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TLTRO III and banks' loan book rebalancing during the pandemic: less 'targeted' than intended for some?

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Abstract

Targeted longer-term refinancing operations (TLTROs) helped supporting bank lending to firms and to households in the course of the COVID-19 pandemic. The use of TLTRO funding for mortgage loans to households had explicitly not been included into the targeted loan categories of these schemes, thereby, limiting potential unintended side effects on residential real estate markets. This paper, by means of an empirical analysis, assesses the impact of the relaxation of TLTRO III conditions at the beginning of the COVID-19 pandemic on euro area banks' loan portfolio composition. Our findings suggest that the targeted funding instrument under the relaxed pandemic conditions might, to some extent, have contributed to further fuelling residential real estate vulnerabilities, especially for banks in already vulnerable countries. Our results also contribute to the discussion on policy design and the preservation of the targeted nature of such support measures going forward and their interaction with financial stability.

JEL classification: E52, E58, G01, G21, G28.

Keywords: COVID-19 pandemic, unconventional monetary policy, TLTRO, residential real estate.

Non-technical summary

How did euro area banks' loan portfolio composition change after the easing of conditions for the targeted longer-term refinancing operations III (TLTROs III) in response to the COVID-19 pandemic? Did the eased conditions still provided sufficient incentives to all euro area banks for a targeted use of these funds? This paper studies the impact of changes in TLTRO III conditions at the beginning of the COVID-19 pandemic on euro area banks' loan portfolio composition. To that end, we use data covering a representative sample of euro area banks over the period Q1 2019 to Q2 2021 and empirically test how different groups of banks rebalanced their loan portfolio.

TLTROs have been designed to support banks' extension of corporate and consumer loans by providing preferential funding conditions for using the obtained funds for new lending in these targeted loan categories, (see Benetton and Fantino, 2021; Afonso and Sousa-Leite, 2020, among others). The use of TLTRO funding for mortgage loans to households had explicitly not been included into the targeted loan categories of these schemes, thereby, limiting potential unintended side effects on residential real estate markets. In response to the COVID-19 pandemic, the Governing Council of European Central Bank (ECB) decided on a range of monetary policy support measures including a notable easing of conditions for its TLTRO III. Before the pandemic, the support of TLTROs III to targeted sectors of the economy was ensured by requiring that lending growth toward these sectors exceeded certain benchmarks in order to obtain the most favourable borrowing conditions. With the pandemic, these requirements were eased in order to facilitate the support to the real economy, which might have indirectly supported also other forms of lending.

With our empirical analysis, we find that banks participating in the TLTRO III programme increased their share of mortgage lending more than other banks after the easing of TLTRO III conditions. We also find that this result is driven by banks located in countries where vulnerabilities in residential real estate markets had already built-up before the pandemic. Therefore, our findings suggest that the relaxation of TLTRO III conditions after the pandemic outbreak might, to some extent, have contributed to further fuelling residential real estate vulnerabilities, especially in some countries. From a financial stability perspective, these findings highlight side effects of a specific accommodative monetary policy tool, which had not been put in the context of residential real estate vulnerabilities so far. Concerning the characteristics of banks engaged in this rebalancing of loan portfolios towards mortgage loans, the evidence is, however, quite mixed: banks that rebalanced towards mortgage lending are, on the one hand, more resilient banks (with higher liquidity and more capitalized) and, on the other hand, also smaller and less profitable banks, as well as

banks more specialized in mortgage lending. The engagement of smaller and less profitable banks thereby suggests a potential increase in pockets of risk among banks already highly exposed to residential real estate vulnerabilities.

Our findings complement earlier literature on unintended consequences of previous (non-targeted) liquidity operations focusing mainly on banks' engagement in carry trades (see Crosignani et al., 2020; Acharya and Steffen, 2015; Altavilla et al., 2017; Andreeva and Vlassopoulos, 2019). However, for the first time in the literature, we shed some light on potential unintended consequences of TLTRO policies on residential real estate vulnerabilities.

1 Introduction

How did euro area banks' loan portfolio composition change after the easing of conditions for the targeted long-term refinancing operations III (TLTROs III) in response to the COVID-19 pandemic? Did the eased conditions still provide sufficient incentives to all euro area banks for a targeted use of these funds? In response to the COVID-19 pandemic, the Governing Council of the European Central Bank (ECB) decided on a range of monetary policy support measures including a notable easing of conditions for its TLTROs III.[1] They aimed at facilitating banks' lending to firms and households in response to liquidity strains caused by the pandemic and related lockdown measures. In conjunction with the ECB's temporary collateral easing measures, prudential relief and public state guarantees, these measures helped bolstering bank lending to firms and households in the course of the pandemic, in particular in 2020 and 2021 (Altavilla et al., 2023; Da Silva et al., 2021; Barbiero et al., 2021). Likewise, evidence from the Eurosystem's bank lending survey points to a notable supportive impact of the eased TLTRO III conditions on bank lending by the eased TLTRO III conditions (ECB, 2020c). Beyond supporting the targeted loan categories, however, survey participants also indicated a resulting increase in mortgage lending.[2] As a matter of fact, the ECB also indicated in its Financial Stability Review that residential real estate (RRE) vulnerabilities still increased during the pandemic (Lo Duca et al., 2021).

Via its TLTROs, the ECB has traditionally targeted its support to banks' extension of corporate and consumer loans by providing preferential funding conditions if banks use the obtained funds for new lending in these targeted loan categories (see Benetton and Fantino, 2021; Afonso and Sousa-Leite, 2020, among others). The use of TLTRO funding for mortgage loans to households had explicitly not been included in the targeted loan categories of these schemes, thereby, limiting potential unintended side effects on RRE markets.[3] Before the pandemic, the support of TLTRO III to targeted sectors of the economy was ensured by requiring that lending growth toward these sectors exceeded certain benchmarks in order to obtain the most favourable borrowing conditions. With the pandemic, these requirements were eased in order to facilitate the support to the real economy.[4] However, the announced easing of TLTRO III conditions in support of banks' liquidity provision to the real economy might have supported also other forms of lending. As a matter of fact, mortgage lending continued to develop dynamically throughout the pandemic in countries marked

[1] See Section 3 for further details and references.

[2] At the euro area aggregate level, the ECB report on the Eurosystem's bank lending survey (BLS) for Q3 2020 not only finds that 'a substantial net percentage (47%) of euro area banks indicated a positive impact of the TLTRO III on their lending volumes to enterprises over the past six months (after 11% in the April survey)', but it further indicates that 'the reported positive impact also increased for housing loans (net percentage of 14%, after 4% and for consumer credit (10%, after 5%)'. Thus, the number of banks that reported an increase in mortgage loans on account of TLTRO III more than tripled compared to before the easing of TLTRO conditions.

