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From purchases to exit: central bank interventions in corporate debt markets

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ABSTRACT

Central banks increasingly act as market-makers-of-last-resort, yet the impact and exit of such interventions remain poorly understood. Using euro-area data, we analyze the cycle of market freeze, intervention, and exit in short-term debt markets. A run on money market funds (MMFs) triggered a collapse in these markets in March 2020. Firms replaced only 27% of lost funding through credit lines. The European Central Bank intervened, fully replacing MMFs for some firms and allowing them to issue more debt at lower rates and longer maturities. After the ECB's exit, more-exposed firms faced higher yields (+20.2 bps), reduced MMF investments, and fewer new relationships. Credit line take-up did not materially change post-exit.

Keywords: Short-term corporate debt; market-maker-of-last resort; central bank intervention; exit; commercial paper; money market funds
JEL classification codes: G11; G23; G32; E58

Non-Technical Summary

The financial system underwent dramatic changes after the Great Financial Crisis; with the role of banks declining and the role of market-based financing and non-bank financial intermediaries growing. In response, central banks around the world have expanded their policy toolkit and, in times of market stress, have intervened in financial markets directly, deploying large-scale asset purchases and other tools to stabilize markets. Put differently, central banks no longer only act as a lender-of-last-resort to banks but also as a market-maker-of-last-resort.

We study the role of central banks as market-makers-of-last-resort by examining a full cycle of market collapse, central bank intervention and eventual exit in the euro-area commercial paper market during the COVID-19 pandemic. We start by documenting that in March 2020 the market for commercial paper—a key source of short-term funding for firms—collapsed due to a run on money market funds (MMFs), which had been the dominant investors in this market. As a result, many firms faced severe liquidity constraints, managing to replace only a fraction of the funding lost from MMFs through alternative sources such as bank credit lines.

The close links between money market funds and the issuer of commercial paper thus have adverse consequences in crisis times. The rapid decline in commercial paper issuance was driven at least in part by distressed money market funds. Put differently, frictions in money market funds affect the liquidity constraints that non-financial firms face.

The liquidity crisis prompted the ECB to intervene for the first time ever in the non-financial commercial paper market as part of the Pandemic Emergency Purchase Programme (PEPP). Over the first two months of the program, the ECB purchased €35 billion of commercial paper, accounting for more than 40% of the market's pre-crisis size. By analyzing unique securities- and firm-level data, our study demonstrates that firms whose commercial paper was eligible for ECB purchases significantly increased their issuance volumes, extended the maturity of their debt, and benefited from reduced borrowing costs compared to firms with ineligible paper. The intervention thus helped to stabilize the market.

We then proceed by analyzing the impact of the ECB's exit from the market. As the

central bank began to unwind its intervention in 2021 and ceased purchases entirely by 2023, firms that had been more dependent on the program faced steeper increases in borrowing costs and reduced investment from MMFs. These firms also formed fewer new relationships with MMFs, making them more vulnerable in a post-intervention environment.

These findings on central bank interventions and exits illustrate both the effectiveness of central bank interventions in restoring market stability during a crisis and the consequences when such support is withdrawn. The central bank intervention in commercial paper markets alleviated liquidity constraints and supported the recovery of these markets. Once the central bank exited the market, firms that relied more on the intervention faced higher yields, reduced investment from MMFs, and fewer new relationships. Overall, we contribute to a better understanding of how central bank interventions and the subsequent exit affect corporate debt markets.

1. Introduction

The financial system underwent dramatic changes after the Great Financial Crisis; with the role of banks declining and the role of market-based financing and non-bank financial intermediaries growing. With more than half of all financial assets now held outside the banking system, the financial system is seemingly more prone to severe market disruptions.

In response, central banks around the world have expanded their policy toolkit and, in times of market stress, have intervened in financial markets directly, deploying large-scale asset purchases and other tools to stabilize markets (see, e.g., Breckenfelder and Hoerova (2021), Haddad, Moreira, and Muir (2021), Li, Li, Machiavelli, and Zhou (2021), Vissing-Jorgensen (2021),Boyarchenko, Kovner, and Shachar (2022)). Put differently, central banks no longer only act as a lender-of-last-resort to banks but also as a market-maker-of-last-resort. Although market-maker-of-last-resort interventions have become more frequent, there remains limited evidence on their impact on markets and market participants, especially when it comes to the exit from such interventions and what their long-term impact on markets is.

This paper shows how stress in non-bank financial intermediaries deteriorates funding conditions for firms, how central bank entry can stabilize these short-term funding markets and what happens when the central bank exits the market. We use the March 2020 collapse in the euro-area commercial paper market for firms as a laboratory for our analysis. This is a perfect environment for our study as it allows us to analyze a full cycle of market collapse, central bank intervention and central bank exit, in a market that is of key importance for providing short-term liquidity to firms and that is heavily dependent on non-bank intermediaries.

To study these issues, we employ an extensive and unique combination of proprietary and commercial datasets available at the European Central Bank (ECB). Using the ECB's Securities Holdings Statistics, we document at the security level that Money Market Funds (MMFs) serve as critical non-bank intermediaries in the commercial paper market, which is a key short-term funding market for firms. We then combine these data with the Thomson Reuters Lipper database to link individual MMFs to firms issuing commercial paper. This

allows us to analyze how runs on individual MMFs affect firms' access to short-term liquidity. Furthermore, we employ the euro-area credit registry database (AnaCredit) to assess whether firms were able to compensate for the reduction in commercial paper by turning to bank credit. To study the impact of central bank purchases and exit, we rely on confidential data on ECB/Eurosystem security-level holdings of the relevant securities. Finally, we obtain firm-level data from Orbis and additional security-level information on yields, maturity etc. from the ECB's Centralized Securities Database.

We start by establishing that the collapse in the commercial paper market was driven by a run on money market funds (MMFs), key investors in this short-term funding market for firms. At the end of 2019, almost 60% of all outstanding non-financial euro-area commercial paper was held by euro-area money-market funds. In addition, commercial paper transactions are typically relationship-based: often one fund buys the entire issuance and holds it until maturity before renewing a similar arrangement with the same firm.

Our first main finding is that the dominant investor status of money market funds had a direct impact on commercial paper markets: funds experiencing outflows reduced their exposure to firms more than other funds. This result holds when comparing the changes in outstanding commercial paper from the same issuer at multiple money market funds (i.e., following a Khwaja and Mian (2008) type of setup). In this way, we ensure that our results cannot be attributed to firm-specific shocks to the demand for short-term credit that likely surfaced during the initial weeks of the COVID-19 pandemic. In other words, there was a direct spillover of the stress experienced by money market funds to the firms relying on these funds to buy their commercial paper. Additionally, we show that firms were not able to switch to other investors in commercial paper markets, nor were they able to substitute this drop in market funding with bank funding: firms were able to replace only 27 cents on each euro of maturing debt through bank credit lines.

In the face of a run on money market funds and a collapse in the key market for firm liquidity, the European Central Bank intervened by purchasing commercial paper under the Pandemic Emergency Purchase Program (PEPP), primarily in the primary market. The short-term impact on the commercial paper market was substantial. During the first two months of the program, net purchases of commercial paper under PEPP amounted to ap-

prox. 35 billion euro, or more than 40% of the amount outstanding at the end of 2019.[1]

We show that the PEPP intervention in commercial paper markets allowed firms to issue more commercial paper, at longer maturities, and at lower interest rates. To identify the impact of the PEPP we make use of the fact that not all commercial paper is eligible for purchase under the program.[2] We compare the issuance behavior of firms that issue eligible commercial paper to the behavior of firms that issue non-eligible commercial paper in a difference-in-differences setup around the introduction of the PEPP.

The key identifying assumption is that, conditional on a host of control variables, non-eligible commercial paper provides a good counterfactual for the issuance characteristics (volume, maturity, and yields) of eligible paper in the absence of the PEPP. The main threat to our identifying assumption is that the issuance behavior of eligible and non-eligible firms contain different time trends, which cannot be differenced out in a difference-in-differences setup. To limit this threat, we provide several pieces of evidence of parallel trends in issuance behavior of both groups before the introduction of PEPP. Most importantly, we show that issuing volumes are on a similar downward trend for both the eligible and non-eligible sample during the first weeks of March (i.e., at the onset of the COVID-19 crisis). This indicates that any difference in issuance behavior that we observe post-PEPP is unlikely to be caused by differential reactions to COVID-19, as this type of reaction should already be there during the first weeks of the pandemic as well. Additionally, comparing a host of balance sheet and P&L variables of eligible and non-eligible firms suggests that both groups were ex-ante very similar in terms of solvency and liquidity characteristics.

Our analysis shows that firms issuing eligible commercial paper increased outstanding amounts by around 20% over the first four weeks after the start of PEPP, compared to a decrease in outstanding amounts by 30% for firms issuing non-eligible commercial paper. Additionally, eligible firms increased the maturity at issuance by around 70%, relative to non-eligible firms. Eligible firms also managed to issue at a lower yield relative to non-eligible firms.

Finally, we turn to the exit of the central bank from the commercial paper market. Figure

[1] For comparison, total amount of outstanding commercial paper for non-financial companies at the end of 2019 was approx. 85 billion euro.

[2] For details regarding the eligibility criteria, see Section 2.

1 illustrates that the central bank's average holdings of eligible firms' commercial paper surged to over 70% during its interventionin 2020. In early 2021, as the central bank started exiting the short-term corporate debt market, these holdings began to decline, returning to near zero by 2023.

We study the impact of this staggered central bank exit on eligible firms' commercial paper issuance, the structure of this market and firms' reliance on bank credit lines. After exit, firms whose commercial paper was more frequently bought by the ECB pay a 33 basis points (bps) higher interest rate on newly issued paper, compared to the pre-intervention period. In contrast, the rate increase for firms that relied less on central bank purchases was limited to 13bps. Both the maturity of commercial paper issued after exit and the number of issuances was similar to the pre-intervention numbers, independent of the size of the PEPP intervention for the firm.

Holdings by money market funds also change: after exit, MMFs reduced their holdings of firms whose commercial paper was more frequently bought by the ECB compared to holdings of other eligible firms. Further, new relationships between firms and money market funds were formed during the exit period, though firms whose commercial paper was more frequently bought by the ECB established fewer new relationships.

Finally, while the introduction of the PEPP brought back credit line usage to pre-COVID-19 levels after the strong increase in the first quarter of 2020, the central banks' exit had no material long-term impact on credit line availability or take-up. In general, the Covid-19 episode did increase committed credit line amounts across the board without changing take-up levels. Thus, firms increased their credit line buffers against liquidity shocks.

Overall, our paper indicates that the close links between money market funds and the issuer of commercial paper have adverse consequences in crisis times: The rapid decline in commercial paper issuance was at least partly driven by distressed money market funds. Put differently, frictions in money market funds affect the liquidity constraints that non-financial firms face. The central bank intervention alleviated these constraints and supported the recovery of commercial paper markets. Once the central bank exited the market, firms that were more reliant on the intervention faced higher yields, reduced investment from MMFs, and fewer new relationships, indicating more challenging market conditions for those firms

post-intervention.

Our paper is related to several strands of literature. First, we contribute to the literature on central bank interventions in corporate debt markets, by studying the consequences of such interventions both for the supply and the demand side in the private market. Our data allows us to provide unique insights on the impact of a full cycle, from the market collapse, through the central bank intervention to what happens after the central bank exits. Existing work often focuses on secondary bond markets and documents how central bank purchases support market functioning and provide a liquidity backstop for commercial paper markets (e.g., Adrian, Marchioni, and Kimbrough (2011), Boyarchenko, Crump, and Kovner (2020), Boyarchenko, Kovner, and Shachar (2022)) and corporate bond markets (e.g., Falato, Goldstein, and Hortaçsu (2021), Gilchrist, Wei, Yue, and Zakrajšek (2024), O'Hara and Zhou (2021)). Several papers examine central bank liquidity backstops for broker-dealers and other financial intermediaries (Duygan-Bump, Parkinson, Rosengren, Suarez, and Willen (2013), Acharya, Fleming, Hrung, and Sarkar (2017), Carlson and Macchiavelli (2020), Cipriani, Anadu, Craver, and Spada (2022)).[3] Adding to this literature, we provide an in-depth, firm-level analysis of how central bank purchases affect issuance conditions for firms in primary markets. We also detail what happens once the central banks exits, a topic on which empirical evidence is particularly scarce.

