The Great Lockdown: pandemic response policies and bank lending conditions*

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Abstract

This study analyses the policy measures taken in the euro area in response to the outbreak and the escalating diffusion of new coronavirus (COVID-19) pandemic. We focus on monetary, microprudential and macroprudential policies designed specifically to support bank lending conditions. For identification, we use proprietary data on participation in central bank liquidity operations, high-frequency reactions to monetary policy announcements, and confidential supervisory information on bank capital requirements. We show that in the absence of the funding cost relief and capital relief associated with the pandemic response measures, banks' ability to supply credit would have been severely affected. The results are robust to controlling for other concomitant policy measures such as government guarantees or quantitative easing. Our findings also indicate that the coordinated intervention by monetary and prudential authorities amplified the effects of the individual measures in supporting liquidity conditions and helping to sustain the flow of credit to the private sector. Finally, we find that, in absence of monetary and prudential policies, the pandemic would have lead to a significantly larger decline in firms' employment.

JEL classification: E51, E52, E58, G01, G21, G28.
Keywords: COVID-19 crisis, monetary policy, bank lending, prudential policy.

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1 Introduction

The worldwide spread of the coronavirus and the associated containment measures launched since the first quarter of 2020 have led to disruptions in many economic activities, including the banking sector. Although banks entered the crisis with a higher level of capital and liquidity than in other recent crisis episodes, the observed sharp tightening in financial conditions, the heightened funding stress and the major repricing in risky assets have tested their resilience. These developments, together with the increasing potential for more adverse scenarios to materialise – leading to substantial mark-to-market and credit losses for banks – triggered an unprecedented policy intervention. In many jurisdictions, the policy response to the COVID-19 crisis resulted in a series of new measures by monetary and prudential authorities.

In this paper we address two related questions. First, has banks' intermediation capacity been affected by the policy response to the crisis? Second, has the coordinated nature of the pandemic response policies triggered an amplification effect above and beyond the impact of their individual announcement and implementation?

The first question relates to the effectiveness of individual measures in the euro area specifically designed to support bank lending conditions in response to the COVID-19 pandemic. These measures primarily include the recalibration of targeted longer-term refinancing operations (TLTROs) and the various initiatives in the sphere of microprudential and macroprudential supervision. Importantly, although the analysis does not quantify the role of government loan guarantee schemes and other measures taken by individual governments, we do control for them in the empirical analysis.

The present paper is, to the best of our knowledge, the first study to analyse the monetary policy measures taken after the pandemic outbreak in the euro area. Previous literature on the effectiveness of targeted liquidity provision highlights the importance of these measures for reducing fragmentation and sustaining the flow of credit to households and firms (e.g. Boeckx, de Sola Perea, Peersman, 2020; Benetton and Fantino, 2021; Rostagno, Altavilla, Carboni, Lemke, Motto, Saint Guilhem, Yiangou, 2021). The evidence provided in this paper sheds further light on their effectiveness under conditions of extremely severe market distress.

Early assessments of the US measures taken in response to the coronavirus crisis indicate that the Federal Reserve's policies should be specifically geared towards injecting liquidity

into small and medium-sized firms, i.e. those more liquidity constrained and for which the social costs of bankruptcy are higher (Brunnermeier and Krishnamurthy, 2020). In this sense, the TLTROs seem to be the policy best suited to addressing this concern, as they have been explicitly designed to support bank lending for those activities most affected by the spread of COVID-19. Evidence from the US also indicates that banks were able to accommodate a substantial spike in liquidity demand because of their high pre-pandemic capital positions and the liquidity injection programs by the Federal Reserve (Li, Strahan and Zhang 2020). However, as the crisis unfolds bank asset quality might be increasingly affected in line with the evidence that banks more exposed to the pandemic have also recorded larger increases in loan loss provisions and non-performing loans (Beck and Keil, 2020).

Evidence on the effectiveness of microprudential and macroprudential measures is also very scant. The few available studies focus on the US economy and start from the idea that the pandemic fallout will most likely translate into large shortfalls in bank capital. These studies generally conclude that, faced with this deteriorated scenario, supervisors should aim at decreasing capital requirements while at the same time encouraging banks to raise new capital (Blank et al., 2020). Regulators should also prevent capital depletion through restrictions on dividend pay-outs or share buybacks (Acharya and Steffen, 2020; Borio and Restoy 2020).

The second question relates to whether the coordinated nature of the pandemic response policies might have triggered some amplification effects. Accommodative monetary policy has been coupled with an easing of macroprudential and microprudential measures. We are interested in whether the effects on bank lending associated with this combination of measures are larger than the effects associated with the same measures taken in isolation. This is an important question with vast policy implications and it boils down to whether monetary policy and prudential policy are complements or substitutes (see Altavilla, Boucinha, Peydró, Smets, 2020; and Altavilla, Laeven, Peydró, 2020). If the policies are complementary, this would indeed point to benefits of tight coordination of policies. The rationale is related but distinct from the "leaning against the wind" orientation of monetary policy, which involves taking financial stability considerations into account in setting monetary policy objectives (see Woodford, 2012; Borio, 2014; Svensson, 2017).

In general, given that the pandemic is still under way, producing an econometric assessment of the two questions described above is very challenging. However, the confidential data

we have accumulated since the start of the pandemic already allow us to estimate the overall support these measures have provided for lending conditions since early 2020. The use of post-pandemic data to quantify funding and capital relief associated to the policies is crucial to address the potential structural break in the economic relationships following the start of the COVID-19 crisis. Moreover, in order to analyse the robustness of our findings with respect to previous studies, we compare the estimated impact of the pandemic response measures on lending with the results of a wide range of studies conducted on similar measures announced before the start of the pandemic.

The main results of the analysis are the following.

First, in the absence of the pandemic response measures, persistent impairments in access to market-based funding, coupled with the substantial surge in demand for loans to meet emergency liquidity needs, would have seriously undermined banks' intermediation capacity. Withholding reassurance that further TLTRO funding would be available to meet the increased demand for emergency liquidity would have allowed funding tensions to build up in the banking sector. This could in itself have produced significant dislocations in bank lending conditions. The cumulative impact on loan growth of the non-standard monetary policy measures deployed is sizeable, even after controlling for concomitant policy measures such as government guarantees or quantitative easing. Using local projection methods, we show that over the period 2020-23, in the absence of TLTRO III, lending to firms would be at least 3 percentage points lower. In parallel, the microprudential and macroprudential measures effectively reduced regulatory capital requirements by 1.5 percentage points. This complemented monetary policy action by providing ample space for banks to support the economy, with an estimated contribution to loan growth of around 2.7 percentage points. We compare the responses of bank lending conditions to the policy measures during the pandemic with the impact of similar measures announced in the past. We find no evidence of decreasing returns, with the stimulus provided by the policy measures running through the intermediation chain in a more timely manner than in the past exactly on account of the specific design of the policy response, which was tailored to the pandemic emergency.

Second, the analysis documents strong complementarities between the measures. Liquidity providing measures complemented by microprudential and macroprudential interventions have been able to mitigate the adverse impact of the pandemic on banks' intermediation capacity. In other words, these response measures prevented the materialisation of an

adverse equilibrium of acute financial market volatility coupled with impaired access to funding, which would have resulted in a substantial further contraction in lending.

In a final exercise, we explore the potential real economic effects of pandemic measures by assessing whether and how these measures might influence firms' behaviour. The nature of this empirical exercise is more illustrative as data availability forces us to rely on firm balance sheet characteristics observed before the start of the pandemic. We find that firms more exposed to TLTROs and capital relief measures tend to increase their employment levels significantly.

The paper is structured as follows. Section 2 presents some stylised facts and discusses the policy response measures announced after the outbreak of COVID-19. Section 3 focuses on the impact of monetary and prudential measures on bank lending conditions. Section 4 provides evidence of the real effects of pandemic relief measures. Section 5 provides some concluding remarks.

2 Stylised facts

The accelerating spread of the COVID-19 pandemic required the implementation of unprecedented containment measures by national governments across the globe. The "Great lockdown", as this period is also referred to in IMF and World Bank documents, was necessary to contain the spread of the virus. However, the unprecedented disruption in mobility and trade had a major impact on regional and global value chains, with industries more affected by travel restrictions, such as tourism and services, suffering the greatest losses. The severe impact on economic activity is visible both in soft information and in hard data. (see Figure 1).

Insert Figure 1

The severe and abrupt fall in business activity constrained firms' revenues, with a direct impact on their creditworthiness and cash flows in the short term, undermining their ability to meet commitments towards employees, suppliers and creditors. The increased credit risk on banks' balance sheets, coupled with uncertainty and risk aversion in financial markets, translated into higher funding costs for banks and a sharp repricing of risk, as illustrated by the widening of spreads on credit default swaps (CDS) and the increase in bank bond yields at the beginning of the COVID-19 crisis (see Figure 2 and Figure 3). In particular, the yields on the riskiest types of bank bonds (contingent convertibles

or "CoCos") increased by over 10 percentage points, from below 4% before the outbreak of the pandemic to close to 15% in mid-March 2020. Importantly, the deterioration in market conditions for banks was wide-spread across all euro area countries. The increase in corporate bond yields confirms the broad-based nature of the shock, which was not confined to the banking sector alone.

Insert Figure 2 and Figure 3.

The policy response was swift and ample. In the euro area, monetary, supervisory, macroprudential and fiscal authorities have all contributed with different instruments – and to different extents – to mitigating the impact of the lockdowns.

The monetary policy response to the COVID-19 crisis revolved around two main tools. First, liquidity-providing operations aimed at helping banks secure affordable funding in order to support access to credit for firms and households. These took the form of a recalibration of the existing targeted longer-term refinancing operations (TLTRO III) and the introduction of pandemic emergency long-term refinancing operations (PELTRO). The second tool was based on asset purchase programmes helping the economy absorb the shock, including a recalibration of the expanded asset purchase programme (APP) and the launch of the new pandemic emergency purchase programme (PEPP).[1]

The recalibrations of the TLTRO III introduced in March and April 2020 were pivotal in enhancing the accommodative potential of programme.[2] The introduction of a temporary rate reduction, during which the TLTRO III rate could be as low as 50 basis points below the deposit facility rate, rendered the programme extremely attractive compared to alternative funding sources for all banks across the euro area. Moreover, the expansion of the maximum amounts that banks could borrow under the TLTRO III programme significantly expanded the scope for the facility to serve as an immediately available source

[1] These measures were further complemented by temporary adjustments to the ECB collateral framework. These increased the availability of eligible collateral with which banks can participate in liquidity-providing operations and therefore mitigated the tightening of financial conditions across the euro area. Finally, swap lines across the globe were also reactivated in response to the current difficult situation.

[2] These changes consisted in: i) increasing the borrowing allowance by €1.2 trillion so as to expand the reach of the programme; ii) removing the per-operation limit so as to better align participation in the operations with the timing of the crisis; iii) providing sizeable pricing incentives to frontload participation in the June 2020 operation by scheduling a temporary rate reduction between June 2020 and June 2021; iv) last but not least, setting the stage for a rapid scaling back of the programme as early as September 2021 if conditions were to improve sufficiently by introducing the option of voluntary repayments for banks.

of term funding for euro area banks.[3] The resulting borrowing under TLTRO III in June 2020 amounted to EUR 1.3 trillion, the largest amount ever allotted in a single liquidity operation, and reached EUR 1.8 as of December 2020 (see Figure 4).

Insert Figure 4.

In parallel to monetary policy action, a series of temporary supervisory measures aimed at sustaining banks' ability to keep funding the real economy despite the coronavirus crisis were announced in March 2020. These measures were further enhanced by the relaxation of macroprudential buffers by several national authorities. Together, they have released around €140 billion of capital for euro area banks (see Figure 5), effectively reducing the regulatory capital requirement and increasing banks' capital buffers by 1.5 percentage points on aggregate.[4] In addition, the European Central Bank (ECB) also advised banks not to distribute dividends or buy back any shares until at least January 2021. This aimed mitigating incentives for banks to use the additional balance sheet capacity resulting from supervisory and macroprudential measures for pay-outs to boost their value, as that would divert resources away from the intended policy objective of shielding the economy from the adverse impact of the coronavirus crisis.

Insert Figure 5.

The support measures implemented by monetary and prudential authorities helped banks to accommodate the unprecedented increase in credit demand that followed the outbreak of the COVID-19 pandemic, as euro area firms strived to meet their liabilities when their revenues collapsed. Together with uncertainty-driven cash hoarding, the increased demand for financing working capital fuelled an unprecedented spike in credit demand: from March to May 2020, the increase in lending to firms amounted to around €250 billion on aggregate

[3] In addition, a series of "bridge" LTROs priced at the deposit facility rate (DFR) were introduced to bridge liquidity needs between the announcement of the TLTRO recalibration in March 2020 and the first subsequent operation in June 2020. These bridge operations contributed to a timely easing of access to ample Eurosystem liquidity.

[4] Banks were allowed to temporarily operate below the level of capital defined by the Pilar 2 Guidance (P2G), a measure which brought forth around €90 billion in capital relief. In addition, banks were allowed to make use of lower quality capital instruments that do not qualify as CET1 capital to meet the Pillar 2 Requirement (P2R), anticipating the implementation of a measure that would come into effect in January 2021, which resulted in approximatively €30 billion of capital relief. The combination of macroprudential measures implemented by the ECB and by several national authorities to reduce or deactivate regulatory buffers was estimated to release around €20 billion of capital.

– the largest increase on record in a three-month period. While an increase in credit demand would typically exert upward pressure on borrowing costs, this pressure did not translate into higher lending rates for firms, also thanks to the support measures that prevented a tightening of borrowing conditions through targeted and sizeable funding cost and liquidity relief.

3 Estimating the impact on bank lending conditions

In what follows we show how TLTROs and capital relief measures have contributed to support bank lending in the immediate aftermath of the pandemic shock, both as individual policies and in conjunction with one another. The first part of this section illustrates the unique data we use to conduct our empirical analysis. The second and third parts show the impact of TLTROs and changes in capital buffers in general. The fourth part weaves these two threads together to illustrate the combined effect of credit easing and capital relief measures.