[3] See for example (ECB, 2021e).

[4] See Section 3.2 for a detailed description of the changes in TLTRO III conditions during the pandemic.

already pre-pandemic by vulnerabilities in RRE markets (ECB, 2022).

In this paper, we assess the impact of changes in TLTRO III conditions at the beginning of the COVID-19 pandemic on the composition of euro area banks' loan portfolios. To that end, we use bank-level balance sheet, financial and market operations data for a sample of 246 banks over the period Q1 2019 – Q2 2021 and a difference-in-differences research design. This design allows us to analyse whether banks rebalanced their loan portfolios after the changes in the TLTRO III conditions. Beyond the aforementioned support to overall firm lending at the aggregate level, our empirical analysis suggests that TLTRO III participating banks increased the share of mortgage lending in their overall loan portfolios following the change in TLTRO III conditions. Additionally, we find that these results are more pronounced in countries where vulnerabilities in RRE markets had already built up before the pandemic.[5] Concerning the characteristics of banks engaging in this rebalancing of loan portfolios towards mortgage loans, we find mixed evidence: some banks that rebalanced towards mortgage lending are more resilient banks (with higher liquidity and more capitalized); other banks are instead some smaller and less profitable banks, as well as those more specialized in mortgage lending. This points to a potential increase in pockets of risk among banks already exposed to RRE vulnerabilities.

Hence, beyond supporting banks' lending to firms and households in liquidity needs, our findings suggest that the targeted funding instrument, under the relaxed pandemic conditions, might have contributed to further fuelling RRE vulnerabilities, especially in some countries. As an unintended consequence of the easing in TLTRO III conditions, these findings complement earlier literature on unintended consequences of previous (non-targeted) liquidity operations focusing mainly on banks' engagement in carry trades, (Crosignani et al., 2020; Acharya and Steffen, 2015; Altavilla et al., 2017; Andreeva and Vlassopoulos, 2019). However, to our knowledge, this is the first study trying to assess unintended consequences of TLTRO policies on RRE vulnerabilities.[6] Therefore, our findings not only contribute to the discussion on policy design and the preservation of the targeted nature of such support measures going forward, but also on the potential relevance of their unintended side effects from a financial stability perspective.

In the remainder of this paper, we first provide some background on the related literature in Section 2 and explain the institutional settings of TLTROs and the changes in their conditions in the context of the pandemic in Section 3. Section 4 describes the data and the sample of banks considered in this analysis. Section 5 presents our empirical assessment first focusing on banks participating in TLTROs III and then further investigating differences across countries and types of banks. Finally, Section 6 concludes.

[5] See Section 4 for details on the countries' classification. This is in clear contrast to TLTRO participating banks in other countries.

[6] Berg et al. (2024) highlight the unintended reallocation of bank loans to the real estate sector in the context of a Quantitative Easing policy by the ECB, the Corporate Sector Purchase Programme (CSPP), and its financial stability implications for Germany.

2 Related literature

Our paper contributes most narrowly to the literature assessing the bank lending impact of the latest generation of TLTROs, namely TLTRO III, including the specific modifications owing to the pandemic, for which available papers find a positive contribution of TLTROs on the targeted lending categories. Barbiero et al. (2021) identify a substantial compression in cost of bank funding by TLTROs III, both via direct and indirect channels, supporting borrowing conditions for households and firms. They point to the role of this support in accommodating loan demand also in interaction with pandemic loan guarantee programs and other pandemic policy support measures. Da Silva et al. (2021) confirm the positive impact of the TLTRO III programme on the extension of non-financial corporation loans in the euro area including for shorter maturities. Also Kwapil et al. (2021) attribute a positive impact on the extension of both non-financial corporation and consumer loans in Austria to the TLTRO III programme but also identify such positive effects for a larger loan aggregate including mortgage loans to households.

In a somewhat broader context, our paper feeds into the literature on the ECB's TLTROs more generally, covering the first two series of TLTROs by the ECB and related policy design considerations. Sugo and Vergote (2020) identify the key drivers for banks' TLTRO uptake, namely the pricing of the operation, as well as banks' amount of eligible collateral and its composition. They point to the fact that the Governing Council of the ECB changed exactly these parameters during COVID-19 crisis in March-April 2020 to facilitate a large uptake of the operations by banks at the beginning of the pandemic, i.e. it lowered TLTRO rates and expanded the amount and types of eligible collateral. With regard to their impact on bank lending, Afonso and Sousa-Leite (2020) find a positive impact in the euro area mainly for less vulnerable countries while identifying for Portugal lower lending rates charged by TLTRO bidding banks. By contrast, Laine (2019) confirms the positive impact of the TLTRO II programme on non-financial corporate lending in the euro area but finds this to be driven by 'crisis countries' (Spain, Italy, Greece or Portugal) and not to apply to consumer loans. Bats and Hudepohl (2019) focus on how the design of TLTRO II - and here more specifically of the lending benchmarks – influenced bank credit flows in the euro area with binding benchmarks found to be more effective in stimulating bank lending. Likewise related to policy design, Benetton and Fantino (2021) find that for Italian banks the targeted design of the TLTRO I programme ensured a supportive impact on lending and limited potential unintended consequences.[7] They also highlight the relevance of a competitive environment for a positive impact on lending.[8]

[7] For a detailed assessment of the TLTRO II impact on lending in Italy across firm and bank characteristics see Esposito et al. (2020).

[8] Andreeva and García-Posada (2021) also find evidence for the role of competition in the transmission of TLTRO I to the loan supply with indirect effects from non-bidding banks, mainly transmitted via eased credit standards rather than reductions in lending margins as prevalent for bidding banks.

Concerning the preceding non-targeted longer-term refinancing operations (LTROs) and related policy design, our paper complements the literature which assesses the impact and the unintended consequences of previous (non-targeted) liquidity operations, specifically banks' engagement in carry trades. While for instance Andrade et al. (2019) find that in France these operations enhanced banks' credit supply, even though mainly for larger borrowers and not for riskier borrowers, they do not find evidence for so-called 'carry trades', i.e. banks' use of these funds to purchase high-yielding sovereign debt. By contrast, Carpinelli and Crosignani (2021) report that these liquidity operations supported banks' credit supply for Italy, but that banks used most of the obtained liquidity to buy domestic government bonds and substitute for missing wholesale funding. In line with these results, Acharya and Steffen (2015), Altavilla et al. (2017) and Andreeva and Vlassopoulos (2019) find indications for carry trades by banks in countries with higher sovereign risk in the context of these liquidity operations.