Second, we contribute to the literature on the growing importance of non-banks in providing funding to corporates. We provide evidence on the importance of money market funds for the functioning of commercial paper markets. Using detailed, security-level information on commercial paper holdings we show how liquidity shocks to money market funds can spill over to non-financial firms. Earlier work shows that, for large firms, commercial paper constitutes an important part of firms' short-term funding instruments (Colla, Ippolito, and Li (2013)), that firms use commercial paper to provide start-up financing for capital investment (Kahl, Shivdasani, and Wang (2015)), and that firms systematically reduce their outstanding short-term debt on quarterly and annual disclosure dates (Klingler,

[3]Covitz and Downing (2007) study the determinants of very short-term corporate yield spreads using a comprehensive database on transactions of commercial paper issued by domestic U.S. nonfinancial corporations over 1998-2003. Covitz, Liang, and Suarez (2013) study "runs" on asset-backed commercial paper programs in 2007 (those programs financed a wide range of assets beyond nonfinancial companies, including highly rated mortgage- and other asset-backed securities).

Syrstad, and Vuillemey (2021)). Most closely related to our work is Lugo (2021), who argues that demand by money market funds for commercial paper affects firms' use of short-term debt. Also related is Zhu (2021). He documents that holders of a firm's existing bonds are more likely to invest in additional new issuance from the same firm, and shows that strong bondholder flows predict a higher probability that a firm will issue new bonds. We document strong ties between funds and firms through commercial paper holdings and study the direct spillover effects from large outflows in money market funds to commercial paper issuers. We also document how central bank interventions in commercial paper markets can alleviate these spillover effects.

Third, our paper relates to a broader strand of papers investigating the behavior of – and the fragility in - mutual funds. Conceptually, fragility in mutual funds has been linked to the liquidity transformation provided to fund investors, the relative illiquidity of fund assets, and possible complementarities in actions of fund investors (e.g., Chen, Goldstein, and Jiang (2010), Goldstein, Jiang, and Ng (2017), Schmidt, Timmermann, and Wermers (2016), Zeng (2017)). There are, therefore, some similarities with liquidity services provided by banks and the associated fragility (e.g., Diamond and Dybvig (1983), Goldstein and Pauzner (2005)). Ma, Xiao, and Zeng (2022) provide a framework to study the role of bank debt versus mutual fund equity in liquidity transformation. Eisenbach and Phelan (2022) construct a model to explain how strategic investor behavior can create fragility in safe asset markets. Recently, several papers investigated how mutual funds fared during the COVID-19 crisis (e.g., Breckenfelder and Ivashina (2021), Cipriani and Spada (2020), Falato, Goldstein, and Hortaçsu (2021), Giannetti and Jotikasthira (2021), Haddad, Moreira, and Muir (2021), Jiang, Li, Sun, and Wang (2022), Ma, Xiao, and Zeng (2022) and Pastor and Vorsatz (2020)). Our paper is unique in that it focusses on money market funds, commercial paper markets and the ECBs PEPP program, and provides a security-level analysis on the impact of fund outflows on commercial paper issuance, and their terms and conditions.

Finally, given the focus on money market funds during crisis times, our work is also related to several papers that studied runs on money market funds in 2008 (e.g., Kacperczyk and Schnabl (2013), McCabe (2010), Schmidt, Timmermann, and Wermers (2016), Strahan and Tanyeri (2015)) and on prime funds in 2011 (e.g.,Chernenko and Sunderam (2014),

Ivashina, Scharfstein, and Stein (2015), and Gallagher, Schmidt, Timmermann, and Wermers (2020)). [4]

The remainder of the paper is organized as follows. In Section 2, we provide institutional details on the European commercial paper market and the Pandemic Emergency Purchase Program. In Section 3, we describe the data we use. In Section 4, we outline our empirical strategy. In Section 5, we present the results. Section 6 concludes.

2. The ECB's Pandemic Emergency Purchase Program (PEPP): Institutional background

The World Health Organization declared the COVID-19 outbreak as a global pandemic in the second week of March 2020. Simultaneously, the associated financial market turmoil also reached the commercial paper market (Figure 2).

The March 2020 liquidity crisis prompted the ECB to intervene for the first time ever in the non-financial commercial paper market as part of the Pandemic Emergency Purchase Program (PEPP). The goals were three-fold (de Guindos and Schnabel (2020)): (i) ensuring monetary policy transmission through commercial paper to firms through easing the financing conditions for short-term liquidity needs of non-financial companies, (ii) restoring demand for commercial paper by private sector counterparties, and (iii) incentivising firms to issue commercial paper, thereby reducing their dependence on bank-based finance. The idea was that non-financial corporations would expand their short-term market-based borrowing as banks were reluctant to lend. More market-based funding by some firms would also free up lending capacities of banks that would benefit other firms for which banks play an important role.

The intervention in the commercial paper market was significant: During the first two months of the program, net purchases of commercial paper under PEPP amounted to approx. 35 billion euro, of which 81 % was bought on primary markets. For comparison, net purchases of corporate bonds over that same period were less than one third of this amount

[4] In addition, the literature has examined the effects of post-crisis MMF regulations and reforms (e.g., Li, Li, Machiavelli, and Zhou (2021), Hanson, Scharfstein, and Sunderam (2015), McCabe, Cipriani, Holscher, and Martin (2013), Cipriani, Martin, McCabe, and Parigi (2014), Lenkey and Song (2016), Cipriani and Spada (2021).

(10.5 billion euro), which illustrates the importance of the commercial paper purchases for the corporate sector part of PEPP in the initial phase of the crisis.[5]

The eligibility criteria for commercial paper purchases by the Eurosystem are similar to those of other securities: a security needs to: a) be investment grade (i.e., have a minimum credit assessment of at least BBB-); b) be issued by a private or public sector entity residing in the euro area; c) be denominated in EUR; d) have a yield greater than the deposit facility rate (DFR); e) have a maximum residual maturity of 30 years and 264 days and a minimum residual maturity of 28 days; and f) the issuer cannot be a credit institutions, the issuer does not have any parent undertaking, which is a credit institution, and/or the issuer is not an asset management vehicle or national asset management and divestment fund established to support financial sector restructuring or resolution.

The timeline of ECB interventions to counter the escalating financial market tensions looked as follows: On March 12, the ECB announced the expansion of the existing Asset Purchase Program (APP), which did not include any commercial paper purchases. On March 18, the ECB announced the Pandemic Emergency Purchase Program (PEPP), with an initial envelope of 750 billion EUR (extension by an additional 600 billion EUR on June 4). A key difference between PEPP and the existing APP was that purchases were conducted in a flexible manner, which allows for fluctuations in the distribution of purchase flows over time, across asset classes and among jurisdictions, and that the purchase of commercial paper under this program was allowed. On March 25, the legal documentation of the PEPP was published. First purchases were conducted on March 26, 2020.

3. Data and sample construction

The goal of our analysis is to understand whether and how stress in money market funds spilled over to commercial paper markets, which role the ECB's Pandemic Purchase Program (PEPP) played in the recovery of commercial paper markets, and what happened after the ECB exited the market. To do so, we combine data on commercial paper issuances, fund flows, fund holdings of commercial paper and firm balance sheet and P&L info.

[5]Purchases of public bonds over that period amounted to 186.6 billion euro.

We start by selecting all euro-area non-financial firms that have euro-denominated commercial paper outstanding between February 28, 2020, and May 31, 2020. We extract this information from the ECB's Centralised Securities Database (CSDB). The CSDB is a security-by-security level Eurosystem database that contains data on instruments and issuers including issuance volume, maturity and issuance date, security type (e.g., zero coupon), currency, ratings, and issuer information (location, issuer organization).

For each ISIN-level issuance of these firms, we collect information on the volume issued, issue date, maturity, and interest rate. We further enrich the CSDB data with information on whether the issuance appears in the list of assets that are eligible to use as collateral in transactions with the ECB.[6] Euro-denominated commercial paper issued by non-financial firms established in the euro area that can be used as collateral in transactions with the ECB is eligible for PEPP. Finally, we download firm-specific balance sheet and P&L information from Bureau van Dijk's Orbis database. For each firm, we collect information on its total assets, leverage, and cash holdings for the accounting year 2019.

Next, we match these issuances with the commercial paper held by money market funds. We collect fund holdings data from the Thomson Reuter Lipper Database. We retrieve fund-level data on outflows, performance, and ISIN-level portfolio holdings. Fund flow information, total net assets (TNA) and trading prices, are available at daily frequency. ISIN-level fund holdings information is available at monthly frequency. We observe the portfolio holdings at market valuation and as shares of the fund's total holding. Lipper sources the portfolio holdings directly from the fund management companies. Unavailable fund holdings are typically linked to non-disclosure agreements and embargo periods. We compute daily net fund flows variable as is standard in the literature (see, e.g., Falato, Goldstein, and Hortaçsu (2021)):

$$flows_{i,t} = (TNA_{i,t} - (1 + r_{i,t}) * TNA_{i,t-1})/TNA_{i,t-1}, \quad (1)$$

where $TNA_{i,t}$ is total net assets of fund i at day t and $r_{i,t}$ is the fund's daily return. We analyze flows on a fund-share level.

For each money market fund, we calculate the net fund flow between February 28, 2020,

[6] see https://www.ecb.europa.eu/paym/coll/assets/html/list-MID.en.html

and March 31, 2020. Additionally, we calculate a weighted fund flow at the firm level, using the share of outstanding commercial paper of a firm that is held by a money market fund on February 28, 2020 as weights. In other words, for each firm f, the firm-level fund flow captures the fund flow between end of February and end of March of all funds that were holding firm f's commercial paper at the end of February.

Summary statistics on all ISIN-level variables can be found in the upper panel of Table 1. Firm-fund level statistics are in the middle panel, while the lower panel includes summary statistics on all firm-level variables used in our analysis.

4. Empirical setup and identification strategy

To investigate whether outflows from money market funds affected commercial paper issuances during March 2020, we run the following regression specification:

$$Log(amount\ outstanding)_{i,f,t} = \alpha + \beta \times Negative\ Fundflow_i \times Post_t + \delta_{f,t} + \gamma_i + \varepsilon_{i,f,t}, \quad (2)$$

The regressions includes data from two points in time: t is either February 28, 2020 or March 31, 2020. $Log(amount\ outstanding)_{i,f,t}$ is the outstanding amount of commercial paper of firm f held by fund i at time t. $Negative\ Fundflow_i$ is a dummy equal to one if the fund flow for fund i was negative between February 28, 2020 and March 31, 2020. $\delta_{f,t}$ denotes a firm-time fixed effect, γ_i represents a fund fixed effect.

This setup with firm-time fixed effects allows us to analyze how differences in fund flows between funds affect their commercial paper holdings of the same firm. In this way, we ensure that our estimates of β are not affected by firm-specific demand for short-term credit. In additional tests, we also interact the $Negative\ Fundflow_i$ dummy with firm-specific characteristics to analyze the heterogeneous impact of fund flows across firms.

Next, we study whether being exposed to funds with negative flows also implies a reduction in outstanding commercial paper at the firm-level (as opposed to at the firm-fund level in equation (2)). In this way, we can track whether firms exposed to a negative shock from one or more funds could still find alternative buyers for their commercial paper (e.g., funds

that did not experience a negative shock or other investors such as banks, insurance companies etc.). For each firm f the firm-level fund flow captures the weighted fund flow between end of February and end of March of all funds that were holding firm f's commercial paper at the end of February. We then run the following specification at the firm-level:

$$Y_f = \alpha + \beta \times Negative\ Fundflow_f + \delta \times X_f + \varepsilon_f, \tag{3}$$

where Y_f is an outcome variable reflecting either a dummy variable equal to one if a firm managed to fully rollover all commercial paper maturing between February 28, 2020, and March 31, 2020, or the growth in outstanding commercial paper over the same time period. $Negative\ Fundflow_f$ is a weighted average of the fund flow over the same period of all funds that were holding firm f's commercial paper at the end of January 2020 (see Section 3). X_f denotes a set of firm-level control variables, including the logarithm of a firm's total assets, its leverage ratio, and its return on assets, all for the accounting year 2019. In our most stringent specification, we also include fixed effects that control for how severely a firm's sector was exposed to the COVID-19 crisis. To do so, we group sectors in 5 buckets: (i) essential and fully active sectors, (ii) active but teleworking sectors, (iii) partly essential and partly active, (iv) non-essential and partly active, and (v) closed. The classification is based on Fana, Fernandez-Macias, Tolan, Torrejon, and Brancati (2020).