Throughout this section we make use of regression analysis and local projection methods (Jordà, 2005) in a panel setting to estimate the dynamic effects of exogenous policy induced shocks. These shocks are measured via daily changes in bond prices around monetary policy announcements in order to tackle potential endogeneity issues related to banks' participation in ECB liquidity operations. We control for loan demand conditions by saturating the model with dummy variables identifying time-varying country developments. Likewise, we control for bank-specific unobserved heterogeneity using bank fixed effects specific to the post-pandemic period, which may capture exposure of certain segments of the euro area banking sector to the pandemic shock. We show that our results are robust to potential confounding factors such as the widespread provision of government guarantee schemes and the asset purchase programmes activated concomitantly to the measures targeted to support bank lending.

3.1 Data

Our empirical analysis relies on various confidential data sources. We obtain information on bank-level loan volumes from the individual Balance Sheet Items (iBSI) dataset. This is a proprietary database maintained by the ECB, which reports the main asset and liability items of over 300 banks resident in the euro area at a monthly frequency. We gather direct information on TLTRO uptake and borrowing allowances from the confidential templates

submitted by each bank as part of its reporting obligations in order to participate in the operations. This tells us exactly how much each bank was entitled to borrow under the various TLTROs and how much it actually borrowed. We exploit confidential information on bank-specific capital requirements coming from the Supervisory Review and Evaluation Process (SREP) put in place by the Single Supervisory Mechanism (SSM), and data on CET1 capital ratios from S&P Market Intelligence (SNL Financial) cross-checked with information from banks' supervisory reports. The combination of bank-level information on both capital requirements and endowments is key to fully characterising banks' capital buffers, especially those resulting from the capital relief measures adopted since March 2020. Lastly, we gather the information on daily movements of bank bond yields from Markit iBoxx.

Table 1 summarises the rich set of bank characteristics we obtain from merging the above datasets. Covering a total of 349 banks, our sample provides comprehensive coverage of banks in the euro area at a monthly frequency from September 2014 to December 2020.

Insert Table 1.

3.2 Targeted liquidity operations and lending growth

TLTROs are term funding operations with attractive pricing and a design that provides incentives to participating banks to extend loans to the private sector (with the exclusion of mortgages). In theory, banks that borrow under these operations not only see their funding costs decrease, which already activates a standard bank lending channel of monetary policy, but also tend to direct that lending towards the targeted sector in order to reap the full benefits from the operations.

In what follows we study whether and to which extent, following the take-up of funds, the behaviour of banks changes if they borrow more under TLTROs. To allow for delayed responses, we estimate impulse response functions for individual banks' loan volumes to changes in participation. We do so using local projection models (Jordà, 2005; Ramey, 2016). The specification is the following:

$$\Delta L^{\tau}_{i,t+h} = \alpha^{\tau}_{c,t,h} + \beta^{\tau}_{h}\text{TLTRO uptake}^{\tau}_{i,t} + \Gamma^{\tau}_{h} X^{\tau}_{i,t-1} + \epsilon^{tau}_{i,t+h} \tag{1}$$

where we allow for a delayed response within 10 months, that is, $h = 1, \ldots, 10$.[5] We con-

[5]We represent only responses up to 10 months because in the post-pandemic period the latest data we

sider two periods separated by the outbreak of the pandemic in the euro area and the related policy response, $\tau = \{\text{Pre-pandemic}\}$ until February 2020 and $\tau = \{\text{Post-pandemic}\}$ from March 2020. Each observation is a bank i in month t. $\Delta L^{\tau}_{i,t+h}$ is the percentage change in volume of loans to NFCs of bank i between $t-1$ and $t+h-1$. The variable TLTRO uptake$^{\tau}_{i,t}$ is the change that occurred over the last three months in the ratio of uptake over borrowing allowance of bank i in period t in any of the TLTRO programmes (TLTRO I, TLTRO II or TLTRO III). Each regression includes country-time $\alpha^{\tau}_{c,t,h}$ and bank $\alpha^{\tau}_{i,h}$ fixed effects, each specific to the horizon h and the period τ. The additional control $X^{\tau}_{i,t-1}$ is the volume of loans to firms of bank i in month $t-1$, capturing some degree of persistence in the uncovered correlations and standing more generally as a proxy of bank size.

The results are reported in Figure 6. TLTRO operations have been associated with more buoyant loan developments since their inception in 2014. Banks that participate more in TLTROs show an increasingly higher loan volume compared to banks that participate less, even controlling for macroeconomic developments at the country level.[6] Before the pandemic, an increase of TLTRO funds equal to 45% of the borrowing allowance, which is similar to what is registered with the largest TLTRO III operation in June 2020 for the aggregate of the euro area banking sector, is associated with a 1.3% increase in loan volumes after 3 quarters. The impact is gradual, reflecting a natural delayed response of loan origination, and persistent, which is in line with the design of TLTROs as term operations which provide liquidity over longer maturities.[7] After the pandemic, the same change in participation is associated with a similar response of lending in the first months after participation, followed by a much larger loan expansion which peaks at over 5% of ex-ante loan volume after 9 months.

Insert Figure 6.

cover is for December 2020 with the shock originating at the earliest in March 2020 (included).

[6] In the Appendix we provide a series of robustness checks on this effect, exploring longer horizons, previous trends and the overall reaction of the rest of the balance sheet items to an increased participation to TLTROs.

[7] TLTRO I consisted in eight quarterly operations expiring in September 2018, with the possibility to repay early two years after allotment. TLTRO II consisted in four quarterly operations with a four-year maturity and an early repayment option after two years. At its announcement in March 2019, TLTRO III was to cover seven quarterly operations with a two-year maturity and no early repayment option. In September 2019, ahead of the first operation, the maturity was extended to three years and early repayment was allowed after two years. In March 2020, amid the pandemic emergency and ahead of the third TLTRO III operation, early repayment was allowed after one year from allotments starting in September 2021.

There are several explanation for this large increase in elasticity. First, borrowing allowances were increased from 30% to 50% of eligible loans (loans to firms and households with the exclusion of mortgages as of February 2019). Second, the structure of the incentive scheme of TLTRO III after the pandemic recalibration is targeted to concentrate the stimulus in the year after March 2020, favouring a front-loading of the support to loan volumes. In fact, once corrected for the change in borrowing allowance, the elasticity at 9 months after the pandemic is similar to what is observed at 24 months before the pandemic (not reported). Third, there may be effects of TLTROs that are not necessarily transmitted via actual participation and that became more prominent during the pandemic. For example, as banks shift their funding in favour of ECB's operations, lower supply of bank bonds in the market leads to lower funding costs above and beyond the effect directly connected to participation. Fourth, and most importantly, this extraordinary impact is likely to reflect the endogeneity of the decision to rely on the TLTRO as a funding option in the extraordinary times of the pandemic, especially in response to differences in bank-specific loan demand.

A reasonable concern is that there may be other, potentially unobserved factors driving both loan dynamics and the decision to participate in TLTROs. For example, a bank-specific ability to attract borrowers which is not aligned with the aggregate demand dynamics captured by country-time fixed effects, could potentially prompt higher loan volumes and the willingness to participate in TLTROs. This is because confidence on the side of prospective participants in meeting the conditions required by the programme would increase. Thus, it is important to isolate an exogenous variation related to TLTRO to identify its effect on bank lending.

With this in mind, we look at the reaction to movements in bank bond yields that occur at daily frequency around TLTRO-related announcements. The set of events considered covers the dates on which TLTRO programmes were announced, and those on which certain technical details and recalibrations were released.[8]

The specification is the following:

$$\Delta L^{\tau}_{i,t+h} = \alpha^{\tau}_{c,t,h} + \alpha^{\tau}_{i,h} + \beta^{\tau}_{h}\text{TLTRO shock}^{\tau}_{i,t} + \Gamma^{\tau}_{h} X^{\tau}_{i,t-1} + \epsilon^{\tau}_{i,t+h} \tag{2}$$

where we allow for a delayed response of various months h. We consider again two periods separated by the outbreak of the pandemic in the euro area and the related policy response,

[8]See Table A.2 in the appendix for the list of events included in our sample.

τ = {Pre-pandemic} until February 2020 and τ = {Post-pandemic} from March 2020. Each observation is a bank i in month t. $\Delta L^{\tau}_{i,t+h}$ is the percentage change in volume of loans to NFCs of bank i between $t-1$ and $t+h-1$. The variable TLTRO shock$^{\tau}_{i,t}$ measures the change in bank bond yields observed between the day before and day after TLTRO-related announcements occurred over month t. The regressions include country-time fixed effects $\alpha^{\tau}_{c,t,h}$ and bank fixed effects $\alpha^{\tau}_{i,h}$, each specific to the horizon h and period τ, as well as additional controls $X^{\tau}_{i,t-1}$.

Table 2 reports the results of this exercise. The sample over which these regressions are estimated is meaningful, covering 102 banks for which bank bond yields are available. Columns 1 to 4 present the estimation of the specification in equation (2) for the pre-pandemic period, columns 5 to 7 for the post-pandemic period. Within each period we look at various horizons. All specifications include country-time and, most importantly, bank fixed effects specific to each period, which means that aggregate and bank-specific demand components that might have emerged in the aftermath of the pandemic are controlled for. The reaction of bond yields around TLTRO announcements is associated with a stronger lending performance and impacts become statistically significant after three quarters. Impacts in the post pandemic period show a stronger reaction of bank lending compared to previous programmes, even when imposing a high saturation of the model. Moreover, historical experience with similar measures suggests that the impact at longer horizons is stronger, which is compatible with a partial frontloading of the stimulus in the post-pandemic period favoured by the interaction of the measure with the capital leeway afforded to banks by micro- and macro-prudential measures.

Insert Table 2.

The impact on lending volumes coming from TLTROs is economically meaningful. In annualised terms, the reaction of bank funding costs registered on 30 April 2020, that is, at the announcement of the extraordinarily accommodative recalibration of TLTRO III conditions which prompted the large participation in the June 2020 operation, would predict an increase of 0.5 percentage points in yearly loan growth according to past regularities, and of 0.9 percentage points if we consider the actual post-pandemic data.

What we isolate in Table 2 is the impact of TLTROs via a specific transmission channel, that is, the increase in bank loan supply from the prospective funding cost relief as measured by bond yield movements around TLTRO announcements. Yet, the impact of

TLTROs at the aggregate level of lending has been studied extensively in the literature. TLTROs activated a large variety of channels of transmission. The mere participation of banks and the extent of their participation offer only a partial view. Aggregate effects, for example, are for the most part absorbed by country-time fixed effects in our specification. Thus, it is important to place our impact in the overall range of estimates explored by previous studies, once the appropriate rescaling has been applied. Figure 7 illustrates the impact on lending growth per annum implied by 17 estimates collected in the literature.

Insert Figure 7.

This meta-analysis shows a wide range of estimates. Higher impacts are normally found in studies that use aggregate data and model the dynamic impact of the measures, whereas cross-sectional studies using micro data tend to isolate specific channels or heterogeneity along the lines of specific bank characteristics. All estimates are expressed as a function of the aggregate utilisation rate, that is, the ratio of actual uptake to borrowing allowance under the various programmes. The uptake in the June operation of TLTRO III was just above €1.3 trillion. Compared with a theoretical borrowing allowance of €2.9 trillion this yields a change in the utilisation rate of around 45%. Based on the evidence reported in Figure 6, the (endogenous) increase in loan growth associated with the realised TLTRO uptake in June 2020 would be around 1.6 percentage points each year, which would be close to the median across studies. Isolating the impact coming from the compression in bank bond yields observed around TLTRO III-related announcements proves therefore to be a sizable yet conservative estimate in the context of various transmission channels.

An additional concern is that the results, especially regarding the increased effectiveness of the measure, may be biased due to the presence of concomitant fiscal and monetary measures, most prominently the widespread provision of government guarantee schemes, the quantitative easing programmes by the ECB, and an enhancement in the incentives to lend due to the negative interest rate policy. Moreover, it might be that the pandemic has brought forth structural changes in the bank business models that reverberated in bank lending behaviours beyond what might be captured by the inclusion of country-time and bank fixed effects.

Columns 1 to 3 of Table 3 show that the impact of the TLTRO shock on loan volumes is robust to controlling for concomitant policy measures, namely, government guarantees, asset purchase programmes by the central bank and the negative interest rate policy. While

country-time fixed effects net out the role played by each country's fiscal capacity and scope to provide government guarantee schemes, controlling for the actual bank-level take-up of government guarantees, as a share of outstanding loans, further identifies banks that are more prone to take advantage of these schemes, either because of their higher exposure to the COVID-related shock or because they adapt their business practices and lending criteria to an environment where such state-sponsored guarantees are available. Guarantees are associated with a higher lending performance, although significance fades away with the horizon. Holdings of government and corporate securities capture the exposure of each bank to the windfalls coming from purchases of these assets by the central bank in the context of its asset purchase programmes (the APP, enhanced in March 2020, and the PEPP, announced in March 2020 and expanded in June 2020). In presence of the bank fixed effects which mop up the overall structure of each bank's balance sheet, this variable captures the substitution in the type of bank investment, from securities to private sector loans, that asset purchase programmes might have favoured. As expected, the sign is negative, although not significant. Lastly, large excess liquidity holdings in presence of the negative interest rate policy remunerating those holdings at negative rates (at 0.5%) induces a higher propensity to originate loans, in an attempt to shed the balance sheet of the negative charge.[9] Given that, on account of asset purchases and TLTROs themselves, aggregate excess liquidity increased considerably with the pandemic, the incidence of excess liquidity at the bank level could well be a confounding factor influencing lending dynamics. The relation with lending growth is indeed positive, though it becomes insignificant at longer horizon. In any case, the inclusion of excess liquidity in the model does not affect the coefficient associated to the TLTRO shock at any horizon.