Focusing on policy changes during the onset of the COVID-19 pandemic, our paper further adds to the growing literature on policy response to the pandemic and the importance of the interplay among the various support measures. In this regard, Altavilla et al. (2023) and Rancoita et al. (2020) highlight the importance of the interplay between fiscal, monetary and prudential policies for lending support.

Putting special focus on the impact of TLTRO III participation on mortgage lending in countries with pre-existing RRE vulnerabilities, we further contribute to the literature assessing the side effects of monetary policy and the relationship between banks' loan portfolios, house prices and low interest rates.[9] In this regard, Jordà et al. (2015) provide historical evidence on the link between low rates and increased mortgage lending and house prices; similarly Hülsewig and Rottmann (2021) focus on the link between unconventional monetary policy and house prices in the euro area in recent years.[10] In addition, Chakraborty et al. (2018) and Martín et al. (2021) find crowding-out effects of commercial lending by mortgage lending in booming housing markets.

3 TLTROs before and after the pandemic

3.1 TLTRO institutional settings

TLTROs are Eurosystem monetary operations that provide funding to credit institutions. These operations offer banks long-term funding at attractive conditions thereby preserving favourable borrowing conditions for banks and stimulating bank lending to the real economy (i.e. euro area households and

[9] See also Berg et al. (2024) for an assessment of unintended effects of QE on German banks resulting in loan portfolio rebalancing towards real estate firms and the related impact on real estate prices and financial stability.

[10] Concerning real estate vulnerabilities, Jordà et al. (2015) and Mian and Sufi (2018) highlight the link between rising house prices paired with elevated household debt and the risk of financial crises.

non-financial corporations). These operations reinforced the ECB's accommodative monetary policy stance and strengthened the transmission of monetary policy, contributing to the objective of keeping inflation below, but close to, 2% over the medium term.[11] These operations have been activated for the first time in 2014 (TLTRO I) to stimulate lending to the real economy after the sovereign debt crisis (ECB, 2014 and ECB/2014/34). The second series of TLTROs (TLTRO II) was activated in 2016 to further ease non-financial private sector credit conditions and to stimulate credit creation (ECB, 2016 and ECB/2016/10). A third series of TLTROs (TLTRO III) was announced in 2019 (ECB/2019/21) and their conditions were significantly eased after the outbreak of the pandemic to support firms and households in their access to credit, in conjunction with other non-standard measures.

Banks participating in TLTROs are entitled to borrow from the Eurosystem at very long maturities (2-4 years depending on the TLTRO series) and very attractive rates. A number of provisions on the limits for the borrowing amount and the charged interest rates aimed to ensure that the provided funding would support the real economy and, in particular, the non-financial corporate sector: the overall amount that banks are allowed to borrow - the *borrowing allowance* - corresponds to a certain share of the total amount of their outstanding stock of eligible loans excluding previous TLTROs, in a specific point in time, prior to the borrowing period - the *reference outstanding amount*).[12] More precisely, the eligible loans coincide with the stock of loans to euro area non-financial corporations and households excluding loans to households for house purchase. This condition overall limited the TLTRO amount that banks highly specialized in non-corporate lending could borrow. The magnitude of the borrowing allowance varied significantly in different TLTRO series ranging from 7% to 55% of the eligible loans. Specifically, cumulated borrowing in TLTRO-I.1 and TLTRO-I.2 could not exceed 7% of the stock of eligible loans as at 30 April 2014 (ECB/2014/34).[13] The borrowing allowance of TLTRO II corresponded to 30% of total amount of eligible loans outstanding as at 31 January 2016 less any amount previously borrowed by that TLTRO-II participant under the first two TLTROs conducted in September and December 2014 (ECB/2016/10). In 2019, the borrowing allowance for TLTRO III was defined in a similar way to TLTRO II (ECB/2019/21), but raised a first time in March 2020 to 50% of the outstanding stock of eligible loans (ECB/2020/13) and a second time in January 2021 to 55% of the outstanding stock of eligible loans (ECB/2021/3). In addition, each bank had specific bid limits in each single operation, in order to avoid an excessive take up of TLTRO funds by individual banks. These limits have ranged between 10% of the borrowing allowance (until before the pandemic) and 100% of the borrowing allowance (from March 2020). The interest rate applied to the TLTROs represented a key incentive for banks to participate in these operations and ensured attractive borrowing conditions with respect to other funding

[11] Following the Strategy Review of July 2021, the ECB aims for a 'symmetric' 2% inflation target over the medium term, see ECB, 2021d.

[12] Each TLTRO series specifies a precise date when these values are calculated.

[13] Then, for each operation TLTRO-I.3 to 8, conditions were differently designed.

sources, if banks complied with specific lending requirements entailed in the TLTRO rules.[14] In this case, the rate was equal to the Eurosystem's main refinancing operations (MROs) rate or its Deposit facility (DF) rate - plus/minus a spread.[15] In TLTRO II and III, banks could benefit from attractive rates, if the *eligible net lending* at a certain point in time exceeded some specified thresholds.[16] These thresholds were defined in relation to some *benchmark outstanding amount of eligible loans* and the *benchmark net lending*, which were calculated over a time period ahead of each TLTRO program (called *first reference period*). In different TLTROs, the threshold defining the most favourable TLTRO interest rates varied significantly.

Besides differences in the calculation of the borrowing allowances and bid limits, the three series of TLTRO programmes approved by the ECB Governing Council presented differences in the length of the borrowing period as well as the interest rate conditions applied.

3.2 TLTRO III and the pandemic

In March 2019, the ECB Governing Council decided to launch a new series of TLTROs (ECB/2019/21). The TLTRO III programme was planned initially as seven rounds of operations at quarterly intervals from September 2019 to March 2021. Similarly to TLTRO II, also TLTRO III had particular conditions attached to the interest rates applied: if the eligible net lending exceeded the benchmark net lending by at least 2.5% of the benchmark outstanding amount as of 31 March 2021,[17] the interest rate applied to all amounts borrowed by the participant under TLTRO III was the average DF rate prevailing over the life of the respective TLTRO III plus a spread of 10 basis points (then lowered to the average DF rate in September 2019, see ECB/2019/28); banks whose net eligible lending did not exceed the benchmark net lending were applied the average MRO rate plus a spread of 10 basis points (then lowered to the average MRO rate in September 2019); if the eligible net lending exceeded the benchmark net lending by less than 2.5% of the benchmark outstanding amount, banks were applied a linear function between the rates applied otherwise. TLTRO III were also planned to have a shorter maturity than previous TLTROs. Initially TLTRO III had a maturity of two years, but this was extended to three years already in September 2019 (ECB/2019/21, ECB/2019/28).