The next question we address is whether the ECB's Pandemic Purchase Program (PEPP) affected the recovery of commercial paper markets that took place from April 2020 onwards. To do so, we use a difference-in-differences framework in which we compare the issuance of eligible and non-eligible commercial paper before and after the introduction of the PEPP. As described in Section 2, commercial paper must meet several criteria to be eligible for purchase by the ECB under the PEPP. Comparing the issuance of these eligible bonds with the issuance of non-eligible bonds should thus give us an estimate of the impact of the PEPP. As such, we estimate the following baseline specification:

$$Y_{i,f,t} = \alpha + \beta \times Post_t \times Eligible_{f,t} + \delta \times Post_t + \gamma_f + \varepsilon_{i,f,t}, \tag{4}$$

where $Y_{i,f,t}$ is an outcome variable reflecting either the logarithm of the volume of com-

mercial paper issued via security i (ISIN-level) by firm f at day t, the log of the maturity of that issuance or the yield of that issuance. $Eligible_f$ is a dummy defined at the firm-level that is equal to one if the firm at any point in time has issued commercial paper that is eligible under the PEPP program. $Post_t$ is a dummy equal to one from March 26, 2020, onwards, and γ is a firm fixed effect. This setup thus compares issuance behavior of firms that issue commercial paper eligible under PEPP, with firms issueing non-eligible paper. In the most conservative setup, we replace the post dummy with a week fixed effect. To limit the influence of confounding events, we use a relatively short window of 4 weeks before and 4 weeks after the implementation date of the PEPP (March 26, 2020). Standard errors are clustered at the firm level.

The key identifying assumption underlying our analysis is that, conditional on firm and time fixed effects, non-eligible commercial paper provides a good counterfactual for the issuance characteristics (volume, maturity, and yields) of eligible paper in the absence of the PEPP. In that case, the estimate of β in regression (4) gives the causal impact of the PEPP on commercial paper characteristics.

The main threat to this assumption is that the issuance behavior of eligible and non-eligible firms contain different time trends, which cannot be differenced out in a difference-in-differences setup. Figures 3 and 4 indicate that this is unlikely to be the case: for both the eligible and non-eligible sample, the volume of outstanding commercial paper (Figure 3) and accordingly the volume of weekly issuances (Figure 4) evolve in a very similar way before the introduction of the PEPP. Importantly, this also holds in the first weeks of March, when issuance volumes start to deteriorate. The fact that volumes are on a similar downward trend for both the eligible and non-eligible sample indicates that any differences in issuance behavior that we observe post-PEPP are unlikely to be caused by differential reactions to COVID-19, as this type of reaction should already be there during the first weeks of the pandemic as well.

Additionally, Table A1 in Appendix suggests that eligible and non-eligible firms are not that different in terms of solvency and liquidity characteristics. The table provides the results for a t-test that compares 2019 balance sheet data between eligible and non-eligible firms. While eligible firms are significantly larger than non-eligible firms, both group of

firms are not significantly different from each other when it comes to firm leverage, interest coverage (measured as Ebitda over interest expenses), profitability (return on assets) or liquidity (current assets minus inventories over current liabilities). Non-eligible firms are thus not fundamentally weaker firms. This helps to ensure that our analysis captures the impact of PEPP on issuance behavior, and not the consequences of differences in investor behavior towards firms' commercial paper depending on fundamental firm characteristics.

Lastly, we analyze the exit of the ECB from the commercial paper market. For each firm f we calculate end-of-quarter dependent variables from March 31, 2018 to March 31, 2023. Holdings by the central bank on security level are reported quarterly to the Securities Holdings Statistics. We then run the following specification at the firm-level:

$$\begin{aligned} Y_{\mathrm{f,t}} =& \beta_1 CB\ exposure_{\mathrm{f}} \times PEPP\ period_{\mathrm{f,t}} + \beta_2 CB\ exposure_{\mathrm{f}} \times EXIT\ period_{\mathrm{f,t}} \\ &+ \gamma_1 PEPP\ period_{\mathrm{f,t}} + \gamma_2 EXIT\ period_{\mathrm{f,t}} + \delta \times X_f + \varepsilon_{\mathrm{f,t}}, \end{aligned} \tag{5}$$

where $Y_{f,t}$ is an outcome variable reflecting either firm-level yields, maturity, money market fund (MMF) holdings, total main investor holdings (MMF + central bank), number of commercial paper issuances, and number of new investor relationships of commercial paper.

$CB\ exposure_f$ measures a firm's exposure to the central bank intervention. It is 1 for firms with above-median exposure and 0 otherwise. The exposure is measured at the firm level as the maximum proportion of the firm's total outstanding commercial paper held by the central bank. The central bank held significant shares of eligible firms, with a median exposure of 0.78. The average exposure of the high-exposure firms is 0.94, while that of the lower-exposure firms is 0.62. The large share of commercial paper held by the central bank—even for the relatively less-exposed firms—indicates that the two groups of firms were similarly held, except that the higher-exposure group was nearly disconnected from other investors at some point during the central bank intervention when almost 100% of their commercial paper was held by the central bank.

$PEPP\ period_{f,t}$ takes the value 1 if the central bank holds a positive share of the firm's outstanding commercial paper at a given point in time, and 0 otherwise. $EXIT\ period_{f,t}$ takes

the value 1 if the central bank's holding of the firm's outstanding commercial paper goes to zero and thereafter, and 0 otherwise. X_f represents firm fixed effects.

The estimates β_1 and β_2 give the differential between the more-exposed versus less-exposed firms for the PEPP period and EXIT period relative to the period before PEPP. γ_1 and γ_2 depict the level effects for both groups during the PEPP period and EXIT period, respectively, relative to the period before PEPP.

The regression setup above allows interpreting the level effects during the intervention and exit periods. However, we cannot exclude the possibility that the time dimension is influencing the results. To address this concern, we incorporate time fixed effects, isolating variation independent of the time component. Additionally, we remove variation associated with the distance to the central bank's exit for each firm. These stringent controls allow comparisons between firms where the exit has already occurred and those where it has not yet occurred. In other words, using the timing of exits allows us to exploit the staggered nature of the central bank's exit on firm level. The model employed to study this is defined as follows:

$$\begin{aligned} Y_{f,t} =& \beta_1 CB\ exposure_f \times PEPPperiod_{f,t} \\ &+ \beta_2 CBexposure_f \times EXITperiod_{f,t} + \mu_t + \delta \times X_{f,t} + \varepsilon_{f,t}, \end{aligned} \tag{6}$$

where most of the variables are similar to those of Equation (5), except μ_t now captures time fixed effects and $X_{f,t}$ is now time-varying and includes dummies for the distance to exit. The distance to exit is calculated as the number of firm-level periods away from exit. For instance, we control for 2 quarters post-exit or 2 quarters before exit, etc. With this regression setup, we compare firms within the same quarter where the central bank has already exited versus those where the central bank has not yet exited, while controlling for how close or how far the exit is for a given firm. This is a stringent specification that allows us to examine the interaction between more-exposed and less-exposed firms. The level effects are perfectly colinear with the fixed effects and therefore dropped.

We end by analysing the impact of ECB exit on firms' credit line usage. To that end, we estimate the following specification:

$$Y_{f,t} = \beta_1 2020Q1_t + \beta_2 PEPP\ period_{f,t} + \beta_3 EXIT\ period_{f,t} + \delta_f + \varepsilon_{f,t}, \quad (7)$$

where $Y_{f,t}$ is an outcome variable reflecting either the maximum amount that can be drawn by a firm from a credit line, the amount of credit that a firm is drawing from a credit line, or the total amount of a credit line that is undrawn. $2020Q1_t$ is a dummy equal to one during the first quarter of 2020 (i.e., the onset of the COVID-19 crisis). The variable $PEPP\ period_{f,t}$ represents the time from the initiation of the PEPP until the ECB's exit for a given firm, while $EXIT\ period_{f,t}$ denotes the four quarters following the ECB's complete divestment from the firm's commercial paper.

5. Results

Following several lock downs across Europe in early March 2020, conditions in commercial paper markets in Europe started to deteriorate from mid-March onwards. While the total amount of outstanding commercial paper for non-financial companies had been growing steadily since the start of the year, it dropped by more than 13% between March 16 and March 26 (Figure 2), as firms could no longer rollover their maturing short-term debt.

The number of non-financial companies able to issue commercial paper dropped even more strongly over that same period. In the week of 9 to 13 March 9, 88 firms issued commercial paper. This dropped to only 38 firms in the last week of March, or a reduction of almost 60%. Unsurprisingly, the number of issuances dropped from around 175 a week in early March to around 50 in the last week of March (Figure 5a). Correspondingly, total weekly issuance volumes dropped from more than 8 billion EUR to below 2 billion EUR (Figure 5b).

After the introduction of the ECBs Pandemic Emergency Purchase Program (PEPP), issuance volumes rebounded from April onwards. By the end of April, the number of weekly issuances hovered around 150, while the aggregate weekly issuance volumes were back above 8 billion EUR.

In what follows, we analyze what is driving the sharp decrease in commercial paper issuances, whether and how the PEPP affected the recovery, and what happened once the central bank exited the market.

5.1 Fund flows and commercial paper issuances

In this section, we relate the drop in commercial paper issuance in March 2020 (as documented in Figure 5a and 5b) to outflows experienced by money market funds during that same period.

Money market funds were pivotal for the liquidity dry-up in commercial paper markets for at least two reasons. First, money market funds are key investors in European commercial paper. For example, European money market funds were holding almost 60% of all outstanding, euro-denominated non-financial commercial paper at the end of 2019. For comparison, the second largest holding sector was the investment fund sector at that point in time, but with a significantly lower holding share of 13%.

Second, European money market funds experienced severe stress at the start of the COVID-19 crisis, suffering large outflows during the second half of March 2020. Figure 6 documents aggregate net fund flows between the end of January 2020 and the end of July 2020, relative to January 30. While money market funds initially experienced an inflow in February and early March 2020, they faced an aggregate outflow of around 4% by the end of March.[7]

The outflows from money market funds (i.e., a reduction in their liabilities) must be matched by a reduction on the asset side of the fund. Funds can either reduce their cash buffers, sell securities, or stop rolling over maturing securities. If funds choose the latter option this could potentially lead to liquidity problems for firms, given the fact that commercial paper by construction tends to be very short-term paper, and thus must be rolled over frequently. Additionally, Zhu (2021) shows that (mutual) funds that hold a firm's existing bonds have a high propensity to acquire additional new issuances from the same firm, indicating that it might be difficult for commercial paper issuers to switch to new investors

[7]The inflow in February and early March is likely due to investors switching from (long-term) investment funds to more liquid money market funds. See e.g., Breckenfelder and Hoerova (2021) for more on outflow in investment fund around the COVID-19 crisis.

(especially during crisis periods).

Below, we first analyze the link between a fund's outflows and commercial paper issuance of firms whose commercial paper is held by that fund. After that, we analyze whether firms can easily switch to selling commercial paper to other funds, or can substitute their commercial paper by drawing down credit lines.

5.1.1 Fund flows and commercial paper issuance at the firm-fund level

Table 2 directly links the outflows from money market funds to the issuance of commercial paper. It shows the regression results for specification (2). The dependent variable is the logarithm of the amount of commercial paper issued by a firm f that is being held by fund i, either at February 28, 2020 or at March 31, 2020. The explanatory variable of interest is the interaction between *Negative flow*, a dummy equal to one if the fund flow for fund i was negative between February 28, 2020 and March 31, 2020, and the *Post* dummy, which is equal to one for all March 31 observations.

The point estimate for the coefficient on the interaction term of -0.227 in column 1 of Table 2 implies that funds facing outflows in March 2020 reduced their commercial paper exposure to the average firm with 22.7 % between the end of February and the end of March. In column 2, we add firm-time fixed effects to the specification. This ensures that our main coefficient is not affected by firm-level changes in the demand for short-term debt over time. Effectively, we are comparing the holdings of two or more funds of the commercial paper of the same firm, and analyze how these holdings evolve between February 28 and March 31, 2020. The point estimate on the interaction term is now -0.16, and still statistically and economically significant. Finally, in column 3 we also include fund fixed effects, to control of any fund-specific characteristics that could affect their commercial paper holdings. The results for this specification imply that funds reduced their commercial paper exposure to the average firm with around 13%. Overall, the analysis in Table 2 confirms that there are strong spillovers from outflows in money market funds to the issuance behavior of non-financial firms.