As we measure the impact of TLTROs mainly via the funding cost relief they afford to the euro area banking system, columns 4 to 7 of Table 3 expand the specification to include also more controls for banks' funding structure, as the latter, especially in deviation from the average level in the sample as captured by bank fixed effects, may have evolved in parallel to the impact of TLTROs and thus influenced credit dynamics. For example, against the backdrop of the unprecedented uncertainty faced by businesses and households, corporate and retail deposits increased considerably since March 2020. A higher reliance on retail deposits might expose banks to a loss of net worth in a negative interest rate environment, curbing their ability to expand loan supply.[10] Moreover, some banks were

[9] See, e.g., Demiralp, Eisenschmidt, Vlassopoulos (2021) and Bottero, Minoiu, Peydró, Polo, Presbitero, Sette (2019).

[10] See Brunnermeier and Koby (2016) and Heider, Saidi, Schepens (2019).

relying on TLTRO funding already before the recalibration of the programme in March and April 2020, which would have exposed them to the additional challenge of rolling over outstanding amounts of central bank liquidity in an environment of impaired access to market-based wholesale funding. Lastly, the availability of sufficiently high capital buffers at the onset of the pandemic, again in an environment of high capital costs brought about by the pandemic, was crucial to bear the weight of the revision in economic outlook and prospective credit risk as well as the large credit expansion predicated by impact of TLTROs, at least in absence of the compensatory measures that we describe in the following section. The impact of TLTRO shocks is robust to the inclusion of controls for all these components of banks' funding structure.

3.3 Capital relief measures and lending growth

An increase in capital buffers generates the necessary leeway for banks to bear more risk and expand their exposure towards the private sector. Similarly, a sudden drop in capital buffers bears the potential to prompt a large deleveraging. The response of loan volumes to sudden changes in this key determinant of banks' risk-bearing capacity is difficult to isolate, as buffers are per se very endogenous to banks' business practices and to macroeconomic developments. Past increases in capital requirements, together with the actual capital relief measures adopted in March and April 2020, offer a natural laboratory for evaluating the impact of sudden changes in capital buffers. When capital buffers have suddenly changed or there have even been outright capital shortfalls , these shocks allow us to isolate the reaction of lending conditions to changes in capital buffers.

We illustrate how the behaviour of banks hit by an increase or a decrease in capital requirements varies, distinguishing between banks that had a high, mid or low level of capital buffer before the shock to absorb the increased requirement or to benefit from the capital relief.

We illustrate how the behaviour of banks hit by a change in their capital requirements varies, distinguishing between banks that had a high, mid or low level of capital buffer before the shock.

The specification is the following:

$$\begin{aligned}\Delta L^{\tau}_{i,t+h} \quad = \quad & \alpha^{\tau}_{c,t,h} + \alpha^{\tau}_{i,h} + \delta^{\tau,mid}_{h} \text{ Capital relief shock}^{\tau}_{i,t} \times D^{\tau,mid}_{i,t-1} + \\ & \delta^{\tau,low}_{h} \text{ Capital relief shock}^{\tau}_{i,t} \times D^{\tau,low}_{i,t-1} + \\ & \delta^{\tau,high}_{h} \text{ Capital relief shock}^{\tau}_{i,t} \times D^{\tau,high}_{i,t-1} + \Gamma^{\tau}_{h} X^{\tau}_{i,t-1} + \epsilon^{\tau}_{i,t+h} \end{aligned} \tag{3}$$

where we allow for a delayed response of various months h. Each observation is a bank i in month t. $\Delta L^{\tau}_{i,t+h}$ is the percentage change in the volume of loans to NFCs granted by bank i between $t-1$ and $t+h-1$. The the variable Capital relief shock$^{\tau}_{i,t}$ is equal to the (inverse of the) change in capital requirements (in percentage points of risk-weighted assets – RWA) that occurred for bank i at time t (extended to cover periods one quarter before and after month t), and $D^{\tau,mid}_{i,t-1}$, $D^{\tau,low}_{i,t-1}$, $D^{\tau,high}_{i,t-1}$ are equal to 1 if the difference (in percentage points of RWA) between the CET1 ratio and the capital requirement of bank i in month $t-1$ is between the 25-th and 75-th percentile, below the 25-th percentile, or above the 75-th percentile of the distribution of buffers in February 2020.[11] The additional controls $X^{\tau}_{i,t-1}$ include the level of the capital buffer and the volume of loans to firms of bank i in month $t-1$. Each regression includes country-time $\alpha^{\tau}_{c,t,h}$ and bank $\alpha^{\tau}_{i,h}$ fixed effects, each specific to the horizon h and the period τ.

Table 4 reports the results. First, banks with higher ex-ante capital buffers react less to changes in capital requirements. This is intuitive as the capital constraint is less binding for these banks. Second, banks with lower ex-ante capital buffers reacted strongly to past increases in capital requirements as these likely forced them to deleverage in order to address capital shortfalls. Third, banks with intermediate capital buffers benefitted the most from the capital relief measures adopted in March and April 2020. Their stronger reaction compared to banks with lower buffer may be linked to the need to have sufficient capital leeway to expand their balance sheet in an environment of very high uncertainty, such as that emerged after the outbreak of the pandemic. Finally, the impact of the capital relief was particularly strong in the first 6 months, while weakening at longer horizons.

Insert Table 4.

The impact of the recently adopted capital relief measures on lending volumes is economically sizeable. Considering the estimates for the 50% of banks with neither too high nor

[11] In our sample, the 25-th percentile is 0.9% and the 75-th percentile is 5.6%.

too low levels of ex-ante capital buffers, the registered capital relief of 1.5 percentage points granted through the actions of macroprudential authorities and supervisors may thus have created space for an impact on lending growth as high as 2.7% after 3 quarters. Historical regularities based on pre-pandemic observations would have predicted, for the same capital relief, an increase of 1.8% after 3 quarters which would have reached 2.2% two years after the shock. These impacts are in line with the central tendency of the distribution of impacts found in a wide range of studies covering both cross-sectional analyses and model-based assessments (see Figure 8).

Insert Figure 8.

3.4 Policy complementarities

As shown in Section 3.2, the term funding at cheap rates provided by TLTROs sustained banks' intermediation capacity in general. The question is now whether this is particularly true when banks can rely on their ability to leverage up. The increased availability of capital buffers has the potential to elevate the benefits of the TLTROs from merely providing a substitute for more expensive forms of funding to enabling outright balance sheet expansion, thereby enhancing the monetary stimulus that is eventually conveyed to the real economy.

In what follows we complement the analysis conducted in Section 3.3 with a particular focus on TLTROs' interaction with capital availability. This allows us to shed light on the synergies between the recalibrations in the design of TLTRO III and the capital relief measures adopted by macroprudential and microprudential authorities.

The specification is the following:

$$\begin{aligned} \Delta L_{i,t-1,t+1} &= \alpha_{c,t} + \alpha_i + \beta \text{TLTRO}_{i,t} + \delta \text{Capital Buffer}_{i,t} + \\ &\quad \gamma \text{TLTRO}_{i,t} \times \text{Capital Buffer}_{i,t} + \Gamma X_{i,t-1} + \epsilon_{i,t} \end{aligned} \tag{4}$$

where each observation is a bank i in month t. $\Delta L_{i,t-1,t+1}$ is the percentage change in volume of loans to NFCs issued by bank i between the month before and the month after period t. The variable $TLTRO_{i,t}$ can take two forms. First, it can be the change that occurred over the last three months in the ratio of uptake over borrowing allowance of bank i in period t in TLTRO III during the pandemic. Second, it can be the change in bond yields occurred between the day before and the day after TLTRO-related announcements.

Capital Buffer$_{i,t}$ is the difference (in percentage points of RWA) between the CET1 ratio of bank i in month $t-1$ and its bank-specific capital requirement in month t (when the bank-specific requirement is not available, the capital requirement is the average in country c). The additional controls $X_{i,t-1}$ include, for bank i in month $t-1$, the volume of loans to firms, the share of loans to NFCs covered by government guarantees, the ratio of holdings of securities issued by euro area governments and non-financial corporations over assets, the holdings of excess liquidity over assets, the deposit ratio and the ratio of TLTRO funds over assets. Each regression includes country-time $\alpha_{c,t}$ fixed effects. When warranted, the specification includes also bank fixed effects α_i.

Table 5 shows how the capital relief measures actually allowed for the ample accommodation granted by TLTROs to be translated into higher lending volumes during the pandemic. The effect is always statistically significant. It operates even when controlling for bank-specific unobserved heterogeneity which might be related to banks' differential exposure to the pandemic as well as for the country-month average effects more related to the macroeconomic outlook and the country-specific policy responses. Moreover, results are robust to the inclusion of controls for the concomitant adoption of other policy measures such as government guarantees or asset purchases by the central bank, and for the funding structure of participants (columns 3 and 4). The results proxying TLTRO exposure by the direct measure of TLTRO uptake are shown in columns 1 and 3. As discussed above, these results can suffer from endogeneity problems, which we address by measuring exposure based on banks' funding cost reactions around TLTRO-related events. Considering this more exogenous measure of TLTRO exposure (columns 2 and 4) shows that each percentage point of additional buffer is associated with an increase of around 25% in the impact on lending volumes coming from TLTROs (column 4). These results confirm that the simultaneous adoption of accommodative monetary and micro- and macro-prudential policies has significantly contributed to stave off the large deleveraging pressures that arose at the onset of the pandemic.

Insert Table 5.

4 The real effects of pandemic measures

In the previous section, we find that monetary and prudential measures are estimated to effectively increase lending volumes. In this section we investigate the potential real economic effects of the pandemic measures by assessing whether and how these measures can also

influence firms' behaviour. More precisely, we are interested in whether following policy interventions firms more exposed to pandemic measures increase their employment.

We investigate these questions by matching bank level information with firm level data obtained from Bureau Van Dijk's Orbis – a comprehensive database of financial statements of companies worldwide. Importantly, for each firm Orbis also provides information on the names of the most important banks. We assume that firms connected with intermediaries more affected by TLTROs (i.e. experiencing larger declines in funding costs around TLTRO-related events) or with higher capital buffers as a result of capital relief measures are more exposed to the pandemic measures.

The sample used in the empirical analysis consists of a cross-section of 117,062 firms followed between 2014 and 2018.[12] Table 6 summarizes the main variables of the firm-level dataset. Overall, our sample is highly representative of aggregate and cross-sectional patterns in the euro area. In this respect, it allows us to analyze the real effects of monetary and prudential policies, relying on a sample with large coverage.

Insert Table 6.

Given that the policy shocks occur at the bank level and we are interested in developments at the firm level, we associate to each firm the average shock that the counterpart banks of each firm experience. As shocks, we consider the change in bank bond yields around TLTRO-related events during 2014 and the change in bank capital requirements introduced in January 2015. These shocks are arguably exogenous to firm behaviour for two reasons. First, they are eminently related to banks and have no connection with euro area firms except the channel that passes via banks. Second, bank bond developments are identified at a high frequency before the implementation of TLTRO operations, which started only in September 2014.

In order to explore the impact on firms, we adopt the following specification:

$$\Delta E_{f,H} = \alpha_{c,s,d,H} + \delta_H \text{TLTRO shock}_f + \gamma_H \text{ Capital relief shock}_f + \Gamma_H X_f + \epsilon_{f,H} \quad (5)$$

[12] The construction of our sample is similar to Altavilla, Burlon, Giannetti and Holton (2021). We restrict our sample to 12 euro area countries for which Orbis provides information on counterpart banks (Austria, Estonia, France, Germany, Greece, Latvia, Lithuania, Luxembourg, Malta, the Netherlands, Portugal, and Spain) and to the 102 banks that have traded bank bonds for which we can observe high-frequency changes around TLTRO-related announcements.

where $\Delta E_{f,H}$ is the percentage change in firm f's employment occurred between 2014 and year H, with $H = 2015, \ldots, 2018$; TLTRO shock$_f$ is the average bank bond shock experienced by banks connected to firm f and Capital relief shock$_f$ is the average capital relief shock experienced by the same banks of firm f. When warranted, X_f includes a series of firm-level controls. Each regression includes fixed effects $\alpha_{c,s,d,H}$ to capture demand and industry-specific components and is specific to the horizon H. The fixed effects absorb variation at the country-sector, country-sector-decile of the firm assets distribution and city-sector levels.[13]

Table 7 reports the results of this specification for the two-year horizon ($H = 2016$). Column 1 reports that firm employment expands as a result of TLTRO-related shocks and contracts for capital requirement shocks. Impacts are economically meaningful, as standard deviations of bank bond shocks (4 bp) and capital requirement shocks (0.9 pp) are symmetrically associated to a half percentage point change in employment. Column 2 shows that the expansion in employment is associated also with a parallel increase in firms' total assets, which points to a generalised size effect of the policies. The easing of bank lending conditions brought forth by TLTRO announcements allows firms to expand their business size, whereas the symmetric and opposite effect occurs in case of a tightening in capital requirements that leads to a contraction of capital buffers. For TLTRO-related shocks, this effect is also accompanied by a reduction in firm leverage as shown in column 3, which suggests that firms do not simply get access to larger volumes of cheap credit but rather receive more favourable borrowing conditions which allow them to expand. Column 4 checks whether the observed increases in employment do not come at the detriment of productivity, measured as sales per worker. In fact, business volumes seem to expand sufficiently to fully offset the increase in employment, leaving no significant impact on productivity. The symmetric argument applies to capital shortages generated by changes in capital requirements. While pandemic measures do not seem to enable firms to obtain productivity gains, they equally do not cause productivity losses despite supporting employment.

Insert Table 7.