After the outbreak of the pandemic, the Governing Council of the ECB repeatedly recalibrated the TLTRO III conditions (ECB/2020/13, ECB/2020/25, ECB/2021/3 and ECB/2021/21). The most relevant amendments were related to the changes in the borrowing allowance and the condition to obtain more

[14] Sugo and Vergote (2020) identify the pricing of the operations as one of the three key drivers for banks' take-up in these operations.

[15] Depending on the TLTRO series, the MRO rate was the one prevailing at the time of the tender announcement (TLTRO I), the tender allotment (TLTRO II), or the average during the life of the corresponding TLTRO operation (TLTRO III).

[16] Eligible net lending is defined as gross lending in the form of eligible loans net of repayments of outstanding amounts of eligible loans during a specific period.

[17] According to (ECB/2019/21), the first reference period used to calculate the benchmark outstanding amount and the benchmark net lending ranged between 1 April 2018 and 31 March 2019, and the second reference period used to calculate the net eligible lending ranged between 1 April 2019 and 31 March 2021.

favourable interest rates (ECB/2020/13, ECB/2020/25).[18] As of March 2020 (ECB/2020/13), the borrowing allowance was raised from 30% to 50% of the outstanding amount of eligible loans (as at 28 February 2019).

With the first two recalibrations after the COVID-19 outbreak (ECB/2020/13, ECB/2020/25), the Governing Council decided that particularly favourable interest rates would apply to all amounts borrowed by the participant under TLTRO III over a specific period of time, called *special interest rate period* (from 24 June 2020 to 23 June 2021). To obtain the most favourable interest rate, banks needed just to attain the benchmark net lending over a time window called *special reference period* (from 1 March 2020 to 31 March 2021).[19] To TLTRO III participants whose eligible net lending during the special reference period would equal or exceed their benchmark net lending, an interest rate would apply corresponding to the average DF rate over that period minus 50 basis points (and not higher than -1%); instead, to TLTRO III participants which did not meet this criterion, the average MRO rate during the special interest rate period minus 50 basis points would apply (see Figure 1).[20,21] The extra wedge of 50 basis points included in the interest rates calculations was meant to be only temporary and beyond that period the operations would be charged with an interest rate that was a weighted average of the resulting rates throughout the life of the operation.[22] As a result, banks had a strong incentive to frontload the take-up of TLTRO III. Furthermore, the amendments to the TLTRO III conditions also allowed banks to include the extraordinary lending flows recorded since 1 March 2020 in the assessment of a bank's lending performance needed to get the most favourable conditions. Banks exceeding the benchmark net lending were charged a rate lower than the negative deposit facility rate - during the special interest rate period - resulting in a *de facto* subsidy for their net lending. Moreover, even banks that would not manage to exceed the benchmark net lending, would be charged a negative rate during the special interest rate period (assuming the average main refinancing operation rate during the period would remain at 0 basis points).

[18] Additionally, also the bid limit (i.e. the amount that a bank can borrow in a single operation) was also increased, from 10% of the reference outstanding amount to the whole remaining borrowing allowance.

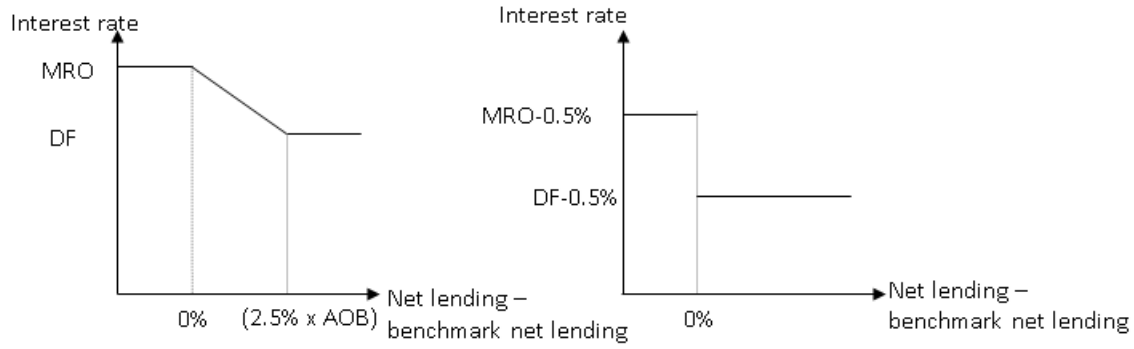
[19] Previously a specific threshold above the benchmark net lending was set to obtain the most favourable rates.

[20] In the first recalibration of TLTRO III parameters in March 2020, the wedge between the DF/MRO rate and the TLTRO III rate was of 25 basis points. This wedge was increased to 50 basis points with the worsening of the pandemic in the spring of 2020.

[21] Interest rates could be lower than the MRO minus 50 basis points also for banks whose eligible net lending during the special reference period was not above the benchmark net lending, but whose eligible net lending exceeded their benchmark net lending during the *second reference period*. For more details, refer to ECB/2020/25, article V.

[22] For the exact calculation of the interest rate outside of the special interest rate period, refer to ECB/2020/25, article V.

Figure 1: TLTRO III interest rate applied before June 2020 (left) and after, during the special interest rate period (right).



Note: The chart reports a stylized representation on the TLTRO III conditions before and after June 2020 for TLTRO III operations during the special interest rate period. AOB stands for benchmark outstanding amount, net lending stands for the eligible net lending, see footnote 16. Some conditions are not reported in the charts, for example those applied to banks whose net lending did not exceed the benchmark during the special interest rate period, but in the second reference period.

In January 2021 (ECB/2021/3), the ECB further extended the favourable conditions applied to TLTRO III lending during the pandemic. More precisely, the special interest rate period was extended by one year (until 23 June 2022) and banks could qualify for the most favourable rates also in this period, if their net lending would exceed the benchmark net lending during the *additional special reference period* (from 1 October 2020 to 31 December 2021). In addition, the borrowing allowance was increased to 55% of the reference outstanding amount.