Next, we examine whether this reduction in short-term credit supply of funds to firms is stronger for some firms than for others. We again use a setup with firm-time fixed effects

to control for the impact of demand for short-term credit. To capture heterogeneity across firms, we interact our *Negative flow* and *Post* dummy with a set of firm characteristics. In particular, we analyze interactions with firm size (measured by total assets), leverage, profitability (measured by return on assets), and financial risk (measured by interest coverage ratio). For all these characteristics, we create a dummy variable equal to one when the firm is in the highest tercile of the distribution of that characteristic. Additionally, we also create a dummy variable capturing whether the firm operates in an industry that was hit hard by the COVID-19 crisis.[8]

The results in Table 3 indicate that the reduction in commercial paper held by funds hit by an outflow is significantly higher for firms that were particularly exposed to the COVID-19 crisis and for small firms. While firms with a low COVID-exposure experience a relative reduction in commercial paper held by funds that face an outflow of 8.5%, this further drops to close to 24% for firms heavily exposed to COVID-19 (column 1 of Table 3). Similarly, we don't find a significant relative reduction in funds' holdings of large firms, while funds faced by outflows do reduce their exposure to the average small firm with around 20%. Other firm-specific characteristics are not taking into account by money market funds when reducing their commercial paper exposures in March 2020. The stronger reduction in exposure to small and covid-hit firms suggests a flight-to-safety of the money markets funds.

5.1.2 Switching to other commercial paper investors or drawing down credit lines

The next question that arises is whether firms that experience a reduction in demand for their short-term debt by their go-to funds can compensate this by selling their debt to other funds or other investors. To test this, we analyze the changes in outstanding commercial paper at the firm level (as opposed to at the firm-fund level in the above analysis). Table 4 shows the result for estimating equation (6). In the first three columns of this table, we regress a rollover dummy on a firm-level *Negative flow* dummy. The former is equal to one if a firm is able to rollover its maturing commercial paper between February 29, 2020 and

[8] We use the classification from Fana, Fernandez-Macias, Tolan, Torrejon, and Brancati (2020) and define a COVID-19 sector in case a sector is defined as non-essential and with many closures (category 5 of the classification) such as hotels, restaurants, etc.

March 31, 2020. The *Negative flow* dummy is equal to 1 if the average weighted net fund flows of all funds that hold commercial paper of a firm on February 28, 2020 was negative between February 28 and March 31, 2020.

Column 1 of Table 4 shows that firms borrowing from funds facing a negative flow are 30 percent less likely to rollover their outstanding commercial paper in March 2020. Adding a number of firm-level control variables and either covid-sector (column 2) or covid-sector-country fixed effects (column 3) do not materially change this results, as we still get a rollover probability that is 28 percent lower for firms exposed to funds that face outflows.[9] Similarly, columns 4 to 6 show that the results also hold when using the firm-level growth in outstanding commercial paper as dependent variable. The growth rate for firms borrowing from funds that face outflows have growth rates that are between 38 and 50 percent lower than other firms.

Having established that the collapse of the commercial paper market was driven primarily by the run on MMFs, we ask whether firms could substitute MMF funding with other sources. An important source of short-term funding are bank credit lines (see, e.g., Li, Strahan, and Zhang (2020)). We obtain monthly data on firms' credit lines from AnaCredit, the euro-area wide credit registry. For each firm that issues commercial paper, we calculate the monthly change in credit line take-up for each month from January 2020 to May 2020 (Δ *credit line take-up*). We relate this firm-level take-up to the firm-level difference between the total amount of commercial paper maturing in a month and the total amount issued (Δ *CP gap*).

Column 1 of Table 5 shows a more positive correlation between the gap in commercial paper issuance and credit line take-up in March 2020, compared to January and February 2020. The estimated coefficient of 0.23 for the interaction term between Δ *CP gap* and the March 2020 dummy implies that a 1 euro gap in commercial paper rollover led to a drawdown from credit lines of 23 cents. For the other months in our sample, we don't find any significant relation between commercial paper shortages and credit line take-up.

Next, we analyze whether this result is driven by firms that are not able to rollover their

[9]The covidsector fixed effect groups sectors in 5 buckets: (i) essential and fully active sectors, (ii) active but teleworking sectors, (iii)partly essential and partly active, (iv) non-essential and partly active, and (v) closed.

maturing commercial paper (i.e., firms with a positive *CP gap*) or by firms that are able to issue more than the amount maturing. Column 2 of Table 5 shows a positive and statistically significant correlation of 0.27 between the *CP gap* and credit line take-up for firms that are not able to rollover their maturing commercial paper in March 2020. A 1 euro shortfall in commercial paper issuance implies an uptake in credit lines of 27 cents. We also get a positive coefficient of 0.14 for April, although borderline insignificant at the 10% level. For firms that manage to rollover their maturing commercial paper, we don't find any significant relation between the gap variable and credit line take-up (column 3). Overall, these results suggest that firms do switch to some extent from commercial paper to credit lines in times of crisis, but this substitution can on average only cover 27% of the drop in funding in commercial paper markets.

5.2 The central bank as market-maker-of-last-resort: PEPP and commercial paper issuances

The Pandemic Emergency Purchase Program was announced by the ECB on the evening of March 18, 2020, and launched on March 26, 2020. Part of the program was aimed at commercial paper markets, allowing the ECB to buy commercial paper of non-financial companies.

Figure 2 shows that a few days after the launch of the program, commercial paper issuance by non-financial firms rebounded, leading to a gradual increase in the total amount of outstanding commercial paper. By end of April, outstanding commercial paper volumes were again at the level of mid-March. This is a first indication that PEPP revived the commercial paper market.

To study whether this rebound in commercial paper issuance was effectively driven by the ECB's purchase program, we make use of the fact that the ECB was only allowed to buy eligible commercial paper. Commercial paper is eligible when it fulfills several criteria, such as being issued in euro, being of high credit quality and not being issued by a financial institution.[10] If the rebound in commercial paper markets is driven by PEPP purchases, we would expect to see a particularly strong increase in the issuance of eligible paper.

[10]See Section 2 for more details on the eligibility criteria.

Figure 3 compares the evolution of the outstanding amount of eligible and non-eligible commercial paper. Eligible outstanding commercial paper is defined as the amount of commercial paper outstanding from firms that ex-ante, i.e., before the introduction of PEPP, issued eligible commercial paper. The figure shows that, before the introduction of PEPP, the stock of commercial paper from eligible and non-eligible firms was evolving in a fairly similar way, steadily growing until mid-March, and decreasing in both groups from mid-March onwards. However, once the PEPP program was activated, outstanding stocks of eligible paper quickly rebounded and reached pre-pandemic levels by the end of April, while non-eligible stocks remained low.

In Table 6 we study the impact of eligibility status on commercial paper issuance at the firm level. We use a similar setup as in Table 4, but add an eligibility dummy as explanatory variable and not only focus on what happens in March 2020, but also in April and May 2020. The dependent variable in each regression is a rollover dummy. In columns 1 and 3, this dummy is equal to one if a firm is able to rollover its maturing commercial paper between February 29 and March 31, 2020. In columns 2 and 4, we look at the rolling over of commercial paper that matured in April 2020, while column 5 focusses on April and May. The eligibility dummy is equal to one if the firm issues commercial paper that fulfills the requirements to be eligible under the PEPP.

The results in column 1 and 3 of Table 6 show that eligibility status had no impact on whether commercial paper could be rolled-over in March 2020. This makes sense, as the PEPP program only became active on March 26, and only really took off in April. Instead, and as shown in Table 3, the fund flow indicator plays a crucial role during this month: firms exposed to firms with negative fund flows are less likely to rollover their maturing commercial paper.

Columns 2, 4 and 5 however show a different picture for April and May 2020, i.e., once PEPP is activated. During these months, eligibility status positively and significantly affects firms' rollover probability. Eligible firms are between 34 and 42 percent more likely to fully rollover their maturing commercial paper.

The first two columns of Table 7 further confirm that PEPP had a positive impact on the issuance volume of eligible commercial paper. In this table, we focus on commercial

paper at the issuance level (ISIN-level) during the 4 weeks before and the 4 weeks after the introduction of the PEPP. The dependent variable in column 1 and 2 is the log of the amount issued. The variable of interest is the interaction term between the eligibility dummy and the post dummy, which is equal to one after the introduction of PEPP. Column 1 shows that, relative to the amount issued by non-eligible firms, the amount of eligible commercial paper being issued is on average 47% higher after the introduction of PEPP. This estimate rises to 51% once we consider firm fixed effects.

Figure 4 illustrates this difference in issuance behavior by plotting the aggregate weekly issuance volumes for eligible and non-eligible firms. While issuances of both groups evolve in a similar way before the introduction of PEPP, with issuance volumes in both groups hovering around 4 billion EUR a week before the drop in mid-March, we see a much stronger pick-up of issuance volumes for eligible firms after the introduction of PEPP.

One might be worried that eligible firms have specific characteristics that make it easier for them to access commercial paper markets in crisis times, apart from being eligible for PEPP. There are at least two reasons, however, why this is unlikely. First, commercial paper markets started showing signs of stress already in mid-March, approximately two weeks before the implementation of PEPP. As evident from figures 3 and 4, both eligible and non-eligible firms issued commercial paper at a very similar pace. The similar issuance behavior of eligible and non-eligible firms in the pre-PEPP period is also reassuring for the parallel trend assumption of our difference-in-differences analysis. Second, when comparing balance sheet characteristics such as firm leverage and cash holdings, there is no significant difference between eligible and non-eligible firms.

Eligible firms not only are able to issue once PEPP is introduced, but they also manage to increase the maturity of their issuances. Column 3 of Table 7 indicates that, while the maturity of non-eligible issuances decreased by 39.3% after the introduction of PEPP, the maturity of eligible issuances increases by 30.3% (-39.3 + 69.5). Put differently, relative to the non-eligible issuances, the maturity for eligible issuances increased with 69.5%. Column 4 confirms these results when week and firm fixed effects are added to the specification in column 3.

Table 8 describes the impact of PEPP on the yield at issuance for the full sample and for

different maturity buckets. We split the sample in four maturity buckets: below 1 month, 1 to 3 months, 3 to 6 months and above 6 months. The results show that yields especially went down for eligible commercial paper between 1 and 6 months. The non-result for the below 1 month category is not a surprise, as PEPP purchases need to have a maturity of at least 28 days. The bulk of the issuances is in the 1 to 3 months bucket, so it is no surprise to see a strong impact there: eligible issuers in this bucket experience a relative decline in their short-term funding cost of 13.8 basis points.

5.3 Central bank exit

5.3.1 Central bank exit and commercial paper issuance

Figure 1 shows the average central bank holdings of firms' commercial paper, in percent, between March 31, 2018, and March 31, 2023. There was a rapid increase at the beginning of the central bank intervention, with central bank holdings of commercial paper exceeding 70% in 2020. This started to decline when the central bank began exiting the short-term corporate debt market as early as the beginning of 2021. By 2023, the central bank's holdings had reverted close to zero. This provides us with the opportunity to study the intervention and the staggered exit by the central bank at the firm level.

Table 9 presents the results of estimating Equation (5) and shows the impact of the European Central Bank's staggered exit from the commercial paper market.$CB\ exposure_f$ measures a firm's exposure to the central bank intervention. It is 1 for firms with above-median exposure and 0 otherwise. The exposure is measured at the firm level as the maximum proportion of the firm's total outstanding commercial paper held by the central bank. The data is at the quarterly level, and runs from Q1 2018 until Q3 2023.

In Column 1, we present the impact on yields. During the PEPP period, yields for eligible firms with limited exposure to the central bank increased by 4.9 basis points relative to the period before the central bank intervention. During the exit period, yields for these firms increased by 12.9 basis points. However, more-exposed firms were affected differentially. While during the PEPP period, yields of more-exposed firms were not significantly different from those of less-exposed firms, after the exit of the central bank, more-exposed firms faced

an additional 20.2 basis points yield increase.

Looking at maturity (column 2), there is an increase during the PEPP period of about 45 days in the maturity of commercial paper. However, this effect is not lasting, as during the exit period there is no significant difference compared to the pre-PEPP period. Additionally, there is no significant difference between more-exposed and less-exposed firms.

Next, we show how the holdings of money market funds (MMFs) change in column 3. During the PEPP period, MMFs—which are by far the largest investors in commercial paper—held about 100 million euros less in exposed firms. Once the central bank exited, the gap between more-exposed firms and less-exposed firms widened to about 180 million euros.

The two largest investors during the PEPP period were the central bank and MMFs. Column 4 shows that there was a large increase during the PEPP period of about 400 million euros per firm in total main investor holdings. There was no significant difference between more-exposed and less-exposed firms during this period; both types of firms were able to increase their commercial paper significantly, either by selling to the ECB or to MMFs. With the exit, less-exposed firms could maintain about 225 million euros more compared to the pre-period. More-exposed firms, however, could not increase their commercial paper volumes relative to the pre-period, which is shown by the significant differential that is of similar magnitude (negative) as the level effect (positive).

The results in column 5 indicate that the changes in the volume issued are not due to changes in the number of issuances. There are no significant level effects nor significant differential effects in the number of issuances during the PEPP period and the exit period.