Table 8 confirms that TLTRO and capital relief shocks are transmitted to firms' employment via an increase in bank lending. Column 1 shows that if we substitute the two shocks

[13]Given that shocks occur at the bank level, we cluster errors at the bank level, which is the most conservative approach. We associate one bank to each firm for those firms (less than 50%) that report more than one bank. Results are the same with robust standard errors.

with the increase in bank credit as predicted by the shocks at the bank level we obtain the same positive impact on firm employment. Column 2 validates this interpretation by showing that if we use the actual bank credit, which is not necessarily related to TLTROs or a change in capital requirements, we do not obtain the same response of employment. The portion of bank credit that helps to explain employment dynamics is the one related to the reaction of banks to TLTRO and capital relief shocks. Columns 3 to 5 offer a series of robustness checks that expand the saturation of the model to include fixed effects also for firm size or for a finer grid of geographical location and industrial specialisation, so as to control further for demand factors and industry dynamics or local developments. Columns 6 to 8 include a series of controls to account for firm and bank characteristics. The impact of TLTRO and capital relief shocks is unaffected by this demanding sequence of controls.

Insert Table 8.

Figure 9 illustrates the impact on firm employment of a one standard deviation shock for both TLTRO announcements and capital requirements at different horizons. The effects of TLTRO-related shocks stabilize after the second year, whereas capital requirement shocks take more time to cumulate, progressively reaching a -0.8% impact after 4 years. Impacts are not driven by pre-existing trends in employment nor in other firm characteristics.[14]

Insert Figure 9.

The impacts predicted for the current juncture by these illustrative regressions based on past experiences are economically meaningful. Considering the funding cost relief and the capital relief observed over the period between March and April 2020, the overall impact of the pandemic measures bears the potential to forestall an employment decline in the corporate sector over 2020-2022 of 1.7%, equivalent to more than 1 million workers.[15]

[14] See Table A.3 in the appendix.

[15] The 1 million figure is obtained by applying the percentage increase predicted by the coefficients reported in Table 7, column 1, to 80 million private sector employees in the euro area on average in the 3 years before 2020, which result from subtracting from total employment the self-employed and the employees of the public sector.

5 Conclusions

The unprecedented policy response to the COVID-19 crisis, in the form of new and more targeted measures, has been crucial for counteracting the adverse economic consequences associated with the outbreak and intensification of the crisis. In the euro area, national and supranational policymakers have reacted promptly with several policy initiatives. This paper assesses a subset of these measures: those directly targeted at improving bank lending conditions.

We addressed two related questions. First, has banks' intermediation capacity been affected by the policy response to the crisis? Second, has the coordinated nature of the pandemic response policies triggered an amplification effect above and beyond the impact of their individual announcement and implementation?

In general, given that the pandemic is still under way, producing an econometric assessment of our two main questions is very challenging. However, using confidential data since the start of the pandemic already allows us to estimate the overall support these measures have provided for lending conditions at the peak of the crisis. The use of post-pandemic data to quantify funding and capital relief associated to the policies is crucial to address relevant issues related to the potential structural break in the economic relationships following the start of the COVID-19 crisis. We reach two main conclusions.

First, the pandemic response policies have prevented the materialisation of an adverse equilibrium which would have resulted in a substantial contraction in lending and an even sharper collapse in real economic activity. The measures had significant repercussions on banks' capacity to remain active carriers of the monetary stimulus. Comparing the responses of bank lending conditions to the policy measures during the pandemic with the impact of similar measures in the past, we find no evidence of decreasing returns, also after controlling for the simultaneous adoption of fiscal measures like government guarantees and quantitative easing policies by the ECB.

Second, the analysis reveals important complementarities between a targeted stimulus for loan origination via funding operations and the preservation of the capital buffers necessary to produce the intended increase in exposures. The close coordination between monetary policy and prudential measures has generated an amplification effect on lending and the additional impact on lending from a coordinated intervention is found to be sizeable.

In a final illustrative exercise, we assess the potential real effects of the joint pandemic

response measures by estimating the adjustment in labour input variables using individual firms balance sheet data. We find that in absence of monetary and prudential policies firms' employment would have significantly declined.

References

[1] Acharya, V., and Steffen, S. (2020) "'Stress Test' for Banks as Liquidity Insurers in a time of COVID", mimeo.

[2] Albertazzi, U., Altavilla, C., Barbiero, F., Boucinha, M. and Di Maggio, M. (2019), "The incentive channel of monetary policy: quasi-experimental evidence from liquidity operations", mimeo.

[3] Aiyar, S., Calomiris, D., Wieladek, T. (2012), "Does Macro-Pru Leak? Evidence from a UK Policy Experiment", NBER Working Papers, No 17822.

[4] Altavilla, C., Boucinha M., Peydró J. L., Smets F.R. (2020), "Banking Supervision, Monetary Policy and Risk-Taking: Big Data Evidence from 15 Credit Registers", ECB Working Paper Series, No. 2349.

[5] Altavilla, C., Burlon, L., Giannetti, M., Holton, S. (2021), "Is there a zero lower bound? The effects of negative policy rates on banks and firms", Journal of Financial Economics, forthcoming.

[6] Altavilla, C., Canova, F. and Ciccarelli, M. (2020), "Mending the broken link: Heterogeneous bank lending rates and monetary policy pass-through", Journal of Monetary Economics, Vol. 110, pp. 81-98.

[7] Altavilla, C., Laeven, L., Peydró, J. L. (2020) "Monetary and Macroprudential Policy Complementarities: Evidence from European Credit Registers", mimeo.

[8] Afonso, A. and Sousa-Leite, J. (2019), "The transmission of unconventional monetary policy to bank credit supply: evidence from the TLTRO", Working Papers, No 201901, Banco de Portugal.

[9] Andreeva, D. C. and García-Posada, M. (2021), "The impact of the ECB's targeted long-term refinancing operations on banks' lending policies: the role of competition", Journal of Banking & Finance, Vol. 122.

[10] Arce, O., Gimeno, R. and Mayordomo, S. (2020), "Making Room for the Needy: The Credit-Reallocation Effects of the ECB's Corporate QE", Review of Finance, Vol. 25(1), pp. 43–84.

[11] Balfoussia, H. and Gibson, H. D. (2016), "Financial conditions and economic activity: the potential impact of the targeted long-term refinancing operations (TLTROs)", Applied Economics Letters, Vol. 23(6), pp. 449-456.

[12] Bats, J. and Hudepohl, T. (2019), "Impact of targeted credit easing by the ECB: Bank-level evidence", DNB Working Papers, No 631, De Nederlandsche Bank.

[13] Beck, T. and Keil, J. (2021), "Are Banks Catching Corona? Effects of COVID on Lending in the US", CEPR Discussion Paper 15869.

[14] Benetton, M. and Fantino, D. (2021), "Targeted Monetary Policy and Bank Lending Behavior" , Journal of Financial Economics, forthcoming.

[15] Berrospide, J. M. and Edge, R. M. (2019), "The Effects of Bank Capital Buffers on Bank Lending and Firm Activity: What Can We Learn from Five Years of Stress-Test Results?", Finance and Economics Discussion Series 2019, No 050, Board of Governors of the Federal Reserve System, United States.

[16] Blank, M., Hanson, S. G., Stein, J. C. and Sunderam, A. (2020), "How should U.S. bank regulators respond to the COVID-19 crisis?", Hutchins Center Working Papers, No 63.

[17] Boeckx, J., de Sola Perea, M. and Peersman, G. (2020), "The transmission mechanism of credit support policies in the euro area" , European Economic Review, Vol. 124(C).

[18] Borio, C. (2014) "Monetary policy and financial stability: what role in prevention and recovery?", BIS Working Paper, No 440.

[19] Borio, C. and Restoy, F. (2020), "Reflections on regulatory responses to the Covid-19 pandemic", FSI Briefs No 1, BIS, April 2020.

[20] Bottero, M., Minoiu, C., Peydró, J.-L., Polo, A., Presbitero, A., and Sette, E. (2019). "Negative Monetary Policy Rates and Portfolio Rebalancing: Evidence from Credit Register Data", International Monetary Fund WP/19/44.

[21] Bridges, J., Gregory, D., Nielsen, M., Pezzini, S., Radia, M. and Spaltro, M. (2014), "The impact of capital requirements on bank lending", Bank of England Working Papers, No 486.

[22] Brunnermeier, M. K., and Koby, Y. (2016). "The reversal interest rate: An effective lower bound on monetary policy", Working Paper, Princeton University.

[23] Brunnermeier, M. and Krishnamurthy, A. (2020), "Corporate Debt Overhang and Credit Policy", Brooking Paper on Economic Activity, June 2020.

[24] Coenen, G., Karadi P., Schmidt S. and Warne A. (2018), "The New Area-Wide Model II: an extended version of the ECB's micro-founded model for forecasting and policy analysis with a financial sector", ECB Working Papers, No 2200.

[25] Cravo Ferreira, M. (2019), What happens when the ECB opens the cash tap? An application to the Portuguese credit market, dissertation, Universidade Católica Portuguesa.

[26] Darracq Pariès, M., Jacquinot, P. and Papadopoulou, N. (2016), "Parsing financial fragmentation in the euro area: a multi-country DSGE perspective", ECB Working Papers, No 1891.

[27] Darracq Pariès, M., Kok-Sorensen, C. and Rodriguez-Palenzuela, D. (2011) "Macroeconomic Propagation under Different Regulatory Regimes: Evidence from an Estimated DSGE Model for the Euro Area", International Journal of Central Banking, Vol. 7(4): 49–113.

[28] De Nicolò, G. (2019), "The costs and benefits of bank capital requirements", Global Finance Journal, Elsevier, Vol. 39(C), pages 21-25

[29] De Nicolò, G., Gamba, A. and Lucchetta, M. (2014), "Microprudential Regulation in a Dynamic Model of Banking", Review of Financial Studies, Vol. 27(7), pages 2097-2138.

[30] Demiralp, S., Eisenschmidt, J. and Vlassopoulos, T. (2021). "Negative interest rates, excess liquidity and retail deposits: Banks' reaction to unconventional monetary policy in the euro area", European Economic Review, Vol. 136, 103745.

[31] Esposito, L., Fantino, D. and Sung, Y. (2020), "The impact of TLTRO2 on the Italian credit market: some econometric evidence", Working Papers, No 1264, Banca d'Italia.

[32] Flanagan, T. (2020), "Stealth Recapitalization and Bank Risk Taking: Evidence from TLTROs", available at SSRN No 3442284.

[33] Fraisse, H., Lé, M. and Thesmar, D. (2020), "The Real Effects of Bank Capital Requirements", Management Science Vol. 66(1), pp.5-23.

[34] Gibson, H. D., Hall, S. G., Petroulas, P., and Tavlas, G. S. (2020), "On the effects of the ECB's funding policies on bank lending", Journal of International Money and Finance Vol. 102, pp. 1021-12.

[35] Heider, F., Saidi, F. and Schepens, G. (2019). "Life Below Zero: Bank Lending Under Negative Policy Rates", Review of Financial Studies, 32, pp. 3728–3761.

[36] Jordà, Ò. (2005), "Estimation and Inference of Impulse Responses by Local Projections", American Economic Review Vol. 95, 161-182.

[37] Laine, O. (2021), "The Effect of Targeted Monetary Policy on Bank Lending", Journal of Banking and Financial Economics, forthcoming.

[38] Li, L., Strahan, P. and Zhang, S. (2020), "Banks as lenders of first resort: Evidence from the COVID-19 crisis", The Review of Corporate Finance Studies 9(3): 472–500.

[39] Mendicino, C., Nikolov K., Suarez J. and Supera D. (2018), "Optimal Dynamic Capital Requirements", Journal of Money, Credit and Banking, Vol. 50(6), pp. 1271-1297.

[40] Offermans, C. J. and Blaes, B. A. (2019), "The Effects of Unconventional Monetary Policies on the Lending Activity of German Banks", mimeo.

[41] Ramey, V. (2016), "Macroeconomic Shocks and Their Propagation", Chapter 2 in Handbook of Macroeconomics, 2016, Vol. 2, pp. 71-162.

[42] Rostagno, M., Altavilla, C., Carboni, G., Lemke, W., Motto, R., Saint Guilhem, A., Yiangou, J. (2021), "Monetary Policy in Times of Crisis: A Tale of Two Decades of the European Central Bank", Oxford University Press (forthcoming).

[43] Svensson, L. E. O. (2017), "Cost-benefit analysis of leaning against the wind", Journal of Monetary Economics, Vol. 90, pp. 193-213.

[44] van Dijk, M. and Dubovik, A. (2018), "Effects of Unconventional Monetary Policy on European Corporate Credit" Discussion Papers, No 372, CPB Netherlands Bureau for Economic Policy Analysis.

[45] Woodford, M. (2012), "Inflation targeting and financial stability", NBER Working Paper No. 17967.

Table 1: Summary statistics for bank level data

Variable name	Units	Definition	Obs.	Mean	St.Dev.	p5	p25	p50	p75	p95
Loan volume	€Mln	Outstanding amounts of loans to NFC.	19919	11979	20640	111	1222	4357	12039	53433
Loan growth	%	Percentage change in loan volume from month *t-1* to month *t*.	19903	0.08	5.04	-5.40	-0.90	0.09	1.21	5.45
Utilisation ratio	%	Ratio between uptake in TLTRO I, TLTRO II or TLTRO III and the respective borrowing allowances.	19618	22.35	36.21	0.00	0.00	0.00	34.67	100.00
TLTRO uptake	p.p.	Change in utilisation ratio between month *t-3* and month *t* if a given bank increases its outstanding amount of TLTRO I, TLTRO II or TLTRO III between month *t-3* and month *t*.	19576	3.97	17.48	0.00	0.00	0.00	0.00	34.13
TLTRO shock	b.p.	Change in bank bond yields (with opposite sign so a decrease is reported with positive sign) occurred between the day before and the day of TLTRO-related announcements cumulated until month *t*.	7508	14.87	20.59	-19.53	7.67	15.80	23.44	43.66
Government guarantees/Loans	%	Percentage of loans to non-financial corporations in month *t* covered by government guarantees adopted since March 2020.	20224	1.40	3.14	0.00	0.00	0.00	0.91	8.84
Securities holdings/Assets	%	Ratio of holdings of securities issued by general governments or non-financial corporations over main assets.	14638	7.15	6.76	0.00	1.57	5.65	10.44	21.50
Excess liquidity/Assets	%	Ratio of excess liquidity (current account + deposit facility - minimum reserve requirements) over main assets.	19264	6.15	14.45	0.00	0.02	1.98	6.96	25.13
Deposit ratio	%	Ratio of total deposits to NFC over main liabilities.	19919	38.82	27.26	0.01	9.56	42.81	60.44	80.76
TLTRO funds/Assets	%	Ratio of TLTRO uptake over main assets.	19919	2.08	3.49	0.00	0.00	0.00	2.99	10.70
Capital buffer	%	Difference between level of CET1 ratio and bank-specific capital requirement.	17091	5.69	6.99	-1.30	1.76	3.90	7.45	20.63
Capital relief shock	p.p.	Decrease in capital requirement occurred in any month between *t-3* and *t+2* (in month *t* for March and April 2020).	19919	-0.29	1.09	-2.33	-0.61	0.00	0.00	1.32

Notes: Observations are reported at the bank and month level. Our sample consists of a panel of 349 banks over the period from September 2014 to December 2020.