4 Data and sample

Our database consists of a balanced panel of 246 banks from 19 euro area countries covering 63% of euro area total assets, 54% of euro area mortgage loans and 89% of TLTRO III uptakes over the period considered. The database spans over a period from Q1 2019 to Q2 2021, allowing to capture the impact of the major changes in TLTRO III conditions which were announced and implemented between March 2020 and June 2020. Banks are considered at the highest level of consolidation in order to fully capture the overall interaction between monetary policy (in the form of TLTRO III participation), Covid-related fiscal policies and prudential regulation (in the form of capital requirements). Although participation in TLTRO

III did not necessarily occur at the highest level of consolidation,[23] most capital requirements are set at consolidated level. In addition, the issuance of loans covered by state guarantees, even if occurred at a more unconsolidated level, has likely been affected by the capital requirements at consolidated level as the issuance of new lending affects the risk-based capital ratios. For these reasons, considering the banking groups at the highest consolidation should allow to fully capture the interaction of different policies.

For our econometric analysis, we rely on data from different data sources. For balance sheet and financial variables we use supervisory data following the European Banking Authority's supervisory reporting frameworks (COREP and FINREP). We merge supervisory data with TLTRO III uptake data. In our estimations we also include the borrowing allowance as instrumental variable. For banks that participated in the TLTROs III, the borrowing allowance is taken from reporting templates submitted by banks in order to participate in the TLTROs III. For banks that did not participate in TLTROs III, we calculate the borrowing allowance as follows: we calculate 55% of the stock of eligible loans (loans to non-financial corporation plus loans to households less loans to households for house purchase) as of end of February 2019.[24] The full list of variables used in our analysis is listed in Appendix A and the summary statistics of the variables included in the analysis are reported in Table 1.

As the data is reported at different consolidation levels in the different data sources, we consolidate them where necessary. In addition, various cleaning and data processing operations are performed on our database before running the analysis. More specifically,banks with extreme growth (larger than 200%) in either mortgage or non-financial corporation loan shares as well as banks with extreme growth in mortgages (larger than 150%) are eliminated, as these banks mostly likely went through mergers, acquisitions, and restructuring.

In the analysis, we also distinguish between countries with higher exposure to RRE vulnerabilities already pre-pandemic ('RRE-countries') and countries with lower exposure to RRE vulnerabilities ('non-RRE countries'). This distinction is based on indicators of price growth, overvaluation and households' indebtedness which are regularly used for the risk assessment of countries and macroprudential policy recommendations (ESRB, 2022). According to these indicators and taking into account the sample of banks for which we have sufficient data available, the 'RRE-countries' group includes Austria, Belgium, Germany, Estonia, Finland, France, Luxembourg, Malta, the Netherlands, Portugal and Slovakia. The 'non-RRE countries' group includes Cyprus, Spain, Greece, Ireland, Italy, Lithuania, Latvia and Slovenia.

[23] As for other monetary operations, the participation in TLTROs could take place also at a lower consolidation level via either individual entities or groups of subsidiaries.

[24] For these calculations we rely on individual balance sheet item (IBSI) data and aggregated the variables at the highest level of consolidation to match our sample.

Table 1: This table reports the summary statistics statistics for the main variables used in the estimations in the next sections

	Mean	SD	Min	p25	Median	p75	Max	Obs
TLTRO participants								
Mortgage share	0.41	0.2053	-0.0003	0.2847	0.4250	0.5319	0.9765	1566
NFC share	0.44	0.2127	0.0091	0.3132	0.4150	0.5447	0.9996	1566
Allowance to assets	0.13	0.0588	0.0044	0.0916	0.1278	0.1719	0.3056	1566
ROA	0.00	0.0023	-0.0179	0.0002	0.0009	0.0016	0.0220	1566
NPL ratio	0.03	0.0308	0.0007	0.0127	0.0231	0.0396	0.1974	1566
Deposits to assets ratio	0.76	0.1519	0.0541	0.6935	0.8061	0.8700	0.9486	1566
cet1 to mda	0.08	0.0419	0.0106	0.0574	0.0760	0.1001	0.3275	1566
Size	23.81	1.7698	18.3688	22.7053	23.3841	24.7813	28.5260	1566
Leverage	0.07	0.0244	0.0274	0.0542	0.0699	0.0855	0.1923	1566
Non TLTRO participants								
Mortgage share	0.48	0.2794	0.0006	0.2472	0.5181	0.6669	0.9975	608
NFC share	0.35	0.2564	0.0005	0.1937	0.3147	0.4370	0.9985	608
Allowance to assets	0.10	0.0743	0.0000	0.0297	0.1003	0.1578	0.2871	608
ROA	0.00	0.0044	-0.0638	0.0001	0.0009	0.0018	0.0524	608
NPL ratio	0.03	0.0357	0.0005	0.0074	0.0138	0.0376	0.1975	608
Deposits to assets ratio	0.84	0.0957	0.2692	0.8240	0.8654	0.8991	0.9414	608
cet1 to mda	0.11	0.0818	-0.0161	0.0672	0.0937	0.1232	0.7186	608
Size	22.45	1.4371	18.5598	22.0892	22.6563	23.2278	26.4726	608
Leverage	0.09	0.0593	0.0206	0.0613	0.0757	0.1011	0.5668	608
Total								
Mortgage share	0.43	0.2308	-0.0003	0.2764	0.4378	0.5751	0.9975	2174
NFC share	0.42	0.2291	0.0005	0.2689	0.3898	0.5287	0.9996	2174
Allowance to assets	0.12	0.0645	0.0000	0.0811	0.1230	0.1674	0.3056	2174
ROA	0.00	0.0030	-0.0638	0.0002	0.0009	0.0016	0.0524	2174
NPL ratio	0.03	0.0323	0.0005	0.0109	0.0212	0.0394	0.1975	2174
Deposits to assets ratio	0.78	0.1433	0.0541	0.7342	0.8290	0.8792	0.9486	2174
cet1 to mda	0.09	0.0571	-0.0161	0.0599	0.0792	0.1057	0.7186	2174
Size	23.43	1.7917	18.3688	22.5244	23.0999	24.4766	28.5260	2174
Leverage	0.08	0.0382	0.0206	0.0564	0.0716	0.0878	0.5668	2174

5 Estimation

5.1 Loan portfolio rebalancing and TLTRO III participation

In 2020, monetary, fiscal and prudential authorities enacted unprecedented measures in response to the pandemic. TLTRO III, along with other extraordinary measures adopted by fiscal and prudential authorities, aimed to support the real economy by stimulating bank lending to the non-financial private sector (Rancoita et al., 2020; European Systemic Risk Board, 2021; Baudino, 2020; Drehmann et al., 2020). State guarantees and TLTRO III significantly supported lending to the private corporations during the pandemic (see Altavilla

et al., 2023; Da Silva et al., 2021; Falagiarda et al., 2020, among others). TLTRO III operations were specifically designed to support lending to non-financial corporations, excluding lending for house purchases (see Section 3). However, the activation of specific accommodative conditions for TLTRO III operations at the outbreak of the pandemic might have indirectly supported other forms of lending, such as mortgage lending.