In column 6, we examine the relationships a firm has with MMFs. Relationships in this market are sticky, but through the central bank intervention and the crisis, many of them diminished or broke. We find that new relationships were formed both in the PEPP period and exit period relative to the pre-period. There is also a significant difference between more-exposed versus less-exposed firms. More-exposed firms show fewer new relationships during the PEPP period—about 2.6 fewer—and about 3.7 fewer during the exit period.

Overall, the results show that the central bank intervention kept the yields and maturity for eligible firms constant between those firms more-exposed and less-exposed. Once the

central bank exited from the commercial paper market, firms that were more-exposed to the intervention experienced higher yields, lower investment by money market funds (MMFs), and fewer new relationships with MMFs. This suggests that while the central bank intervention was effective, firms that relied more on it face a more difficult commercial paper market after exit.

Table 10 shows the result of the regression setup that is designed to isolate the effects of the intervention and exit periods further by addressing potential confounding effects (6). Time fixed effects control for period-specific trends, while firm-specific controls account for variation in the central bank's staggered exit timing. Put differently, this setup allows us to compare firms where the central bank has already exited versus those where the central bank has not yet exited within the same quarter, while controlling for how close or how far the exit is for a given firm. While the level effects of the previous table are now perfectly co-linear with the additional fixed effects, the interaction terms remain similar both in magnitude and significance.

5.3.2 Central bank exit and credit lines

Next, we analyze the consequences of central bank exit for firms' credit line take-up. Table 5 in Section 5.1.2 showed that firms compensated for part of the reduction in commercial paper availability at the onset of the COVID-19 crisis in the first quarter of 2020 with credit line drawdowns. In this section, we study the long-term evolution of firms' reliance on credit lines between the first quarter of 2019 and the last quarter of 2024.

Column 1 of Table 11 provides information on the availability of credit lines. The dependent variable is the volume of credit lines committed to firms. The results show that the availability of credit lines increased by approximately 50% for the average firm in our sample in the first quarter of 2020 ($2020Q1_t$ is a dummy equal to one during this quarter). These committed amounts remained elevated during the PEPP period, and also after the ECB stopped holding commercial paper of a particular firm.

Columns 2 and 3 of Table 11 provide more detailed insights into firms' credit line usage. The dependent variable in Column 2 is the log of the amount of credit that a firm is drawing from a credit line. The results in Column 2 confirm the strong increase in take-up in the

first quarter of 2020. This is consistent with our findings in Table 5, which documented that part of the reduction in commercial paper issuance was offset by increased credit line take-up. During the PEPP intervention period credit line usage is no different than before the COVID-19 crisis. Similarly, the exit of the ECB from the commercial paper market has no material impact on firms' credit line usage. Given that the committed amounts did increase (Column 1), the logical consequence is that the non-used part of the credit line increased significantly during the PEPP intervention period, and stayed elevated after the exit of the ECB. This is confirmed in Column 3 of Table 11, where the dependent variable is the unused portion of the credit line. Finally, Table A2 in appendix shows that credit line availability or take-up is not materially different between firms with above or below median exposure to the central bank.

Overall, these results suggest that the PEPP intervention in commercial paper markets had no long-term impact on the use of credit lines by firms. Firms relied heavily on bank credit lines at the onset of the COVID-19 crisis, but this reliance was brought back to pre-COVID-19 levels once the PEPP became active. The COVID-19 episode led to a permanently increased availability of credit lines that these companies can rely on.

6. Conclusion

The commercial paper market came to an almost complete standstill during the COVID-19 crisis in March 2020. In the last two weeks of March 2020 the aggregate weekly volume issued by non-financial euro area commercial paper dropped from about 8 billion EUR to below 2 billion EUR. This had direct effects on firms relying on short-term market funding for their day-to-day operations. In the euro area, more than 80% of short-term market debt is commercial paper.

We show that the standstill was at least partly driven by distressed money market funds. Liquidity strains in money market funds caused a reduction in demand for non-financial commercial paper, thereby putting pressure on firms relying on these short-term markets for day-to-day liquidity needs.

We also document the role of the ECB's Pandemic Emergency Purchase Program (PEPP) in the recovery of commercial paper markets. Our analysis indicates that the revival in commercial paper issuance in April and May 2020 was driven by PEPP purchases. PEPP not only allowed firms to issue more commercial paper, but also led to better terms and conditions. Last, we show that firms became less sensitive to outflows in money market funds through the PEPP.

When the large-scale intervention ended, more-exposed firms were adversely affected. Although their yields were not significantly different from less-exposed firms during the PEPP period, they faced an additional 20.2 basis points increase after the central bank's exit. Money market funds (MMFs), the largest investors in commercial paper, held about 100 million euros less in average-exposed firms during the PEPP period, widening to 180 million euros post-exit. Consequently, firms more reliant on the intervention encountered higher yields, reduced MMF investment, and fewer new relationships, indicating a more challenging commercial paper market for those firms after the intervention ended.

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Figures and Tables

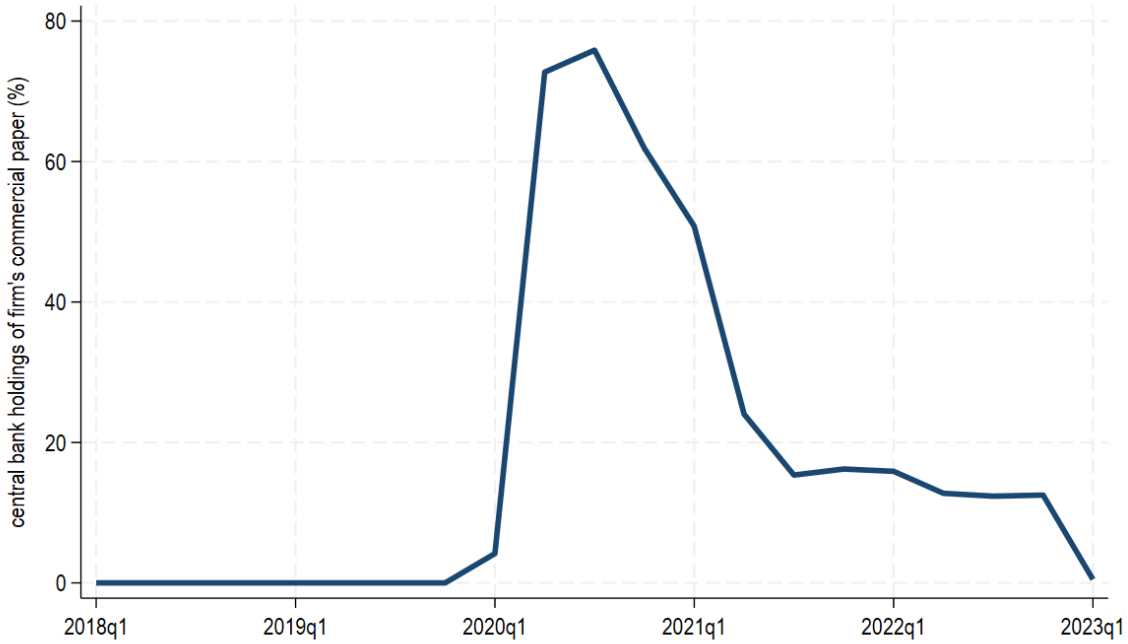


Figure 1: **Average central bank holdings of eligible firm's commercial paper (non-financial companies).** This figure shows the evolution of the percentage holdings of firms' commercial paper issued by euro-area non-financial companies between March 31, 2018, and March 31, 2023. The sample consists of firms eligible for central bank purchases that are matched with fund-level data from Lipper. Data on holdings is collected from the ECB's Securities Holdings Statistics (SHS).

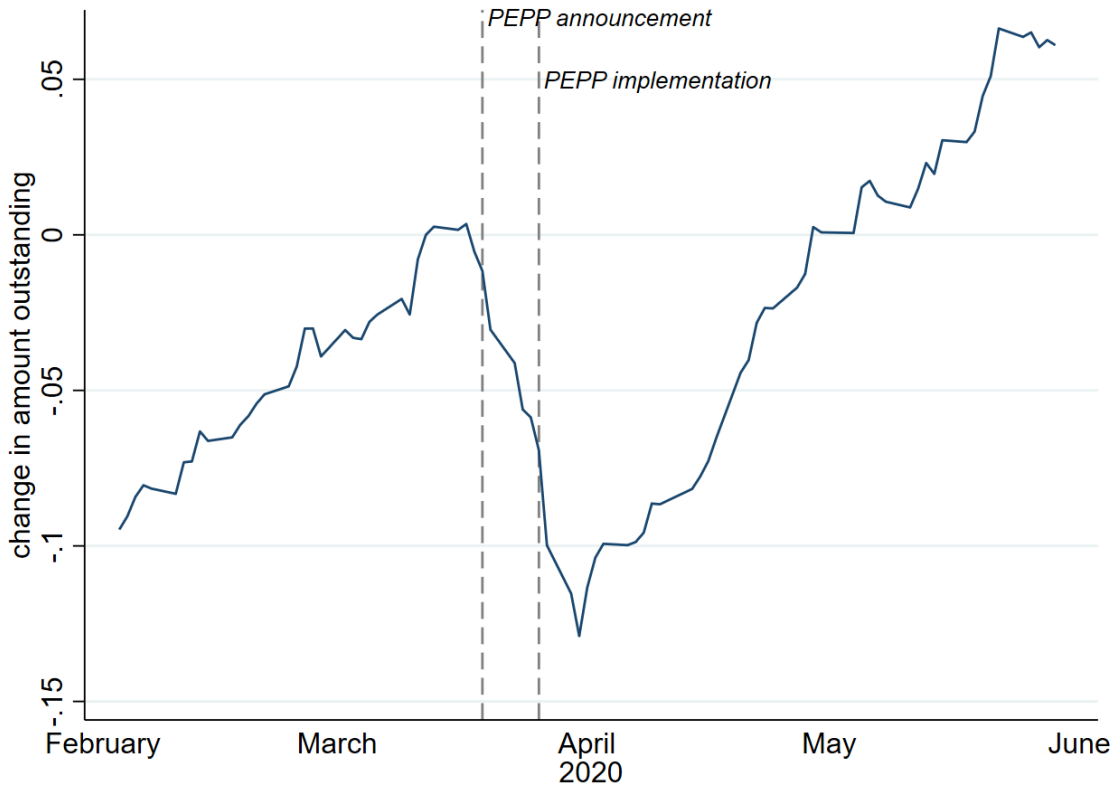


Figure 2: **Aggregate outstanding volume of commercial paper issued (non-financial companies).** This figure shows the evolution of an index of the aggregate outstanding volume of euro-denominated commercial paper issued by euro-area non-financial companies between February 1, 2020 and May 29, 2020. The index is set at zero on March 12, 2020. Data on outstanding commercial paper is collected from the ECB's Centralised Securities Database (CSDB).

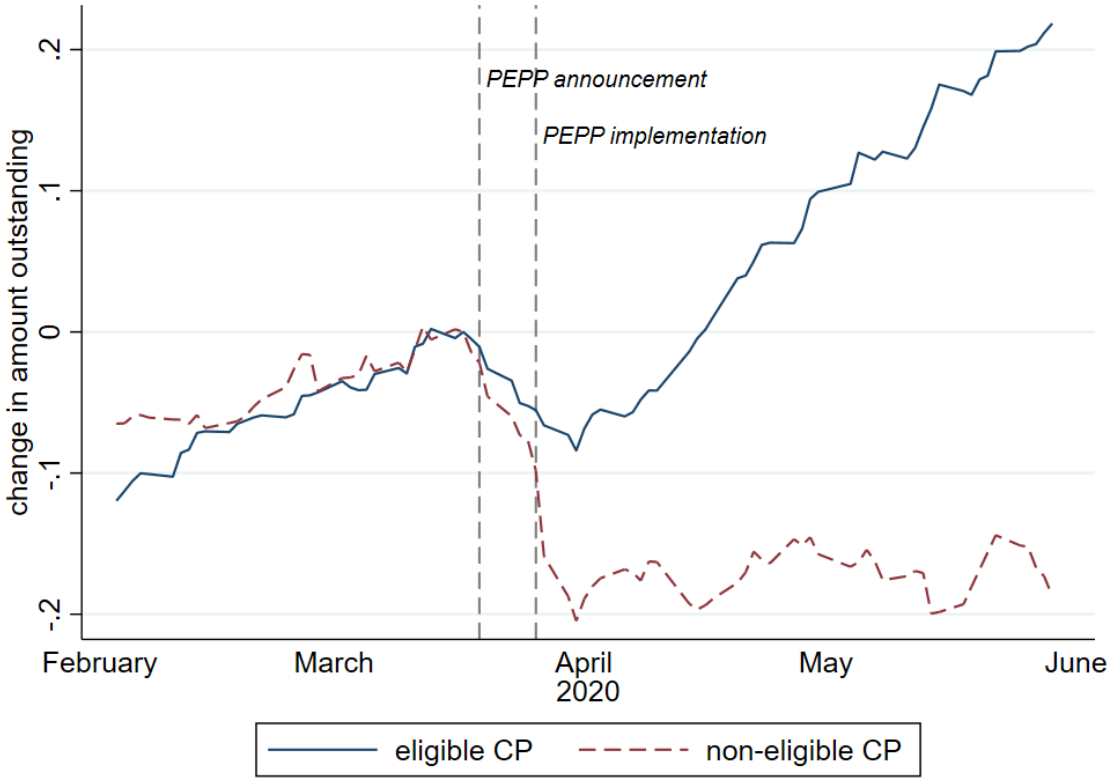


Figure 3: **Aggregate outstanding volume of commercial paper issued (non-financial companies)** This figure shows the evolution of two indices: the solid blue line index of the aggregate outstanding volume of euro-denominated commercial paper issued by euro-area non-financial companies (NFCs) that fulfills the eligibility requirements for the ECB's Pandemic Purchases Program (PEPP). The dashed red line shows a similar index, but for commercial paper that is not eligible for PEPP. Both indices are set at zero on March 12, 2020. The sample period is February 1, 2020 until May 29, 2020 Data on outstanding commercial paper is collected from the ECB's Centralised Securities Database (CSDB). Data on paper eligibility is based on the list of eligible ECB collateral (https://www.ecb.europa.eu/paym/coll/assets/html/list-MID.en.html).