Table 2: TLTRO shocks and loan growth, before and after the pandemic

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	Pre-pandemic				Post-pandemic		
Dependent variable	Loan growth 3 months ahead	Loan growth 6 months ahead	Loan growth 9 months ahead	Loan growth 24 months ahead	Loan growth 3 months ahead	Loan growth 6 months ahead	Loan growth 9 months ahead
TLTRO shock	0.016	0.054**	0.061*	0.155*	0.046	0.043	0.117***
	(0.016)	(0.022)	(0.032)	(0.080)	(0.030)	(0.033)	(0.028)
Control for bank size	YES	YES	YES	YES	YES	YES	YES
Bank FE	YES	YES	YES	YES	YES	YES	YES
Country-time FE	YES	YES	YES	YES	YES	YES	YES
Observations	5,095	5,053	5,011	3,836	616	385	154
R-squared	0.279	0.353	0.416	0.615	0.388	0.578	0.740

Notes: The table reports the coefficients resulting from the regressions $\Delta L^{\tau}_{i,t+h} = \alpha^{\tau}_{c,t,h} + \alpha^{\tau}_{i,h} + \beta^{\tau}_{h}\text{TLTRO shock}^{\tau}_{i,t} + \Gamma^{\tau}_{h} X^{\tau}_{i,t-1} + \epsilon^{\tau}_{i,t+h}$ where we allow for a delayed response of 3, 6, 9 and 24 months, that is, $h = \{3, 6, 9, 24\}$. We consider two periods separated by the outbreak of the pandemic in the euro area and the related policy response, $\tau = \{$Pre-pandemic until February 2020 and $\tau =$ Post-pandemic$\}$ from March 2020. Each observation is a bank i in month t. $\Delta L^{\tau}_{i,t+h}$ is the percentage change in volume of loans to NFCs of bank i between $t-1$ and $t+h-1$. The variable TLTRO shock$^{\tau}_{i,t}$ measures the change in bank bond yields observed between the day before and day after TLTRO-related announcements occurred over month t. The regressions include country-time fixed effects $\alpha^{\tau}_{c,t,h}$ and bank fixed effects $\alpha^{\tau}_{i,h}$, each specific to the horizon h and period τ. The additional control $X^{\tau}_{i,t-1}$ is the volume of loans to firms of bank i in month $t-1$. Standard errors are clustered at the country-time level, and reported in parentheses. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

Table 3: Robustness to other policy measures and structural changes

	(1)	(2)	(3)	(4)	(5)	(6)
	Controls for concomitant policy measures			Controls for concomitant policy measures and funding structure		
Dependent variable	Loan growth 3 months ahead	Loan growth 6 months ahead	Loan growth 9 months ahead	Loan growth 3 months ahead	Loan growth 6 months ahead	Loan growth 9 months ahead
TLTRO shock	0.065	0.118**	0.136***	0.072*	0.126**	0.142***
	(0.039)	(0.050)	(0.041)	(0.041)	(0.054)	(0.039)
Government guarantees/Loans	0.427**	1.057	-	0.360**	1.076	-
	(0.186)	(0.801)		(0.173)	(0.796)	
Securities holdings/Assets	-0.206	-1.368	-0.752	-0.296	-1.439*	-0.990
	(0.504)	(0.864)	(0.749)	(0.504)	(0.844)	(0.818)
Excess liquidity/Assets	0.071	1.063**	-0.099	0.088	1.083**	-0.091
	(0.158)	(0.450)	(0.841)	(0.182)	(0.471)	(0.928)
Deposit ratio				-0.391	-0.094	-0.820
				(0.299)	(0.351)	(0.982)
TLTRO funds/Assets				-0.375**	-0.527***	0.124
				(0.181)	(0.169)	(0.330)
Capital buffer				-0.410	-0.777	-0.088
				(0.428)	(1.237)	(1.123)
Control for bank size	YES	YES	YES	YES	YES	YES
Bank FE	YES	YES	YES	YES	YES	YES
Country-time FE	YES	YES	YES	YES	YES	YES
Observations	640	400	160	616	385	154
R-squared	0.402	0.631	0.758	0.397	0.622	0.743

Notes: The table reports the coefficients resulting from the regressions $\Delta L^{\tau}_{i,t+h} = \alpha^{\tau}_{c,t,h} + \alpha^{\tau}_{i,h} + \beta^{\tau}_{h}\text{TLTRO shock}^{\tau}_{i,t} + \Gamma^{\tau}_{h} X^{\tau}_{i,t-1} + \epsilon^{\tau}_{i,t+h}$ where we allow for a delayed response of 3, 6 and 9 months, that is, $h = \{3, 6, 9\}$. We consider the period τ after the pandemic, from March 2020. Each observation is a bank i in month t. $\Delta L^{\tau}_{i,t+h}$ is the percentage change in volume of loans to NFCs of bank i between $t-1$ and $t+h-1$. The variable TLTRO $\text{shock}^{\tau}_{i,t}$ measures the change in bank bond yields observed between the day before and day after TLTRO-related announcements occurred over month t. The regressions include country-time fixed effects $\alpha^{\tau}_{c,t,h}$ and bank fixed effects $\alpha^{\tau}_{i,h}$, each specific to the horizon h and period τ. The additional controls $X^{\tau}_{i,t-1}$ are, for bank i in month $t-1$, the volume of loans to firms, the share of loans to NFCs covered by government guarantees (missing at 9 months ahead as there were no government guarantees related to the COVID19 pandemic in February 2020), the ratio of holdings of securities issued by euro area governments and non-financial corporations over assets, the holdings of excess liquidity over assets, the deposit ratio, the ratio of TLTRO funds over assets, and the capital buffer. Standard errors are clustered at the country-time level, and reported in parentheses. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

Table 4: Capital relief shocks and loan growth, before and after the pandemic

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	Pre-pandemic				Post-pandemic		
Dependent variable	Loan growth 3 months ahead	Loan growth 6 months ahead	Loan growth 9 months ahead	Loan growth 24 months ahead	Loan growth 3 months ahead	Loan growth 6 months ahead	Loan growth 9 months ahead
Capital relief shock	0.419***	0.889***	1.187***	1.467***	1.779**	3.230***	1.781*
	(0.118)	(0.199)	(0.285)	(0.463)	(0.866)	(1.224)	(1.050)
Capital relief shock (low capital)	0.525**	0.916***	1.316***	0.447	1.766**	2.325**	-0.849
	(0.232)	(0.290)	(0.426)	(0.894)	(0.778)	(1.139)	(1.115)
Capital relief shock (high capital)	0.211*	0.421*	0.558**	-0.174	0.767	2.156**	-0.617
	(0.127)	(0.217)	(0.285)	(0.447)	(0.636)	(0.855)	(0.736)
Controls for bank size and capital buffer	YES	YES	YES	YES	YES	YES	YES
Bank FE	YES	YES	YES	YES	YES	YES	YES
Country-time FE	YES	YES	YES	YES	YES	YES	YES
Observations	14,651	14,534	14,418	11,187	1,684	1,050	420
R-squared	0.264	0.347	0.390	0.579	0.464	0.780	0.898

Notes: The table reports the coefficients resulting from the regressions $\Delta L^{\tau}_{i,t+h} = \alpha^{\tau}_{c,t,h} + \alpha^{\tau}_{i,h} + \delta^{\tau,mid}_{h}$ Capital relief shock$^{\tau}_{i,t} \times D^{\tau,mid}_{i,t-1} + \delta^{\tau,low}_{h}$ Capital relief shock$^{\tau}_{i,t} \times D^{\tau,low}_{i,t-1} + \delta^{\tau,high}_{h}$ Capital relief shock$^{\tau}_{i,t} \times D^{\tau,high}_{i,t-1} + \Gamma^{\tau}_{h} X^{\tau}_{i,t-1} + \epsilon^{\tau}_{i,t+h}$ where we allow for a delayed response of 3, 6, 9 and 24 months, that is, $h = \{3, 6, 9, 24\}$. We consider two periods separated by the outbreak of the pandemic in the euro area and the related policy response, $\tau = \{$Pre-pandemic until February 2020 and $\tau =$ Post-pandemic$\}$ from March 2020. Each observation is a bank i in month t. $\Delta L^{\tau}_{i,t+h}$ is the percentage change in the volume of loans to NFCs granted by bank i between $t-1$ and $t+h-1$, the variable Capital relief shock$^{\tau}_{i,t}$ is equal to the (inverse of the) change in capital requirements (in percentage points of risk-weighted assets – RWA) that occurred for bank i at time t (extended to cover periods one quarter before and after month t), and $D^{\tau,mid}_{i,t-1}$, $D^{\tau,low}_{i,t-1}$, $D^{\tau,high}_{i,t-1}$ are equal to 1 if the difference (in percentage points of RWA) between the CET1 ratio and the capital requirement of bank i in month $t-1$ is between the 25-th and 75-th percentile, below the 25-th percentile, or above the 75-th percentile of the distribution of buffers in February 2020. The additional controls $X^{\tau}_{i,t-1}$ include the level of the capital buffer and the volume of loans to firms of bank i in month $t-1$. Each regression includes country-time $\alpha^{\tau}_{c,t,h}$ and bank $\alpha^{\tau}_{i,h}$ fixed effects, each specific to the horizon h and the period τ. Standard errors are clustered at the country-time level, and reported in parentheses. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

Table 5: Interaction between TLTROs and capital buffer

Dependent variable: Loan growth	(1)	(2)	(3)	(4)
TLTRO uptake*Capital buffer	0.002***		0.001*	
	(0.001)		(0.001)	
TLTRO shock*Capital buffer		0.021***		0.026***
		(0.008)		(0.007)
TLTRO uptake	0.011**		0.019***	
	(0.005)		(0.007)	
TLTRO shock		0.093***		0.104***
		(0.032)		(0.036)
Government guarantees/Loans			-0.004	0.159
			(0.035)	(0.108)
Securities holdings/Assets			0.031	0.207
			(0.031)	(0.317)
Excess liquidity/Assets			-0.064	-0.024
			(0.050)	(0.137)
Deposit ratio			0.017*	-0.421*
			(0.009)	(0.235)
TLTRO funds/Assets			-0.060	-0.205
			(0.049)	(0.183)
Controls for bank size and capital buffer	YES	YES	YES	YES
Country-time FE	YES	YES	YES	YES
Bank FE	NO	YES	NO	YES
Observations	1,887	828	1,374	693
R-squared	0.138	0.343	0.132	0.325

Notes: The table reports the results from the regression $\Delta L_{i,t-1,t+1} = \alpha_{c,t} + \alpha_i + \beta TLTRO_{i,t} + \delta \text{Capital Buffer}_{i,t} + \gamma \text{TLTRO}_{i,t} \times \text{Capital Buffer}_{i,t} + \Gamma X_{i,t-1} + \epsilon_{i,t}$. $\Delta L_{i,t-1,t+1}$ is the percentage change in volume of loans to NFCs issued by bank i between $t-1$ and $t+1$, the variable $\text{TLTRO}^{\tau}_{i,t}$ can take two forms. In columns 1 and 3, it is the change that occurred over the last three months in the ratio of uptake over borrowing allowance of bank i in period t in TLTRO III during the pandemic period. In columns 2 and 4, it is the change in bond yields occurred between the day before and the day after TLTRO-related announcements. $\text{Capital Buffer}_{i,t}$ is the difference (in percentage points of RWA) between the CET1 ratio of bank i in month $t-1$ and its bank-specific capital requirement in month t (when the bank-specific requirement is not available, the capital requirement is the average in country c). The additional controls $X_{i,t-1}$ include, for bank i in month $t-1$, the volume of loans to firms (all columns), the share of loans to NFCs covered by government guarantees, the ratio of holdings of securities issued by euro area governments and non-financial corporations over assets, the holdings of excess liquidity over assets, the deposit ratio, and the ratio of TLTRO funds over assets (columns 3 and 4). Each regression includes country-time $\alpha_{c,t}$ fixed effects. Columns 2 and 4 include also bank fixed effects α_i. Standard errors are clustered at the country-time level, and reported in parentheses. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