As we know that RRE vulnerabilities have continued to increase in the euro area even during pandemic (ESRB, 2022), we ask whether the use of TLTRO III may have indirectly contributed to the further build-up of these vulnerabilities, even though lending for house purchases was not part of the targeted loan categories of the TLTRO III. Specifically, we assess whether banks' participation in TLTRO III operations correlated with a rebalancing in their loan books toward lending for house purchases. For this purpose, we look at changes in the share of mortgage lending over total loan book exposures to the non-financial private sector between Q1 2019 and Q2 2021 for a representative sample of euro are banks (see Section 4 for more details on the sample).[25] We conduct our econometric analysis by estimating the following difference-in-differences specification:

$$Y_{it} = \beta_0 + \beta_1 TLTRO_{it} + \theta bank\_controls_{it-1} + bankFE + timeFE + country \times timeFE + \epsilon_{it} \quad (1)$$

Where, Y_{it} represents the share of credit to households for mortgage purposes over the banks' total loan book exposures to the non-financial private sector of bank i in quarter t; $TLTRO_{it}$ is the treatment variable taking value 1 after June 2020 for banks that participated either in the June 2020 TLTROs and/or in the September 2020 TLTROs and 0 otherwise. To control for time-varying differences across the two groups of banks we also condition on a set of time-varying lagged bank controls ($bank\_controls_{it-1}$). Specifically, we include: return on assets as a proxy for profitability (roa_{it-1}), non-performing loans over total assets (npl_ratio_{it-1}), customer deposits over total assets as a proxy for the liquidity of the bank (dep_assets_{it-1}), solvency expressed as the distance between the Common Equity Tier 1 ratio (CET1 ratio) and the Maximum Distributable Amount (MDA) threshold ($cet1\_to\_mda_{it-1}$)[26], the leverage ratio as a further proxy of potential regulatory constraints affecting bank lending ($leverage_{it-1}$), and total assets (natural logarithm) as proxy for bank size ($size_{it-1}$).

Furthermore, we include bank fixed effects to control for time-invariant unobserved bank heterogeneity, and time fixed effects to absorb level shifts that can affect all banks in the sample in the same manner (such as monetary policy and changes in regulation common across all banks and jurisdictions). In addition, to

[25] Berg et al. (2024) choose a similar approach when assessing banks' loan portfolio rebalancing towards real estate firms not eligible in the context of the CSPP focusing on the shift in the share of loans to eligible vs non-eligible firms.

[26] This measures the capital headroom. Previous research shows that the capital headroom affects the ability of banks to lend (Couaillier et al., 2021).

address heterogeneities across countries concerning loan demand, differences in support policies and other country specific effects, we use the location of banks' headquarters to control for such unobservable effects. More specifically, we include country-time fixed effects in our specification to absorb a country-level shift for each quarter, alleviating concerns that our results might be driven by such time-varying differences that vary across countries. Finally, we cluster the standard errors at the bank level.

A key concern regarding the estimation of eq.(1) is the voluntary nature of the participation in the TLTROs. For this reason, the estimation might suffer from a selection bias due to non-random treatment assignment (Benetton and Fantino, 2021). To address this issue, we estimate a two stage least squares regression (Berger et al., 2020). We explicitly address this self-selection problem by exploiting the institutional setting of the policy and we instrument the actual TLTRO III take-up with the borrowing allowance, i.e. the maximum amount that banks could borrow as for instance applied by Kwapil et al. (2021) for the assessment of TLTRO III.[27] Our instrumental variable is expected to have significant correlation with our treatment variable as banks with a higher borrowing allowance could take up more TLTRO and are more likely to participate than other banks. Furthermore, the instrumental variable is exogenous to the participation decision as the borrowing allowance threshold is determined by an exogenous rule set by the ECB for all banks and which was different for each TLTRO and relied on past banks' exposure values. According to the TLTRO III rules of April 2020 (ECB/2020/13, ECB/2020/25), the borrowing allowance for each bank (i.e. the maximum amount that each bank could borrow) was equal to 50% of its total reference amount outstanding (i.e. the total outstanding stock of eligible loans), less any amount previously borrowed.[28] As of March 2020 the rules on the borrowing allowance referred to the total reference amount outstanding as at 8 February 2019, one year before the pandemic (see Section 3). This variable is clearly exogenous with respect to the amendments to the easing of the TLTRO III conditions in 2020. The aforementioned reasons suggest that our instrumental variable satisfies the relevance and exclusion restrictions. This way, we control for the potential selection bias introduced by bank choices on participation in the June and September 2020 TLTRO III operations. We construct the instrumental variable as the remaining borrowing allowance before June 2020 normalized by the amount of total assets in 2019. The resulting IV specification of the model is then given by:

$$Y_{it} = \beta_0 + \beta_1 \widehat{TLTRO}_{it} + \theta bank\_controls_{it-1} + bankFE + timeFE + country \times timeFE + \epsilon_{it} \qquad (2)$$

Where $\widehat{TLTRO}_{it}$ is the predicted treatment variable and all remaining terms are defined as in eq.(1). The

[27] Similar approaches in examining the impact of previous TLTRO programmes are used in Afonso and Sousa-Leite (2020), Andreeva and García-Posada (2021), Benetton and Fantino (2021), Esposito et al. (2020) and Laine (2019).

[28] The eligible loans coincide with the stock of loans to euro area non-financial corporations and households excluding loans to households for house purchase, see Section 3

predicted treatment is obtained by the estimation of the following first-stage regression, as in Benetton and Fantino (2021):

$$TLTRO_{it} = \alpha_0 + \alpha_1 IV_i \times post\_TLTRO_t + \theta bank\_controls_{it-1} + bankFE + timeFE + country \times timeFE + \epsilon_{it} \quad (3)$$

Where IV_i is the instrumental variable, and $post\_TLTRO_t$ is an indicator equal after Q1 2020 and 0 otherwise and the remaining variables are defined as in eq.(1). As previously discussed, we use as an instrument the remaining borrowing allowance before June 2020 normalized by the amount of total assets in 2019.[29]

We present the results of the first and second-stage regressions in Table 2 in columns (1) and (2), respectively. The first-stage coefficient of the IV is positive and statistically significant at the 1% level, confirming the relevance of the instrumental variable. Regarding the mortgage share regression in column (2), banks participating in TLTRO III operations increased the share of mortgage lending by 5.5 percentage points more than banks not participating in the TLTRO III programme and the coefficient of the interaction term is significant at the 5% level. Looking at different control variables, banks with higher liquidity ratios (proxied by the deposits-to-assets ratio) overall had a higher share of mortgage lending, as well as smaller banks and less profitable banks. These latter reflect typical characteristics of banks specialized in mortgage lending. For completeness, we report the OLS results for the regression in eq.(1) in columns (3) and (4) of Table 2. Most notably, we find smaller effects in magnitude relative to the 2SLS estimates, but the significance and the sign of the coefficients remain in line with the 2 stage least squares regression for the treatment variable and the controls.