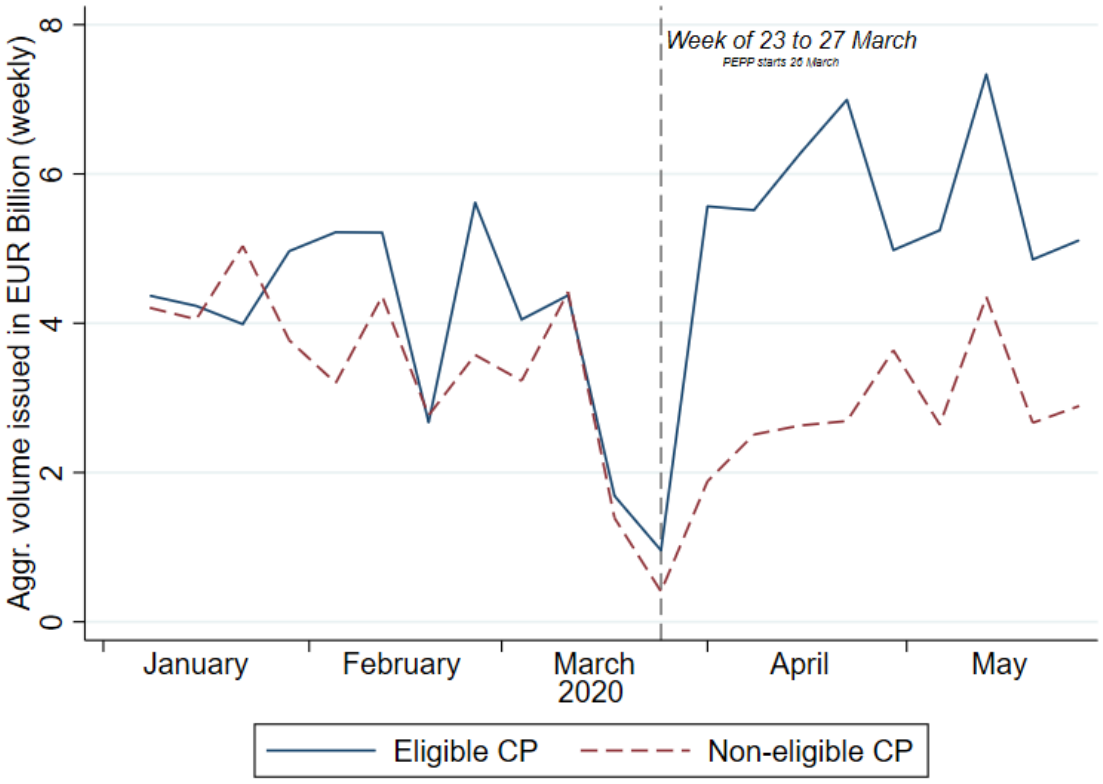
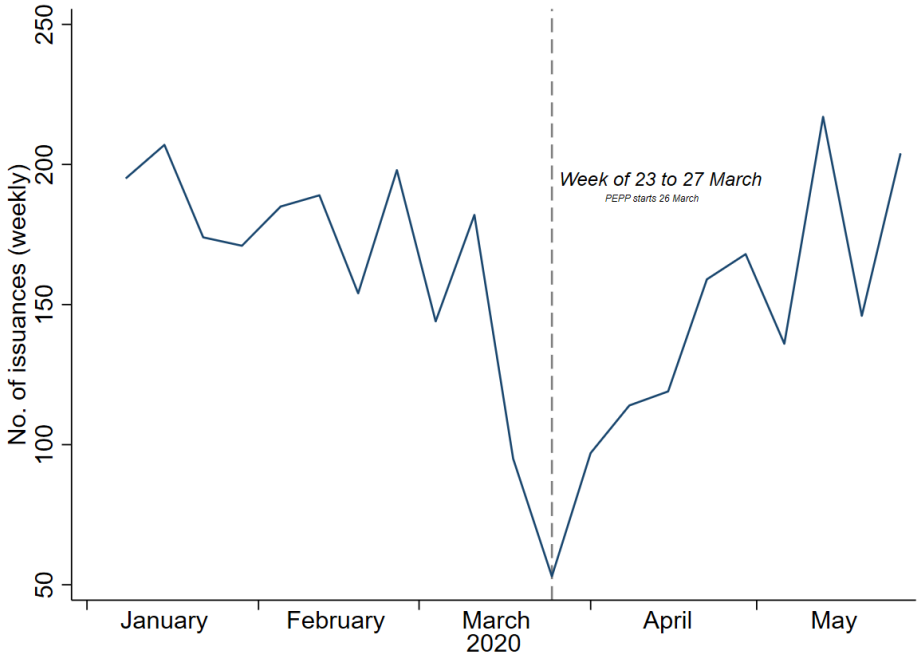
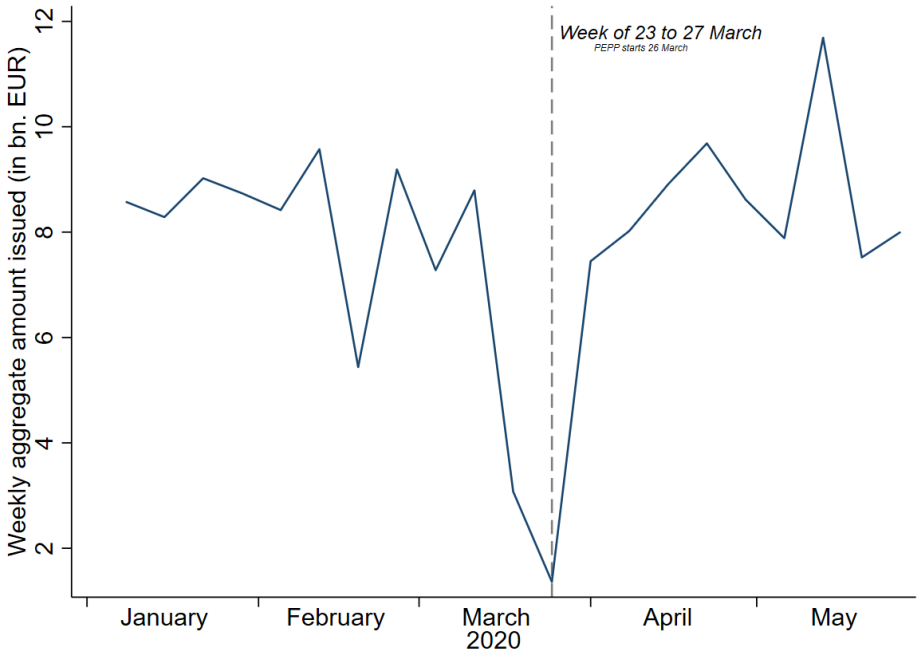


Figure 4: **Aggregate weekly volume of commercial paper issued (non-financial companies)** This figure shows the evolution of the aggregate volume (in billion euro) of euro-denominated commercial paper issuance for two distinct types of commercial paper: the solid blue line represents the weekly aggregate volume of euro-denominated commercial paper issued by euro-area non-financial companies (NFCs) that fulfills the eligibility requirements for the ECB's Pandemic Purchases Program (PEPP). Similarly, the dashed red line shows the aggregate issuance volume of commercial paper that is not eligible for PEPP. The sample period is January 6, 2020 until May 29, 2020. Data on the issuance of commercial paper is collected from the ECB's Centralised Securities Database (CSDB). Data on paper eligibility is based on the list of eligible ECB collateral (https://www.ecb.europa.eu/paym/coll/assets/html/list-MID.en.html).



(a) Nr. of issuances



(b) Weekly issuance volume

Figure 5: **Weekly number and volume of commercial paper issuances (non-financial companies).** Panel (a) of this figure shows the number of euro-denominated commercial paper issuances by euro-area by non-financial companies on a weekly basis between January 6, 2020 and May 30, 2020. Panel (b) shows the weekly aggregate amount of euro-denominated commercial paper issued by euro-area by non-financial companies, in billion euro. All data on commercial paper issuances is collected from the ECB's Centralised Securities Database (CSDB).

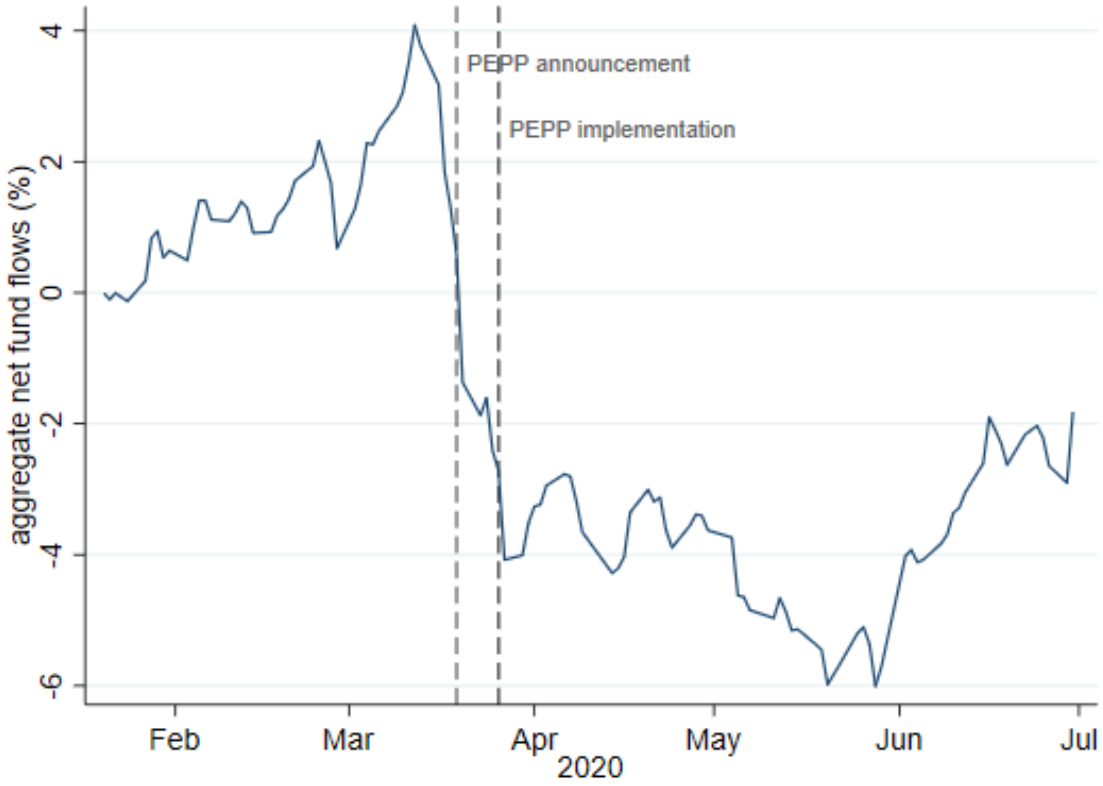


Figure 6: **Aggregate net fund flows** This figure shows the evolution of a fund flow index of money market funds investing into the euro area. The index is set at zero on January 13, 2020. The sample period from January 13, 2020 to June 30, 2020. Data on fund flows is calculated using the Thomson Reuters Lipper database.