Table 6: Summary statistics for firm level data

Variable name	Units	Definition	Obs.	Mean	St.Dev.	p5	p25	p50	p75	p95
TLTRO shock	b.p.	Change in bank bond yields occurred between the day before and the day of TLTRO-related announcements cumulated over 2014. Average across counterpart banks.	117062	14.59	3.98	9.96	13.26	14.43	15.31	22.50
Capital relief shock	p.p.	Increase in bank-specific capital requirements occurred between 2014 and 2015. Average across counterpart banks.	117062	-1.02	0.89	-3.33	-1.00	-0.83	-0.61	0.00
Change in employment	%	Percentage change in firm's number of employees between 2014 and 2016.	117062	5.74	27.83	-40.55	-3.26	0.00	18.23	53.90
Change in assets	%	Percentage change in the volume of firm assets between 2014 and 2016.	117062	7.57	27.79	-33.29	-6.40	4.73	19.65	57.54
Change in leverage	p.p.	Change in the firm ratio of liabilities over assets between 2014 and 2016.	117062	-2.16	10.98	-21.04	-6.98	-1.33	2.74	15.52
Change in productivity	%	Percentage change in firm sales per worker between 2014 and 2016.	117025	2.82	35.70	-54.77	-13.31	2.81	19.29	60.25
Predict bank credit	%	Percentage change in bank loans between 2014 and 2016 predicted by TLTRO and capital relief shocks (country-month and bank FE). Average across counterpart banks.	117062	9.02	2.71	5.76	8.50	9.56	9.90	12.70
Bank credit	%	Change in bank loan volume between 2014 and 2016. Average across counterpart banks.	117062	-7.14	9.23	-22.78	-13.62	-7.24	-2.35	6.66
Assets	log	Log of firm assets in 2014.	117062	14.08	1.53	11.75	13.06	13.96	14.96	16.91
Leverage	%	Firm ratio of liabilities over assets in 2014.	117062	58.15	26.69	12.26	37.42	60.03	79.75	100.00
Liquidity	%	Firm ratio of current assets over assets in 2014.	117062	65.04	26.92	12.84	45.92	70.31	88.46	98.64
Short-term liabilities	%	Firm ratio of current liabilities over liabilities in 2014.	117050	73.07	27.23	18.16	54.52	81.34	98.31	100.00
Interest payments	%	Firm ratio of interest paid over total liabilities in 2014.	117050	2.06	2.06	0.03	0.53	1.52	2.95	5.98
ROA	%	Firm return on assets in 2014.	116327	1.74	8.71	-12.15	0.09	1.39	4.66	15.11
Accounts receivable/Liquid assets	%	Firm ratio of accounts receivable over current assets in 2014.	117057	40.19	27.34	0.44	17.19	38.81	60.78	87.07
Number of banks	%	Number of counterpart banks.	117062	1.81	1.07	1.00	1.00	1.00	2.00	4.00
Capital buffer	%	Level of bank capital buffers in 2014.	117061	3.76	1.18	2.91	2.97	3.50	3.98	7.06

Notes: Observations are reported at the firm level. Our sample consists of a cross-section of 117,062 firms.

Table 7: Impact of TLTRO and capital relief shocks on firms

	(1)	(2)	(3)	(4)
Dependent variable:	Change in employment	Change in assets	Change in leverage	Change in productivity
TLTRO shock	0.130**	0.089*	-0.033***	-0.036
	(0.050)	(0.049)	(0.012)	(0.023)
Capital relief shock	0.598*	0.667*	-0.062	-0.063
	(0.342)	(0.333)	(0.075)	(0.259)
Country-sector fixed effects	Yes	Yes	Yes	Yes
Observations	117,062	117,062	117,062	117,025
R-squared	0.024	0.038	0.021	0.031

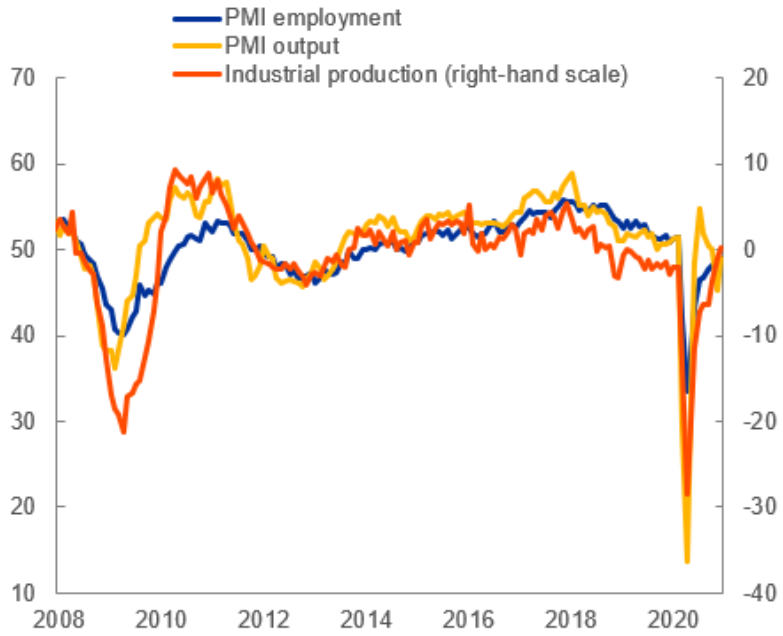
Notes: The table reports the coefficients δ and γ resulting from the regressions $\Delta Y_f = \alpha_{c,s} + \delta \text{TLTRO shock}_f + \gamma \text{ Capital relief shock}_f + \epsilon_f$. ΔY_f is the percentage change in firm f's employment (column 1), the percentage change in firm f's assets (column 2), the change in percentage points in firm f's ratio of liabilities over assets (column 3) and the percentage change in firm f's sales per worker (column 4) occurred between 2014 and 2016. TLTRO shock$_f$ is the average bank bond shock experienced by banks connected to firm f and Capital relief shock$_f$ is the average capital relief shock experienced by the same banks of firm f. Each regression includes country-sector $\alpha_{c,s}$ fixed effects. Standard errors are clustered at the bank level, and reported in parentheses. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

Table 8: Impact of TLTRO and capital relief shocks on firms: Robustness

Dependent variable:	(1) Change in employment	(2) Change in employment	(3) Change in employment	(4) Change in employment	(5) Change in employment	(6) Change in employment	(7) Change in employment	(8) Change in employment
Predicted bank credit	0.156**							
	(0.071)							
Bank credit		0.002						
		(0.019)						
TLTRO shock			0.130**	0.126***	0.144***	0.129***	0.114***	0.138***
			(0.050)	(0.045)	(0.046)	(0.041)	(0.036)	(0.050)
Capital relief shock			0.598*	0.621*	0.716**	0.566**	0.538*	0.693**
			(0.342)	(0.336)	(0.315)	(0.274)	(0.271)	(0.340)
Log(Assets)						-0.040	-0.275	0.087
						(0.155)	(0.422)	(0.647)
Leverage						0.062***	0.062***	0.066***
						(0.006)	(0.007)	(0.009)
Liquidity						0.004	0.005*	0.004
						(0.003)	(0.002)	(0.006)
Short-term liabilities						-0.009	-0.012*	-0.005
						(0.006)	(0.007)	(0.008)
Interest payments						-0.139**	-0.157**	-0.262***
						(0.059)	(0.073)	(0.067)
ROA						0.405***	0.404***	0.401***
						(0.022)	(0.024)	(0.033)
Accounts receivable/Liquid assets						0.044***	0.044***	0.055***
						(0.005)	(0.005)	(0.005)
Number of banks						0.286	0.319	0.174
						(0.208)	(0.199)	(0.128)
Capital buffer						-0.105	-0.076	-0.206
						(0.161)	(0.195)	(0.172)
Country-sector FE	YES	YES	YES	NO	NO	YES	NO	NO
Country-sector-size decile FE	NO	NO	NO	YES	YES	NO	YES	YES
City-sector FE	NO	NO	NO	NO	YES	NO	NO	YES
Observations	117,062	117,062	117,062	114,784	61,711	116,276	114,008	61,339
R-squared	0.024	0.024	0.024	0.070	0.308	0.042	0.087	0.321

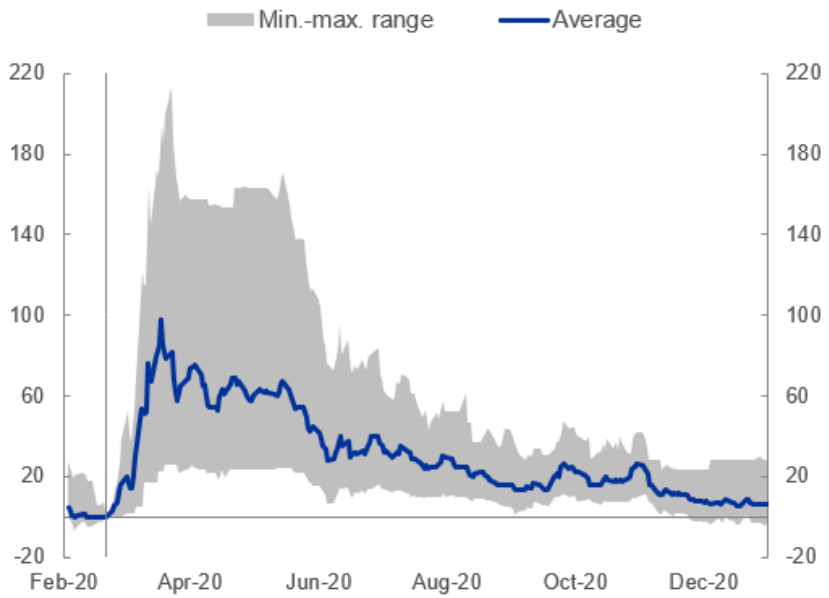
Notes: The table reports a series of regressions where the dependent variable ΔE_f is the percentage change in firm f's employment from 2014 to 2016. Columns 1 and 2 report the coefficient β_H of the regression $\Delta E_f = \alpha_{c,s} + \beta \mathrm{B}_f + \epsilon_f$, where B_f is the (average across counterpart banks) percentage change in bank loans between 2014 and 2016 predicted by TLTRO and capital relief shocks with country-month and bank FE over 2014 (column 1) or the actual percentage change in bank loans between 2014 and 2016 (column 2). Columns 3 to 8 report the coefficients δ and γ resulting from the regressions $\Delta E_f = \alpha_{c,s,d} + \delta \text{TLTRO shock}_f + \gamma \text{ Capital relief shock}_f + \Gamma X_f + \epsilon_f$. TLTRO shock$_f$ is the average bank bond shock experienced in 2014 by banks connected to firm f and Capital relief shock$_f$ is the average capital relief shock experienced in 2014 by the same banks of firm f. X_f include log of assets, leverage, liquidity, short-term liabilities, interest payments, ROA, accounts receivable/liquid assets, number of banks and capital buffer. Each regression includes fixed effects $\alpha_{c,s,d}$ as reported in the table (country-sector, country-sector-decile of firm assets distribution, city-sector). Standard errors are clustered at the bank level, and reported in parentheses. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

Figure 1: Industrial production and euro area Purchasing Managers Index (PMI) - Left-hand scale: index, 50=no change; right-hand scale, year-on-year growth rate



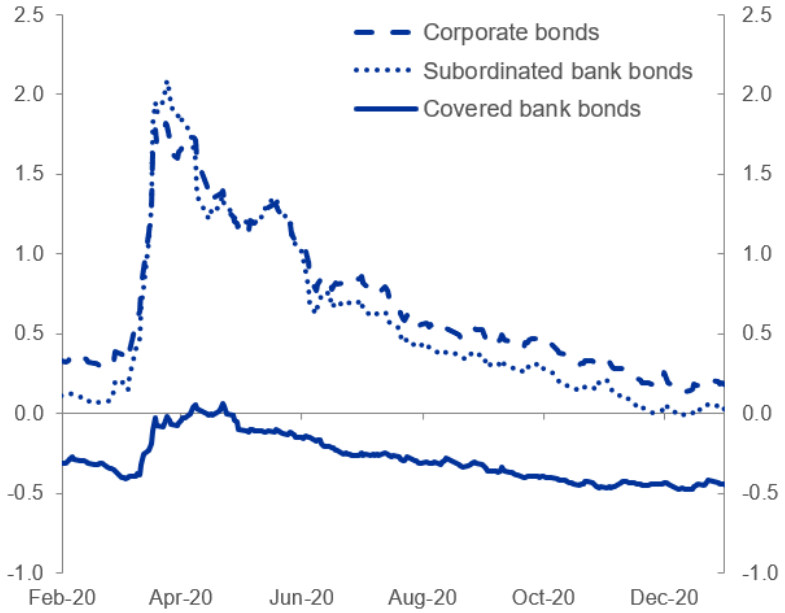
Notes: The figure illustrates developments in economic activity in the euro area based on survey (PMI) and hard data (industrial production) following the outbreak of the pandemic. It shows how these developments compare to those observed in the wake of the financial and sovereign crisis.

Figure 2: Senior five-year CDS of selected banks (basis points: 21 February 2020 = 0)



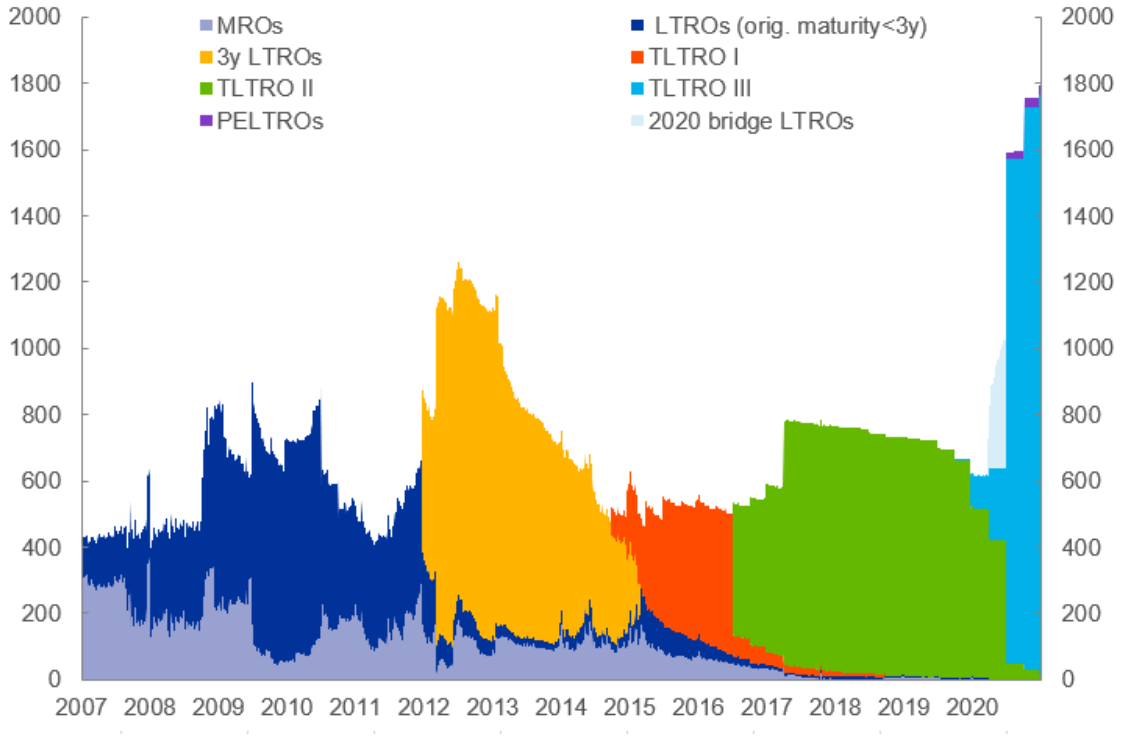
Notes: The figure illustrates the reaction of bank Credit Default Swaps to the outbreak of the pandemic. The average and the min-max range cover a balanced panel of 14 large euro area banks at daily frequency.