[29] As discussed in Section 4, for banks participating in TLTRO III the borrowing allowance was taken from the reporting templates submitted by banks, for non-participating banks, it was calculated as the difference between 50% of the eligible loans as of the end of February 2019 and any outstanding liquidity from previous TLTROs.

Table 2: This table reports the results from eq (1-3). $TLTRO_{it}$ is a dummy variable taking the value of 1 for banks that participated either in the June 2020 TLTROs and/or in the September 2020 TLTROs, $\widehat{TLTRO}_{it}$ is the predicted value of $TLTRO_{it}$ from the first stage regression, $post\_TLTRO_t$ is an indicator variable that takes the value of 1 from Q2 2020 onwards, iv_{it} is the bank borrowing allowance, bank control variables are defined above.

	2SLS		OLS	
	$TLTRO_{it}$ Stage 1	Mortgage Share Stage 2	Mortgage Share	Mortgage Share
	(1)	(2)	(3)	(4)
$TLTRO_{it}$			0.0134*	0.0177**
			(0.0082)	(0.0082)
$\widehat{TLTRO}_{it}$		0.0554**		
		(0.0249)		
$iv_{it} \times post\_TLTRO_t$	2.0054***			
	(0.4788)			
roa_{it-1}	-0.3364	-0.7449**		-0.7770**
	(1.7015)	(0.3168)		(0.3218)
npl_ratio_{it-1}	-0.0180	0.0804		0.0774
	(1.0020)	(0.1649)		(0.1725)
dep_assets_{it-1}	-1.5152***	0.1930**		0.1287**
	(0.5514)	(0.0772)		(0.0641)
$cet1\_to\_mda_{it-1}$	-0.8799	0.0558		0.0333
	(0.9298)	(0.1277)		(0.1294)
$size_{it-1}$	0.6007***	-0.0889**		-0.0630*
	(0.1889)	(0.0403)		(0.0371)
$leverage_{it-1}$	-0.8926	-0.2368		-0.2784
	(1.4336)	(0.2372)		(0.2387)
Within R^2		.	0.0125	0.0449
Bank fixed effects	Yes	Yes	Yes	Yes
Time fixed effects	Yes	Yes	Yes	Yes
Country time fixed effects	Yes	Yes	Yes	Yes
No of banks	246	246	246	246
No of countries	19	19	19	19
Sample	2019q2 - 2021q2	2019q2 - 2021q2	2019q1 - 2021q2	2019q2 - 2021q2
Kleibergen-Paap LM-statistic	17.28	.	.	.
Kleibergen-Paap F statistic	17.54	.	.	.

Standard errors are clustered at the bank level. * p < 0.10, ** p < 0.05, *** p < 0.01

In our setting, we compare the lending behaviour of banks, before and after the latest changes to TLTRO III conditions were introduced in the TLTRO III round of June 2020. A key assumption is that, conditional on bank, time, country-time fixed effects, and a saturated set of bank control variables, banks not taking up TLTRO III can serve as a counterfactual for the lending behaviour of banks that took up TLTRO III.

In this case, β_1 will capture the change in the loan portfolio composition for the treatment group (banks participating in TLTRO III) relative to the control group (non-participating banks). To evaluate the validity of our approach, we compare the average share of mortgage lending of these two groups of banks and we show that they behave similarly before June 2020, confirming the parallel trend assumption. Furthermore, we compare the two groups of banks before the policy intervention, and show that they do not differ significantly in many observable characteristics ahead of June 2020 (we present both of these tests in Appendix B).

A possible concern regarding the specification of our treatment variable ($TLTRO_{it}$) is that a binary variable[30] might not allow to fully identify the impact of participating in TLTRO III operations at bank-level. Namely, a number of other policies were activated at the same moment and there might be a high correlation between the take-up of TLTRO III and other policies. For this reason, we present a number of robustness checks in Appendix C. First, we test how our results would change if the treatment variable would be based on the bank-level actual uptake of TLTRO III (more specifically we look at the TLTRO III uptake normalized by total assets in 2019). Results in Table C1 show that results remain significant and consistent in terms of sign. In this case, the magnitude of the coefficient of the treatment variable is different from the one in Table 2, as the definition of $TLTRO_{it}$ has changed. More precisely, the results would indicate that banks with a one percentage point higher share of TLTRO III uptake increased the share of mortgage lending by 0.3 percentage points. Finally, testing the sensitivity of our results to slight changes of the time sample, allows to check the robustness of our results against potential spurious effects due to concomitant policies or shocks. Namely, our time sample spans from Q1 2019 until Q2 2021 and it includes the second wave of the pandemic in its last quartes, when a number of other policies became effective and more extensively used (for example tax deferrals or other unemployment schemes). For this reason, we replicate our analysis on a shorter sample period to check that the country-time fixed effects control for these confounding factors. Similarly, we exclude Q1 2020 from the sample, as in this quarter some policies were decided, and banks might have already changed their lending decisions. In both cases, results are robust both in terms of significance and magnitude (Table C2).

The observed rebalancing towards mortgage lending might also be driven by a mechanical rebalancing towards lending to non-financial corporations by banks belonging to the control group. Although this might sound less likely (see for example ECB, 2021c), it could still be theoretically possible in our setting. In Appendix D we show the results of the same analysis as in eq.(2) but assuming as dependent variable the share of loans to non-financial corporations, the share of loans to households for consumption and their sum. Results show that banks not-participating in TLTRO III did not rebalance more towards other types of lending than banks participating in TLTRO III and confirm that results are not mechanically driven by the

[30] As discussed earlier, $TLTRO_{it}$ equals 1 after June 2020 for banks that participated either in the June 2020 TLTROs and/or in the September 2020 TLTROs and 0 otherwise.

increase of the denominator in the control group.