Table 1: **Summary Statistics**

ISIN-level						
	N	mean	p50	sd	p5	p95
Issuance volume (million EUR)	1323	43.87	25.00	55.61	2.50	150.00
Maturity (days)	1323	85.90	51.00	92.45	7.00	364.00
Yield (%) - annualized	1128	0.16	0.06	0.45	-0.37	0.71
Eligible	1323	0.37	0.00	0.48	0.00	1.00
Fund-firm level						
Commercial paper holdings (fund-firm level, million EUR)	1513	30.36	20.01	35.88	1.50	89.95
Negative fund flow	1513	0.60	1.00	0.49	0.00	1.00
Fund flow	1513	-0.04	-0.05	0.31	-0.47	0.47
Firm-level						
	N	mean	p50	sd	p5	p95
Rollover dummy	167	0.37	0.00	0.48	0.00	1.00
Growth outstanding CP (%)	167	-0.08	-0.08	0.85	-1.72	2.00
Negative flow dummy	167	0.59				
Weighted fund flow	167	-0.03	-0.04	0.21	-0.39	0.37
Log(total assets)	147	23.23	23.13	1.32	21.35	25.32
Leverage	137	0.70	0.70	0.19	0.38	1.00
Return on assets (%)	137	3.15	2.66	3.31	-1.05	9.09
Eligibility dummy	167	0.54				

In the top panel, the sample consists of all euro-denominated commercial paper (ISIN-level) issued by euro-area non-financial companies between February 28, 2020 and April 23, 2020 (i.e., 4 weeks before and 4 weeks after the ECB's Pandemic Purchases Program (PEPP) became active). *Issuance volume (in million EUR)* is the amount of the commercial paper issuance, *Maturity (days)* is the initial maturity of the commercial paper, *Yield (%) - annualized* is the annualized interest rate (in percent) and *Eligible* is a dummy equal to one in case the firm issuing the commercial paper at any point during the sample period issued eligible commercial paper. The second panel shows summary statistics at the fund-firm level. *Commercial paper holdings (fund-firm level, million EUR)* is the amount of commercial paper of firm f that is held by fund i. The bottom panel presents firm-level summary statistics for all non-financial firms included in our sample. *Rollover dummy* is a dummy variable equal to one if a firm was able to rollover its maturing commercial paper between February 28, 2020 and March 31, 2020. *Log(Total assets)* is the natural logarithm of a firm's total assets. *Leverage* is defined as 1-(equity over total assets). *Eligible* is a dummy equal to one in case the firms issues commercial paper that fulfills the requirements to be eligible under the PEPP. *Fund flow* is the weighted average of the net fund flows between the end of February 2020 and the end of March 2020 of the money market funds that hold commercial paper of a firm, with the weights equal to the share of a firm's commercial paper that was held by a particular money market fund at the end of February, 2020. ISIN-level commercial paper data is collected from the ECB's Centralised Securities Database (CSDB). Data on paper eligibility is based on the list of eligible ECB collateral (https://www.ecb.europa.eu/paym/coll/assets/html/list-MID.en.html). Firm balance sheet data is end-of-year data for 2019, taken from the Bureau van Dijk Orbis database. Data on fund flows is calculated using the Thomson Reuters Lipper database.

Table 2: **Commercial paper and outflows from money market funds**

	(1)	(2)	(3)
	Log(outstanding commercial paper (EUR))$_{i,f,t}$		
$Post_t$ x Negative fund $flow_i$	-0.227*	-0.164*	-0.129**
	(0.116)	(0.0888)	(0.0596)
$Post_t$	0.113		
	(0.0866)		
Negative $flow_i$	0.173	0.148	
	(0.258)	(0.260)	
Observations	1,513	1,448	1,446
R-squared	0.296	0.233	0.692
Firm FE	Y	-	-
Firm-time FE	N	Y	Y
Fund FE	N	N	Y

The sample consists of all non-financial firms whose outstanding commercial paper is at least partly owned by money market funds at any point in time between February 28, 2020 and May 31, 2020. The dependend variable is the log of the total amount outstanding commercial paper of firm f that is owned by money market fund i at time t. Time t is either February 28, 2020 or March 31, 2020. *Negative fund flow*$_i$ is a dummy equal to 1 when the net fund flow of fund i between February 28, 2020 and March 31, 2020 was negative. *Post* is a dummy equal to one on March 31, 2020. Information on the issuance of commercial paper is collected from the ECB's Centralised Securities Database (CSDB). Data on fund flows is calculated using the Thomson Reuters Lipper database. Standard errors are clustered at the firm level.

Table 3: **Commercial paper and outflows from money market funds**

Dependent variable =	(1)	(2)	(3)	(4)	(5)
	Log(outstanding commercial paper (EUR))$_{i,f,t}$				
Firm variable =	COVID-19	Total assets	Leverage	ROA	Interest coverage ratio
Negative fund flow$_i$ x Post$_t$ x Firm variable$_f$	-0.155*	0.200**	-0.0812	0.0951	0.0642
	(0.0911)	(0.100)	(0.108)	(0.0949)	(0.107)
Negative fund flow$_i$ x Post$_t$	-0.0845	-0.208***	-0.115**	-0.173***	-0.182***
	(0.0546)	(0.0590)	(0.0568)	(0.0629)	(0.0631)
Observations	1,495	1,288	1,288	1,288	1,055
R-squared	0.703	0.687	0.686	0.686	0.697
Firm-time FE	Y	Y	Y	Y	Y
Fund FE	Y	Y	Y	Y	Y

The sample consists of all non-financial firms whose outstanding commercial paper is at least partly owned by money market funds at any point in time between February 28, 2020 and May 31, 2020. The depend variable is the log of the total amount outstanding commercial paper of firm f that is owned by money market fund i at time t. Time t is either February 28, 2020 or March 31, 2020. *Negative flow*$_i$ is a dummy equal to 1 if the net fund flow of fund i between February 28, 2020 and March 31, 2020 was negative. *Post* is a dummy equal to one on March 31, 2020. In column 1, *Firm variable*$_f$ is a dummy variable equal to one if the firm operates in a sector seen as non-essential during the COVID-19 pandemic, and in which teleworking is not possible (e.g., construction sector, hotels). In columns 2 to 5, *Firm variable*$_f$ is a dummy variable equal to one if the firm is in the highest tercile of the distribution of a particular firm characteristic, where each column focusses on a different firm characteristic (total assets, leverage, return on assets, and interest rate coverage ratio, respectively). Information on the issuance of commercial paper is collected from the ECB's Centralised Securities Database (CSDB). Data on fund flows is calculated using the Thomson Reuters Lipper database. COVID sector classification is taken from JCR (2020). Firm balance sheet data is taken from the Bureau van Dijk Orbis database. Standard errors are clustered at the firm level.

Table 4: **Commercial paper and weighted fund flows at the firm level**

	(1)	(2)	(3)	(4)	(5)	(6)
	Rollover probability			Growth outstanding CP (%)		
Negative fund flow$_f$	-0.302***	-0.286***	-0.284***	-0.496***	-0.430***	-0.387**
	(0.0746)	(0.0835)	(0.0898)	(0.144)	(0.155)	(0.167)
Log(total assets)$_f$		0.0712***	0.0738**		0.0615	0.0385
		(0.0270)	(0.0301)		(0.0423)	(0.0501)
Leverage$_f$		0.0557	0.0708		-0.162	0.177
		(0.231)	(0.277)		(0.385)	(0.438)
Return on assets$_f$ (%)		0.0275**	0.0222		0.0274	0.0162
		(0.0120)	(0.0140)		(0.0200)	(0.0249)
Constant	0.544***	-1.226*	-1.275	0.215	-1.144	-0.830
	(0.0608)	(0.697)	(0.786)	(0.134)	(1.033)	(1.260)
Observations	167	137	126	167	137	126
R-squared	0.095	0.240	0.271	0.083	0.203	0.245
COVIDsector FE	N	Y	N	N	Y	N
COVIDsector-country FE	N	N	Y	N	N	Y

The sample consists of all non-financial firms whose outstanding commercial paper is at least partly owned by money market funds at any point in time between February 28, 2020 and May 31, 2020. In columns 1 to 3, the depend variable is a dummy variable equal to one if a firm f was able to rollover its maturing commercial paper between February 29, 2020 and March 31, 2020. In columns 4 to 6, the dependent variable is the firm-level growth rate in commercial paper outstanding over the same time period (in %). *Negative fund flow*$_f$ is a dummy equal to 1 if the average weighted net fund flows of all funds i that hold commercial paper of firm f on February 28, 2020 was negative. Columns 2 and 5 include COVIDsector fixed effects, which groups sectors in 5 buckets: (i) essential and fully active sectors, (ii) active but teleworking sectors, (iii) partly essential and partly active, (iv) non-essential and partly active, and (v) closed. In columns 3 and 6 we include country-covidsector fixed effects. Information on the issuance of commercial paper is collected from the ECB's Centralised Securities Database (CSDB). Data on fund flows is calculated using the Thomson Reuters Lipper database. COVID sector classification is taken from JCR (2020). Firm balance sheet data is taken from the Bureau van Dijk Orbis database. Robust standard errors in parentheses.

Table 5: **Commercial paper and credit line drawdowns**

	(1)	(2)	(3)
		Δ Credit line take-up	
	Full sample	Positive CP gap	Negative CP gap
Δ CP gap x March 2020	0.231***	0.272***	0.170
	(0.0587)	(0.0861)	(0.146)
Δ CP gap x April 2020	0.0386	0.140	0.0339
	(0.0599)	(0.0892)	(0.107)
Δ CP gap x May 2020	-0.0199	-0.00444	-0.00303
	(0.0443)	(0.0512)	(0.0765)
Δ CP gap	0.0130	-0.0139	-0.0251
	(0.0199)	(0.0266)	(0.0520)
Observations	729	435	294
R-squared	0.370	0.559	0.308
Firm FE	Y	Y	Y
Time FE	Y	Y	Y

Δ *Credit line take-up* is the month-over-month change in credit line take-up of a firm. Δ *CP gap* is defined as the firm-level difference between the total amount of commercial paper maturing in a month and the total amount issued in that month. *March 2020* is a dummy equal to one in March 2020. *April 2020* and *May 2020* are defined in a similar way. The sample period is January 2020 until May 2020.

Table 6: **Commercial paper and PEPP eligibility at the firm level**

	(1)	(2)	(3)	(4)	(5)
	Rollover probability				
	March	April	March	April	April-May
Eligibility dummy$_f$	0.00516	0.324***	-0.113	0.333***	0.425***
	(0.0725)	(0.0749)	(0.0958)	(0.101)	(0.0953)
Negative fund flow$_{f,March}$	-0.301***	-0.0918	-0.298***	-0.0869	-0.0687
	(0.0759)	(0.0764)	(0.0925)	(0.0974)	(0.0921)
Log(total assets)$_f$			0.0906**	0.0270	0.0377
			(0.0364)	(0.0383)	(0.0362)
Leverage$_f$			0.133	-0.0430	-0.231
			(0.267)	(0.281)	(0.266)
Return on assets$_f$ (%)			0.0226	-0.00265	-0.0204
			(0.0152)	(0.0160)	(0.0151)
Constant	0.541***	0.413***	-1.622*	-0.160	-0.249
	(0.0762)	(0.0772)	(0.891)	(0.938)	(0.887)
Observations	167	167	134	134	134
R-squared	0.095	0.122	0.291	0.225	0.294
COVIDsector-country FE	N	N	Y	Y	Y

The sample consists of all non-financial firms whose outstanding commercial paper is at least partly owned by money market funds at any point in time between February 28, 2020 and May 31, 2020. In columns 1 and 3, the depend variable is a dummy variable equal to one if a firm f was able to rollover its maturing commercial paper between February 29, 2020 and March 31, 2020. In columns 2 and 4, the depend variable is a dummy variable equal to one if a firm f was able to rollover its maturing commercial paper between March 31, 2020 and April 30, 2020. In column 5, the depend variable is a dummy variable equal to one if a firm f was able to rollover its maturing commercial paper between March 31, 2020 and May 31, 2020. *Negative fund flow*$_f$ is a dummy equal to 1 if the average weighted net fund flows between February 28, 2020 and March 31, 2020 of all funds that hold commercial paper of firm f on February 28, 2020 was negative. Columns 3 to 5 include COVIDsector-country fixed effects. The covidsector variable groups sectors in 5 buckets: (i) essential and fully active sectors, (ii) active but teleworking sectors, (iii) partly essential and partly active, (iv) non-essential and partly active, and (v) closed. Information on the issuance of commercial paper is collected from the ECB's Centralised Securities Database (CSDB). Data on fund flows is calculated using the Thomson Reuters Lipper database. COVID sector classification is taken from Fana et al. (2020). Firm balance sheet data is taken from the Bureau van Dijk Orbis database. Robust standard errors in parentheses.