Figure 3: Yields on euro area bank and corporate bonds (percentages per annum)



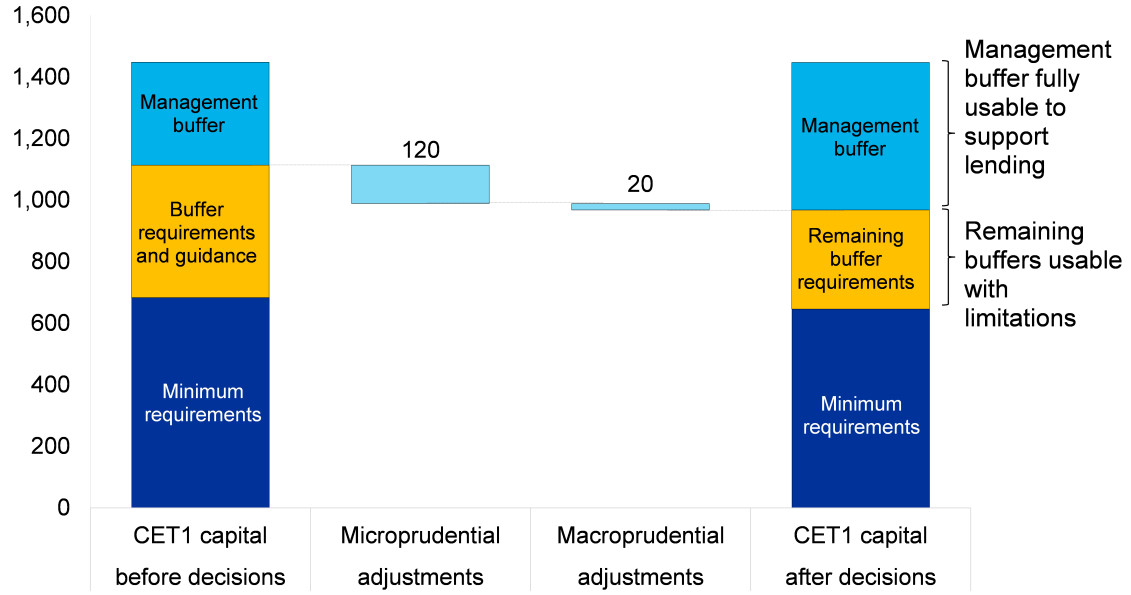
Notes: The bond yields are computed as the daily weighted average yields (by notional amount) for covered bonds and subordinated bonds with a residual maturity of between one and five years issued by banks in selected euro area countries.

Figure 4: Borrowing from the Eurosystem (in EUR billions)



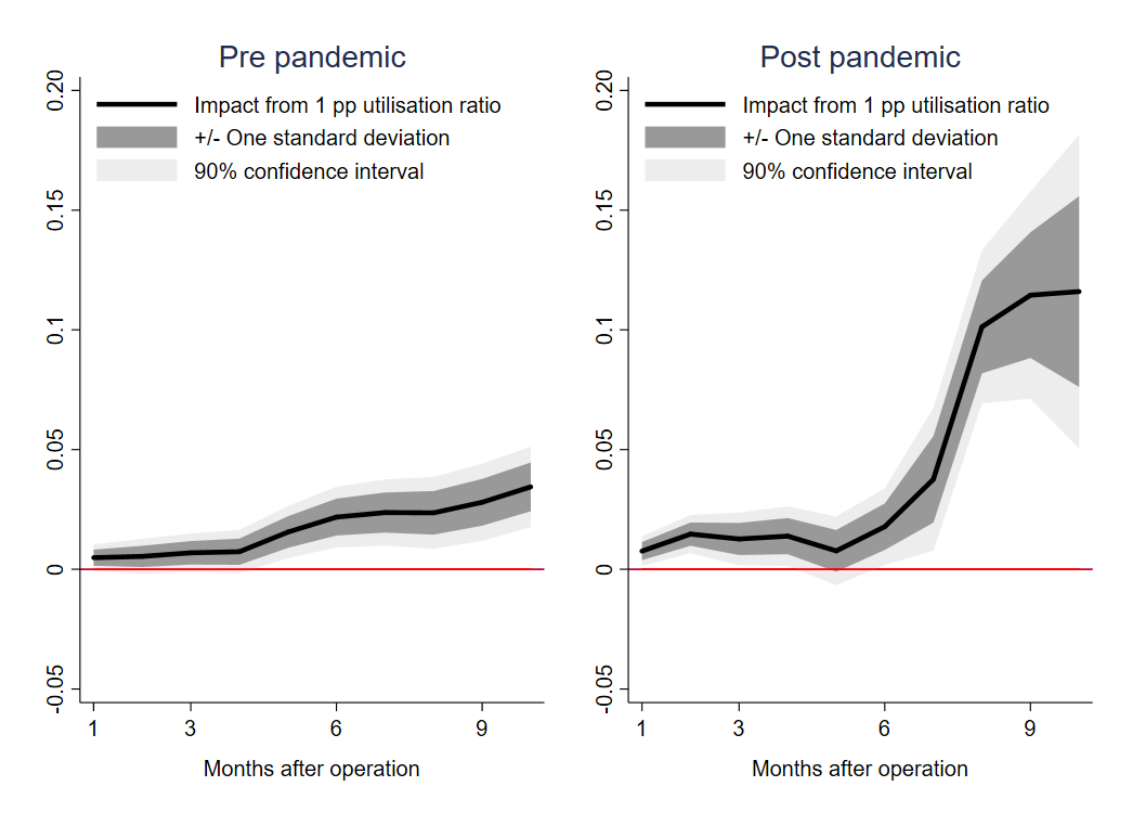
Notes: The figure shows developments in borrowing from the Eurosystem broken down into the different lending facilites. MROs are main refinancing operations. LTROs (orig. maturity <3y) are longer-term refinancing operations with original maturity below 3 years. 3y LTROs are longer-term refinancing operations with a 3-year original maturity. TLTRO I, TLTRO II and TLTRO III refer to the three programmes of targeted longer-term refinancing operations. PELTROs are pandemic emergency longer-term refinancing operations. 2020 bridge LTROs are longer-term refinancing operations introduced to bridge liquidity needs between the announcement of the TLTRO recalibration in March 2020 and the first subsequent operation in June 2020.

Figure 5: CET1 capital stack and remaining macroprudential capital buffers in the euro area (Q4 2019 - EUR billions)



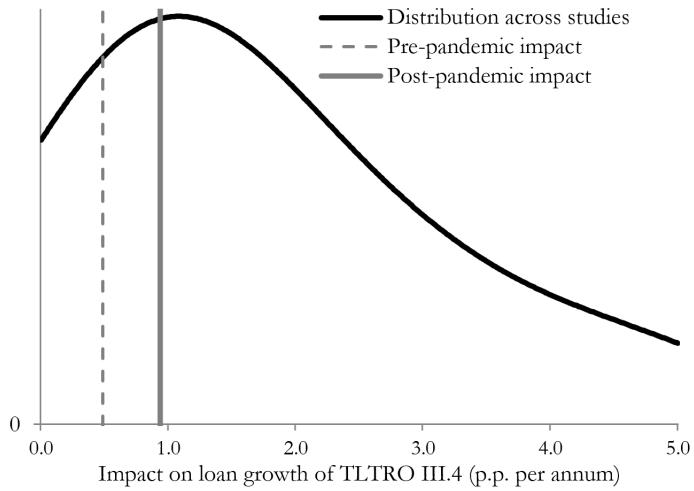
Notes: The sample covers significant and less significant institutions, consolidated at the euro area level. Microprudential adjustments include the decision on the regulatory adjustment of the P2R and making P2G temporarily usable (see press the release by European banking supervision dated 20 March 2020). Macroprudential adjustments include the releases of the CCyB, the SyRB and the other systemically O-SII buffer.

Figure 6: TLTRO participation and loan growth before and after the pandemic (percentage of ex ante volume)



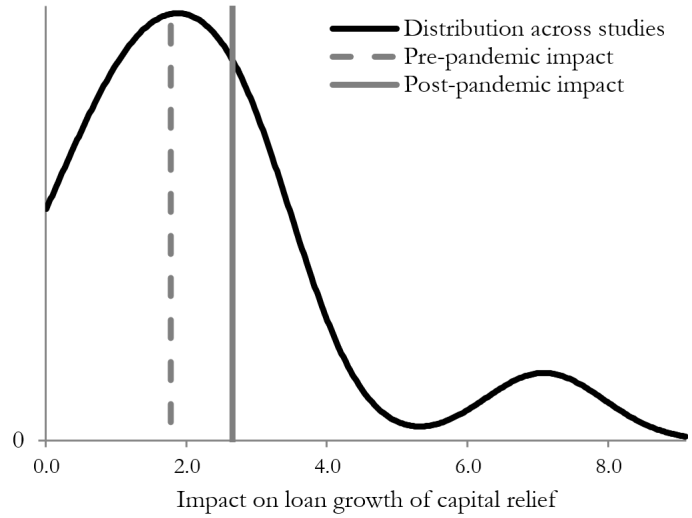
Notes: The figure reports the coefficients resulting from the regressions $\Delta L^{\tau}_{i,t+h} = \alpha^{\tau}_{c,t,h} + \beta^{\tau}_{h}\text{TLTRO uptake}^{\tau}_{i,t} + \Gamma^{\tau}_{h} X^{\tau}_{i,t-1} + \epsilon^{tau}_{i,t+h}$, for $h = 1, \ldots, 10$. $\Delta L_{i,t+h}$ is the percentage change in volume of loans to NFCs issued by bank i between $t-1$ and $t+h-1$. The variable $\text{TLTRO uptake}^{\tau}_{i,t}$ is the change that occurred over the last three months in the ratio of uptake over borrowing allowance of bank i in period t in any of the TLTRO programmes (TLTRO I, TLTRO II or TLTRO III). Each regression includes country-time $\alpha^{tau}_{c,t,h}$ fixed effects and is specific to the horizon h and the period τ. The additional control $X^{\tau}_{i,t-1}$ is the volume of loans to firms of bank i in month $t-1$. The solid line reports the coefficients β^{tau}_{h} while the grey area reports the 90% confidence intervals for each horizon h with standard errors clustered at the country-time level. The darker grey area highlights the coefficient plus/minus one standard deviation. The sample for the LHS panel starts in September 2014 and finishes in February 2020, the sample for the RHS panel stars in March 2020 and finishes in December 2020.

Figure 7: Distribution of the impact on loan growth of TLTROs across studies



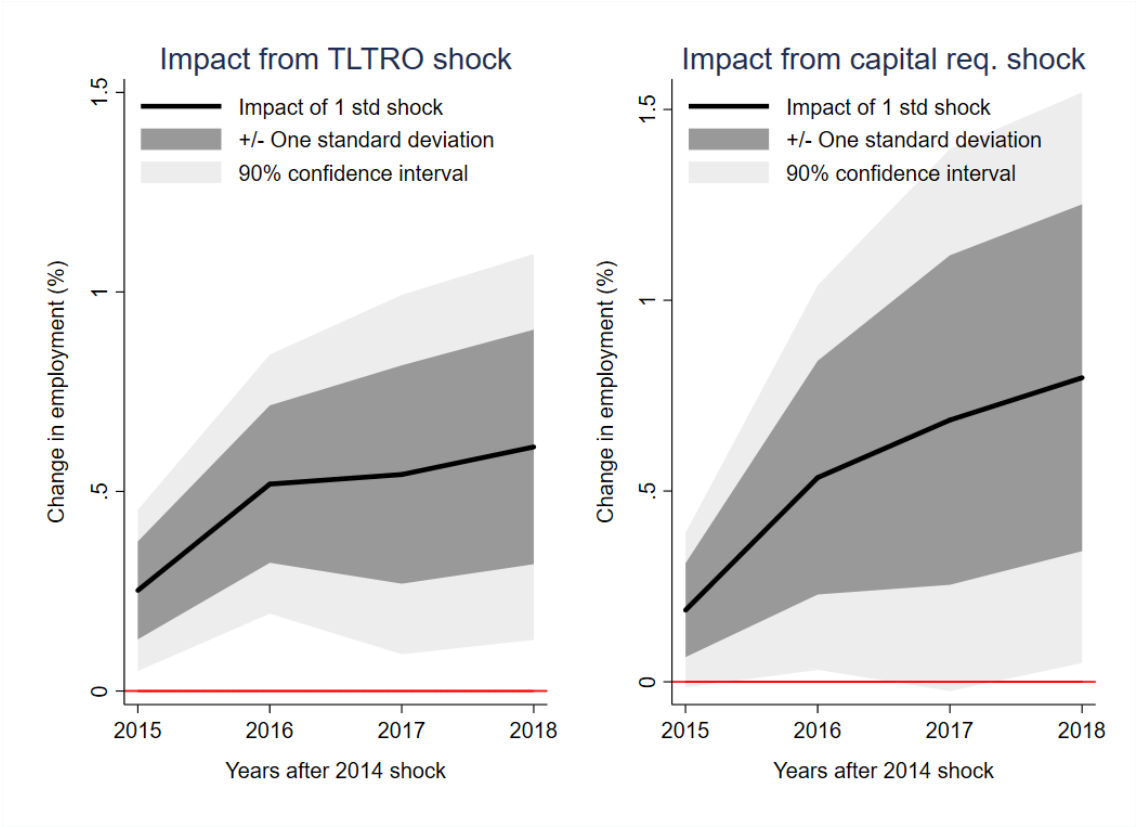
Notes: All estimates are imputed from impacts estimated 9 months ahead. The grey dashed and solid vertical lines report the estimates based on Table 2 (0.5 and 0.9 percentage points) for the pre-pandemic and post-pandemic period, respectively. The solid line shows the kernel density of the distribution of 17 estimates, truncated at the minimum and maximum estimate. The studies included in the meta-analysis are: Afonso and Sousa-Leite (2019); Albertazzi, Altavilla, Barbiero, Boucinha, Di Maggio (2019); Altavilla, Canova, Ciccarelli (2020); Andreeva and García-Posada (2021); Arce, Gimeno, Mayordomo (2020); Balfoussia and Gibson (2016); Bats and Hudepohl (2019); Benetton and Fantino (2021); Boeckx, de Sola Perea, Peersman (2020); Cravo Ferreira (2019); Esposito, Fantino, Sung (2020); Flanagan (2020); Gibson, Hall, Petroulas, Tavlas (2020); Laine (2021); Offermans and Blaes (2019); Rostagno, Altavilla, Carboni, Lemke, Motto, Saint Guilhem, Yiangou (2021); van Dijk. and Dubovik (2018).

