction.

## 6. Conclusion

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. In this paper we address this issue empirically, by looking at the credit conditions applied to firms with different levels of liquidity in Italy over the period 2006–18. Results are consistent with the view that liquidity helps firms to obtain cheaper bank funding. Thus, liquidity carries a positive signal for lenders, likely indicating that firms are perceived to have a high continuation value and store cash to respond to temporary illiquidity shocks. Liquidity may also be perceived favorably by lenders owing to its high pledgeability. In addition to this, ample cash balances may improve firms' bargaining power during the negotiation process with the bank.

We also show that firm liquidity interferes with the transmission of monetary policy rate changes to lending rates. Interestingly, this happens as changes in the yield curve prompt firms to rebalance their liquidity, increasing it after a flattening and reducing it after a steepening. Thus, in normal times, firm liquidity dampens the transmission of monetary policy.

Importantly, these findings give rise to a number of underexplored questions. First, they indicate that companies' overall funding mix may be relevant for the transmission of monetary policy, suggesting that future research could explore the traditional bank lending channel more deeply to study its interplay with firms' external and internal funding choices. Second, how the effect we identify plays out in the real economy remains an open question, in particular with respect to its impact on investment and growth and whether it affects the whole economy or is concentrated in certain sectors. Finally, the results suggest that credit conditions respond to more than changes in the short-term policy rate, and that the whole constellation of risk-free returns has to be considered in assessing the transmission of monetary policy.

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