Table 7: **PEPP and commercial paper - volumes and maturity**

	(1)	(2)	(3)	(4)
	Log(Volume per issuance)		Log(Maturity (days))	
Eligibility dummy$_f$ x Post$_t$	0.470***	0.510***	0.695***	0.714***
	(0.119)	(0.110)	(0.151)	(0.146)
Post$_t$	-0.292***		-0.393***	
	(0.0950)		(0.0901)	
Observations	1,323	1,323	1,323	1,323
R-squared	0.496	0.516	0.461	0.473
Week FE	N	Y	N	Y
Firm FE	Y	Y	Y	Y
No. firms	129	129	129	129

This table analyzes commercial paper issuances (at the ISIN-level) during the 8 weeks around the launch of the ECB's Pandemic Emergency Purchase Program (PEPP). *Log(Volume per issuance)* is the logarithm of the issued amount. *Post* is a dummy equal to 0 during the 4 weeks before the start of the PEPP (March 26, 2020), and equal to 1 during the first 4 weeks of PEPP. *Eligible* is a dummy equal to 1 for firms that issued eligible commercial paper at least once between February 28, 2020 and May 31, 2020. All columns include firm fixed effects. In columns 2 and 4 we additionally add week fixed effects. Standard errors are clustered at the firm level. Each firm in our sample has at least 1 issuance in the pre-PEPP period, and at least 1 issuance during the post period.

Table 8: **PEPP and commercial paper yields: maturity buckets**

	(1) Yield (%) - all	(2) Yield (%) - all	(3) Yield (%) - below 1 month	(4) Yield (%) - 1 to 3 months	(5) Yield (%) - 3 to 6 months	(6) Yield (%) - above 6 months
$Eligible_i$ x $Post_t$	-0.00345	-0.00438	0.230	-0.138**	-0.253*	0.0384
	(0.0570)	(0.0546)	(0.246)	(0.0620)	(0.138)	(0.0870)
$Post_t$	0.385***					
	(0.0462)					
$Log(Maturity)_{i,j}$	0.0967***	0.101***	0.0375	0.123***	0.254***	0.322**
	(0.0149)	(0.0153)	(0.130)	(0.0250)	(0.0683)	(0.153)
Observations	1,101	1,101	102	579	72	80
R-squared	0.780	0.807	0.755	0.780	0.887	0.932
Week FE	N	Y	Y	Y	Y	Y
Firm FE	Y	Y	Y	Y	Y	Y
No. firms	123	123	16	87	21	22

This table analyzes the yield on commercial paper issuances (at the ISIN-level) during the 8 weeks around the launch of the ECB's Pandemic Emergency Purchase Program (PEPP). In columns 1 and 2 we include all issuances with an initial maturity below 367 days. In columns 3 to 6 we split this sample in 4 subgroups, based on initial maturity: column 3 includes issuances with an initial maturity below 1 month, column 4 includes issuances with a maturity from 1 to 3 months, column 5 includes all issuances with initial maturity from 3 to 6 months, and column 6 all issuances between 6 months and a year. *Yield(%)* is the annualized yield of the commercial paper. *Post* is a dummy equal to 0 during the 4 weeks before the start of the PEPP (March 26, 2020), and equal to 1 during the first 4 weeks of PEPP. *Eligible* is a dummy equal to 1 for firms that issued eligible commercial paper at least one point in time between February 28, 2020 and May 31, 2020 commercial paper, and 0 otherwise. *Log(Maturity$_{i,j}$)* is the logarithm of the initial maturity (in days) of the commercial paper *j* issued by firm *i*. All specifications include firm fixed effects. Specifications 2 to 6 also include week fixed effects. Standard errors are clustered at the firm level. Each firm in our sample has at least 1 issuance in the pre-PEPP period, and at least 1 issuance during the PEPP period.

Table 9: **Central bank intervention and exit**

	(1) yield	(2) maturity	(3) MMF holdings	(4) MMF+ECB holdings	(5) no CPs	(6) new relations
CB exposure$_f$ x PEPP period$_{f,t}$	0.00960	-24.70	-100.9***	-115.2	-1.751	-2.671**
	(0.0296)	(19.35)	(34.32)	(84.28)	(1.313)	(1.113)
CB exposure$_f$ x EXIT period$_{f,t}$	0.202***	-2.771	-183.3**	-193.3**	-1.898	-3.757**
	(0.0627)	(22.26)	(91.49)	(92.80)	(1.631)	(1.477)
PEPP period$_{f,t}$	0.0490***	44.91***	71.87**	401.9***	-0.378	5.998***
	(0.0174)	(15.41)	(28.95)	(66.24)	(0.990)	(0.777)
EXIT period$_{f,t}$	0.129***	17.50	214.7***	225.7***	0.501	9.357***
	(0.0252)	(13.45)	(80.49)	(80.96)	(1.194)	(1.058)
Observations	1,134	1,136	1,136	1,136	1,136	1,136
R-squared	0.190	0.540	0.585	0.584	0.664	0.515
Firm FE	Y	Y	Y	Y	Y	Y
SE cluster	Firm	Firm	Firm	Firm	Firm	Firm

This table presents the impact of the European Central Bank's (ECB) Pandemic Emergency Purchase Program (PEPP) and its staggered exit from the commercial paper market at the firm level. *CB exposure$_f$* measures a firm's exposure to the central bank intervention. It is equal to 1 for firms with above-median exposure and 0 otherwise. The exposure is measured at the firm level as the maximum proportion of the firm's total outstanding commercial paper held by the central bank during the PEPP period.. The variable *PEPP period$_{f,t}$* represents the time from the initiation of the PEPP until the ECB's exit for a given firm, while *EXIT period$_{f,t}$* denotes the period following the ECB's complete divestment from the firm's commercial paper. The dependent variables include firm-level yields, maturity, money market fund (MMF) holdings of commercial paper, total main investor holdings (MMF + central bank), number of commercial paper issuances, and number of new investor relationships. All columns control for firm fixed effects, and standard errors are clustered at the firm level.

Table 10: **Central bank intervention and exit, differential**

	(1) yield	(2) maturity	(3) MMF holdings	(4) MMF+ECB holdings	(5) no CPs	(6) new relations
CB exposure_f x PEPP $\text{period}_{f,t}$	0.0120	0.759	-120.1***	-147.1*	-1.713	-3.791***
	(0.0275)	(17.61)	(34.84)	(82.35)	(1.159)	(0.884)
CB exposure_f x EXIT $\text{period}_{f,t}$	0.130**	15.72	-166.1*	-201.7**	-1.086	-3.822**
	(0.0633)	(23.22)	(94.87)	(96.66)	(1.619)	(1.603)
Observations	1,134	1,136	1,136	1,136	1,136	1,136
R-squared	0.428	0.639	0.604	0.628	0.690	0.544
Firm FE	Y	Y	Y	Y	Y	Y
Time FE	Y	Y	Y	Y	Y	Y
Distance to Exit FE	Y	Y	Y	Y	Y	Y
SE cluster	Firm	Firm	Firm	Firm	Firm	Firm

This table presents the impact of the European Central Bank's (ECB) Pandemic Emergency Purchase Program (PEPP) and its staggered exit from the commercial paper market at the firm level. The table is an extension of Table 9, with a focus on differential effects between firms more vs less exposed to PEPP. Firms are categorized based on their relative exposure to the intervention, defined as $CB\ exposure_f$, with respect to the peak of the firm-level holding. The variable $PEPP\ period_{f,t}$ represents the time from the initiation of the PEPP until the ECB's exit for a given firm, while $EXIT\ period_{f,t}$ denotes the period following the ECB's complete divestment from the firm's commercial paper. The dependent variables include firm-level yields, maturity, money market fund (MMF) holdings of commercial paper, total main investor holdings (MMF + central bank), number of commercial paper issuances, and number of new investor relationships. All columns control for firm fixed effects, time fixed effects, and distance to exit fixed effects. Standard errors are clustered at the firm level.

Table 11: **Central bank intervention, exit, and bank credit lines**

	(1) Log(committed amount)	(2) Log(drawn amount)	(3) Log(undrawn amount)
$2020Q1_t$	0.491**	3.285***	-0.373
	(0.226)	(0.769)	(0.419)
PEPP $period_{f,t}$	0.599**	0.943	0.568*
	(0.235)	(0.770)	(0.318)
EXIT $period_{f,t}$	0.727***	-0.0475	0.986***
	(0.251)	(0.676)	(0.242)
Observations	845	845	845
R-squared	0.564	0.680	0.528
Firm FE	Y	Y	Y

This table presents the impact of the European Central Bank's (ECB) Pandemic Emergency Purchase Program (PEPP) and its staggered exit from the commercial paper market at the firm level on firms' credit line take-up. The sample period is 2019Q1 until 2023Q4. $2020Q1_t$ is a dummy equal to one during the first quarter of 2020 (i.e., the onset of the COVID-19 crisis). The variable $PEPP\ period_{f,t}$ represents the time from the initiation of the PEPP until the ECB's exit for a given firm, while $EXIT\ period_{f,t}$ denotes the four quarters following the ECB's complete divestment from the firm's commercial paper. *Log(committed amount)* is the maximum amount that can be drawn by the firm.*Log(drawn amount)* is the log of the amount of credit that a firm is drawing from a credit line. *Log(undrawn amount)* is the log of the total amount of a credit line that is undrawn. All columns control for firm fixed effects, and standard errors are clustered at the firm level.

Online Appendix

Table A1: **Eligible vs. Non-eligible firms: t-test**

	Non-eligible		Eligible		
	N	Mean	N	Mean	P-value
Leverage ratio	60	.70	77	.71	0.71
Interest coverage ratio (%)	52	5.10	70	4.78	0.81
Return on assets (%)	60	2.88	77	3.35	0.41
Liquidity ratio	60	.94	77	1.89	0.28
Log(total assets)	64	22.77	83	23.58	0.00

This table presents the results of a t-test that compares balance sheet and P&L characteristics between PEPP eligible and non-eligible firms. The data is taken from 2019 yearly reports of the firms. Leverage ratio is defined as 1 minus (total equity/total assets). Interest coverage ratio is defined as ebitda over interest expenses (in %). The liquidity ratio is the ratio of current assets minus inventories over current liabilities (in %).

Table A2: **Central bank intervention, exit and credit lines: the role of exposure to the central bank**

	(1) Log(committed amount)	(2) Log(drawn amount)	(3) Logundrawn amount)
$2020Q1_t$	0.665	3.143***	-0.928
	(0.435)	(1.042)	(0.779)
PEPP $period_{f,t}$	0.825*	0.927	0.927
	(0.483)	(1.344)	(0.567)
EXIT $period_{f,t}$	0.909*	0.293	1.081***
	(0.474)	(1.060)	(0.386)
$2020Q1_t$ x CB $exposure_f$	-0.355	0.296	1.149
	(0.443)	(1.544)	(0.804)
PEPP $period_{f,t}$ x CB $exposure_f$	-0.424	-0.0263	-0.617
	(0.493)	(1.603)	(0.657)
EXIT $period_{f,t}$ x CB $exposure_f$	-0.373	-0.695	-0.197
	(0.491)	(1.345)	(0.478)
Observations	845	845	845
R-squared	0.567	0.680	0.534
Firm FE	Y	Y	Y

This table presents the impact of the European Central Bank's (ECB) Pandemic Emergency Purchase Program (PEPP) and its staggered exit from the commercial paper market at the firm level in credit line take-up. The sample period is 2019Q1 until 2023Q4. $2020Q1_t$ is a dummy equal to one during the first quarter of 2020 (i.e., the onset of the COVID-19 crisis). The variable $PEPP\ period_{f,t}$ represents the time from the initiation of the PEPP until the ECB's exit for a given firm, while $EXIT\ period_{f,t}$ denotes the four quarters following the ECB's complete divestment from the firm's commercial paper. $CB\ exposure_f$ measures a firm's exposure to the central bank intervention. It is equal to 1 for firms with above-median exposure and 0 otherwise. The exposure is measured at the firm level as the maximum proportion of the firm's total outstanding commercial paper held by the central bank during the PEPP period. *Log(committed amount)* is the maximum amount that can be drawn by the firm.*Log(drawn amount)* is the log of the amount of credit that a firm is drawing from a credit line. *Log(undrawn amount)* is the log of the total amount of a credit line that is undrawn. All columns control for firm fixed effects, and standard errors are clustered at the firm level.

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