Figure 8: Distribution of the impact on loan growth of the reduction in capital requirement



Notes: The grey dashed and solid vertical lines report the estimates based on Table 4 (2.2 and 2.7 percentage points) for the pre-pandemic and post-pandemic period, respectively for the banks with a mid level of capital buffers. The solid line shows the kernel density of the distribution of 10 estimates, truncated at the minimum and maximum estimates. The studies included in the meta-analysis are: Aiyar, Calomiris, Wieladek (2012); Berrospide and Edge (2019); Bridges, Gregory, Nielsen, Pezzini, Radia, Spaltro (2014); Coenen, Karadi, Schmidt, Warne (2018); Darracq Pariès, Kok-Sorensen, Rodriguez-Palenzuela (2011); Darracq Pariès, Jacquinot Papadopoulou (2016); De Nicolò (2019); De Nicolò, Gamba, Lucchetta (2014); Fraisse, Lé, Thesmar (2020); and Mendicino, Nikolov, Suarez, Supera (2018).

Figure 9: TLTRO shocks, capital relief shocks and firm employment (percentage of ex ante volume)



Notes: The figure reports the coefficients δ_H and γ_H resulting from the regressions $\Delta E_{f,H} = \alpha_{c,s,H} + \delta_H \text{TLTRO shock}_f + \gamma_H \text{Capital relief shock}_f + \epsilon_{f,H}$, for $H = 2015, \ldots, 2018$. $\Delta E_{f,H}$ is the percentage change in firm f's employment occurred between 2014 and year H, with $H = 2015, \ldots, 2018$, TLTRO shock$_f$ is the average bank bond shock experienced by banks connected to firm f and Capital relief shock$_f$ is the average capital relief shock experienced by the same banks of firm f. Each regression includes country-sector $\alpha_{c,s,H}$ fixed effects to capture demand and industry-specific components and is specific to the horizon H. Solid lines report the coefficients δ_H and γ_H, while grey areas report 90% confidence intervals for each horizon H with standard errors clustered at the bank level. Darker grey areas highlight the coefficients plus/minus one standard deviation.

APPENDIX: TLTRO participation, robustness and transmission

Table A.1 offers a series of robustness checks. First, in columns 1 and 5 we report the estimates reported in Figure 6 for the horizon of 24 months ahead for the two alternative measures of participation. The sample for these regressions starts in September 2014, that is, with the first TLTRO, so as to compare the lending patterns of the two types of banks over the relevant period. Columns 2 and 6 expand the sample to the earliest data point, that is, August 2007. This allows the inclusion of bank fixed effects, which isolate the component of lending not related to either unobserved bank heterogeneity or aggregate loan developments as captured by the country-time fixed effects. The correlation between participation in TLTROs and higher loan growth remains strong, despite the increase in the saturation of the model. The explained variance of loan developments passes from below 8% to above 40%, despite the sample size almost tripling.

Table A.1: Robustness on TLTRO participation and loan growth

Dependent variable:	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Loan growth	24 months ahead	24 months ahead	24 months back	24 months ahead	24 months ahead	24 months ahead	24 months back	24 months ahead
Change in TLTRO participation	7.513**	5.920**	-0.991	5.446**				
	(3.092)	(2.627)	(2.729)	(2.485)				
Change in utilisation ratio					0.073*	0.054*	0.027	0.069**
					(0.040)	(0.032)	(0.028)	(0.035)
Assets				-21.575***				-25.217***
				(7.904)				(8.222)
ROA				1.351				1.187
				(0.943)				(0.943)
Capitalisation				0.244				-0.078
				(0.524)				(0.493)
Deposit ratio				0.218				0.218
				(0.173)				(0.179)
Excess liquidity				0.189				0.270
				(0.268)				(0.300)
Government bond holdings				0.138				0.343
				(0.421)				(0.401)
Country-time fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Bank fixed effects	-	Yes	Yes	Yes	-	Yes	Yes	Yes
Observations	11,304	33,335	25,851	24,250	11,201	32,549	25,684	23,711
R-squared	0.078	0.410	0.442	0.474	0.078	0.391	0.436	0.473

Notes: Standard errors are double-clustered at the bank and country-time level, and reported in parentheses. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

Columns 3 and 7 of Table A.1 explore whether the higher lending associated with TLTROs is the result of spurious correlation due to pre-existing trends between participant and non-participant banks. In order to shed light on this, we run the same regressions as in columns 2 and 6 but substituting the dependent variable with the difference in loan volumes 24 months before the month in which participation in TLTROs occurs. The exercise reveals that there is no evidence of pre-existing trends, thus providing support for

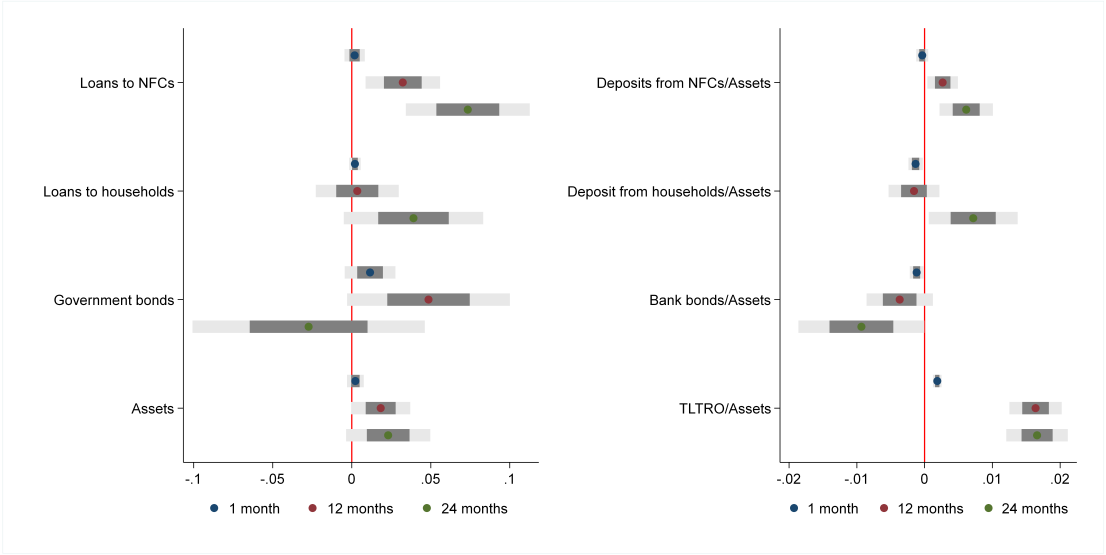
the interpretation of the coefficient as an actual impact of participation on lending.

Lastly, columns 4 and 8 of Table A.1 control for a wide range of additional observable bank characteristics, without any sizeable impact on the estimated coefficient. The relation between lending and participation in TLTROs is not affected by the size of the bank in terms of assets, nor by its profitability, level of capitalisation, funding structure, level of excess liquidity or its holdings of government securities at the time of participation.

While TLTRO participation has an impact on lending, it also affects the overall asset and liability management of banks. The impact on lending to NFCs is not accompanied by a parallel significant expansion in lending to untargeted sectors like households, for funding house purchases, or to governments in the form of higher holdings of public sector securities (see Figure A.1). In fact, as the horizon necessary for loan origination approaches, banks that participate in TLTROs rebalance away from government securities that they may have initially accumulated as a temporary and liquid way to store the additional funds. This accounts for a positive yet not statistically significant expansion of the overall balance sheet of banks once we control for the country-wide developments captured by country fixed effects. Loans to households increase at longer horizons, although not significantly, possibly on account of the positive effects that participation has on net interest income early on. This in turn naturally increases the general intermediation capacity of banks in the longer run.

The liabilities of banks are also affected by TLTRO participation, as banks that start relying on this form of funding accumulate funds up to a constant level of TLTRO reliance, reached after one year from participation. At the same time, banks substitute away from bank bonds. The latter are the marginal form of term funding and tend to be the most expensive when unsecured, and thus the most likely to be replaced by TLTROs. Deposits instead follow developments on the asset side, with reliance on deposits from NFCs increasing symmetrically to higher loan volumes to NFCs, and reliance on deposits from households increasing only over longer horizons.

Figure A.1: TLTRO participation and banks' assets and liabilities



Notes: The figure reports the coefficients resulting from the regressions $\Delta X_{i,t+h} = \alpha_{c,t,h} + \beta_h TLTRO_{i,t}^{uptake} + \epsilon_{i,t+h}$, for $h = 1, \ldots, 24$. $\Delta X_{i,t+h}$ is the percentage change in volume of, respectively, loans to NFCs, loans to households, holdings of government securities, or main assets of bank i between t and $t+h$. For the rest of the variables, it is the change in percentage points of the ratio to main assets of, respectively, deposits from NFCs, deposits from households, bank securities issued, as well as of the volume of TLTRO funding. The specifications are defined as in Figure 9. The dots report the coefficients β_h, the darker areas the coefficients plus-minus one standard deviation and the lighter areas the 95% confidence intervals, for each horizon h with standard errors clustered at the country-time level. The results one month ahead are shown in blue, 12 months ahead in red, and 24 months ahead in green.

APPENDIX: Additional tables

Table A.2: TLTRO-related events

Date	Event type	Event
08-May-14	Governing Council meeting	Draghi ready to act at next meeting
05-Jun-14	Governing Council meeting	TLTRO-I announcement
03-Jul-14	Governing Council meeting	TLTRO-I technical details
29-Jul-14	Press Release	TLTRO-I legal acts publication
22-Jan-15	Governing Council meeting	TLTRO-I modified interest rate
10-Mar-16	Governing Council meeting	TLTRO-II announcement
03-May-16	Press Release	TLTRO-II legal acts publication
07-Mar-19	Governing Council meeting	TLTRO-III announcement
06-Jun-19	Governing Council meeting	TLTRO-III technical details
29-Jul-19	Press Release	TLTRO-III legal acts publication
12-Sep-19	Governing Council meeting	TLTRO-III modified interest rate
12-Mar-20	Governing Council meeting	TLTRO-III easing conditions
30-Apr-20	Governing Council meeting	TLTRO-III pandemic rate reduction
10-Dec-20	Governing Council meeting	TLTRO-III prolonged easing conditions

Notes: The table reports the list of events used to identify the impact of TLTRO announcements on bank bond yields.

Table A.3: Impact of TLTRO and capital relief shocks on firms: Pre-existing trends

	(1)	(2)	(3)	(4)
	TLTRO shock		Capital relief shock	
	Change over previous two years	Change over previous four years	Change over previous two years	Change over previous four years
Employment	0.058	0.075	0.600	0.971*
	(0.040)	(0.051)	(0.371)	(0.520)
Assets	0.056*	0.060	0.273	0.496
	(0.028)	(0.074)	(0.472)	(0.678)
Liabilities	0.012	-0.018	0.256	0.494
	(0.036)	(0.089)	(0.483)	(0.802)
Productivity	0.046	0.007	-0.040	0.209
	(0.039)	(0.092)	(0.417)	(0.555)
Sales	0.106	0.082	0.553	1.232
	(0.065)	(0.131)	(0.730)	(0.988)
ROA	0.010	0.020	-0.137	-0.163
	(0.015)	(0.012)	(0.115)	(0.134)
Liquidity	0.015	0.020	-0.043	-0.067
	(0.009)	(0.013)	(0.049)	(0.090)

Notes: The table reports the coefficients β_H resulting from the regressions $\Delta Y_{f,H} = \alpha_{c,s,H} + \beta_H \mathrm{B}_f + \epsilon_{f,H}$. Each entry refers to a separate regression, where each row indicates to which variable $\Delta Y_{f,H}$ refers and each column indicates how $\Delta Y_{f,H}$ is measured (as a change over the two or four years prior to 2014) and for which shock B_f (TLTRO shock or capital relief shock). Each regression includes country-sector $\alpha_{c,s,H}$ fixed effects. Standard errors are clustered at the bank level, and reported in parentheses. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.