5.2 TLTRO III participation and residential real estate vulnerabilities

After the outbreak of the pandemic, prudential authorities repeatedly warned about the continuous build-up of RRE vulnerabilities in several euro area countries (Lo Duca et al., 2021). Against this background, we assess in a next step whether the overall portfolio re-balancing observed in Section 5.1 has been stronger in countries with pre-pandemic RRE vulnerabilities. In order to understand this, we estimate the following specification (eq. 4):

$$\begin{aligned} Y_{it} = \beta_0 + \beta_1 RRE_i \times \widehat{TLTRO}_{it} + \beta_2 \widehat{TLTRO}_{it} \\ + \theta bank\_controls_{it-1} + bankFE + timeFE + country \times timeFE + \epsilon_{it}, \end{aligned} \tag{4}$$

where, RRE_i is an indicator variable equal to 1 for banks located in countries with pre-pandemic RRE vulnerabilities and 0 otherwise and $\widehat{TLTRO}_{it}$ is the predicted treatment variable as estimated in eq (2).[31] All other variables are defined as in section 5.1. In this setting, we compare the lending behaviour of TLTRO participating banks located in countries with pre-pandemic RRE vulnerabilities ('RRE vulnerable countries'), before and after the latest changes to TLTRO III conditions were introduced in June 2020 against all other banks. A key assumption is that, conditional on bank, time, country-time fixed effects, and a saturated set of bank control variables, banks located in 'non-RRE vulnerable countries' can serve as a counterfactual for the lending behaviour of banks that are located in RRE vulnerable countries. In this case, β_1 will indicate the effect of TLTRO participation on the loan portfolio composition for banks located in countries with higher pre-pandemic RRE vulnerabilities. As illustrated in Appendix E, the parallel trend assumption holds, meaning that the two groups of banks behaved analogously before the policy change.

We present the results of eq.(4) in Table 3. Overall, banks participating in TLTRO III and located in countries with elevated RRE vulnerabilities increased the share of mortgage lending after Q2 2020 by 7.3 percentage points more than banks located elsewhere (see column 2). These results indicate that this group of banks is driving the overall results in Table 1 as the coefficient of the other group of banks is not significant[32]. Looking at different control variables, results remain consistent with Table 1, indicating that typically smaller, less profitable and more liquid banks had a higher share of mortgage lending.

[31] See Section 4 for details for the list of countries and how these were selected.

[32] The coefficient of the variable $\widehat{TLTRO}_{it}$ the effect of TLTRO participation for all other banks.

Table 3: This table reports the results from Eq (4). RRE_i is an indicator variable equal to 1 whenever a bank is located in countries with pre-pandemic RRE vulnerabilities, $\widehat{TLTRO}_{it}$ is the predicted variable of the first stage least square regression, $bank\_controls_{it-1}$ are defined as follows: *roa* is return on assets, *npl_ratio* is the ratio of non-performing loans to total assets, *dep_asset* is the ratio of customer deposits over total assets, *cet1_to_mda* is the distance between the Common Equity Tier 1 ratio (CET1 ratio) and the Maximum Distributable Amount (MDA) threshold, *leverage* is the leverage ratio and size is the natural logarithm of total assets.

	Mortgage Share	
	no controls	controls
	(1)	(2)
$\widehat{TLTRO}_{it} \times RRE_i$	0.0991**	0.0735**
	(0.0460)	(0.0362)
$\widehat{TLTRO}_{it}$	-0.0566	-0.0037
	(0.0369)	(0.0274)
roa_{it-1}		-0.6923**
		(0.3187)
npl_ratio_{it-1}		0.0532
		(0.1633)
dep_assets_{it-1}		0.1635**
		(0.0712)
$cet1\_to\_mda_{it-1}$		0.0754
		(0.1290)
$leverage_{it-1}$		-0.3180
		(0.2501)
$size_{it-1}$		-0.0774**
		(0.0361)
constant	0.4259***	2.1121**
	(0.0089)	(0.8426)
Within R^2	0.0220	0.0526
Bank fixed effects	Yes	Yes
Time fixed effects	Yes	Yes
Country time fixed effects	Yes	Yes
No of banks	246	246
No of countries	19	19
Sample	2019q2 - 2021q2	2019q2 - 2021q2

Standard errors are clustered at the bank level. * p < 0.10, ** p < 0.05, *** p < 0.01

Similarly to section 5.1, it is relevant to ensure that the results are not driven by a substantial increase in lending to non-financial corporations or to households for consumption in the control group. In this specification, actually the likelihood that lending to non-financial corporations might have occurred is higher than in section 5.1. In the current specification, the comparison group is composed of banks located in countries not exposed to RRE vulnerabilities (which include Spain, Italy, Greece), where a relevant amount

of loans covered by state guarantees was issued in the second half of 2020 (more than EUR 160 billion, see Falagiarda et al. (2020)). This could lead to a mechanical increase in the lending to non-financial corporations in non-RRE countries and, therefore, to a decline in the share of mortgages over non-financial private lending in these countries. When the dependent variable is the share of loans to non-financial corporates over non-financial private lending, the coefficient of the interaction term with 'non-RRE countries' is non-significant see Appendix F. This indicates that the rebalancing towards mortgage lending is not driven by a mechanical rebalancing towards non-financial corporate lending in countries not exposed to RRE vulnerabilities.

We further test the robustness of our results with respect to the treatment variable ($TLTRO_{it}$). In particular, we look at how our results would change if the treatment variable would be continuous (similarly to Appendix C), we assume that the treatments variable coincides with the bank-level actual uptake of TLTRO III (specifically, we look at the TLTRO III uptake normalized by total assets in 2019). Also in this case, we find that results remain significant and have similar pattern to our main specification. Namely, we find that the results are driven by banks in countries exposed to RRE vulnerabilities (Appendix G).

5.3 Heterogeneous effects across banks

In this Section, we investigate whether our findings are stronger for banks with specific characteristics. It is relevant to understand, for example, whether the rebalancing of the loan portfolio might have increased the exposure to RRE vulnerabilities in banks already vulnerable from a financial stability perspective. As in section 5.2, we focus also in this section on banks participating in TLTRO III and located in counties with RRE vulnerabilities. To conduct our analysis, we augment eq.(4) and we sequentially add another layer of interactions using various bank characteristics. More specifically, we sequentially estimate the following equation:

$$\begin{aligned} Y_{it} = \beta_0 &+ \beta_1 RRE_i \times \widehat{TLTRO}_{it} \\ &+ \beta_2 \widehat{TLTRO}_{it} \times characteristic_i \\ &+ \beta_3 RRE_i \times \widehat{TLTRO}_{it} \times characteristic_i \\ &+ \theta bank\_controls_{it-1} + bankFE + timeFE + country \times timeFE + \epsilon_{it}, \end{aligned} \tag{5}$$

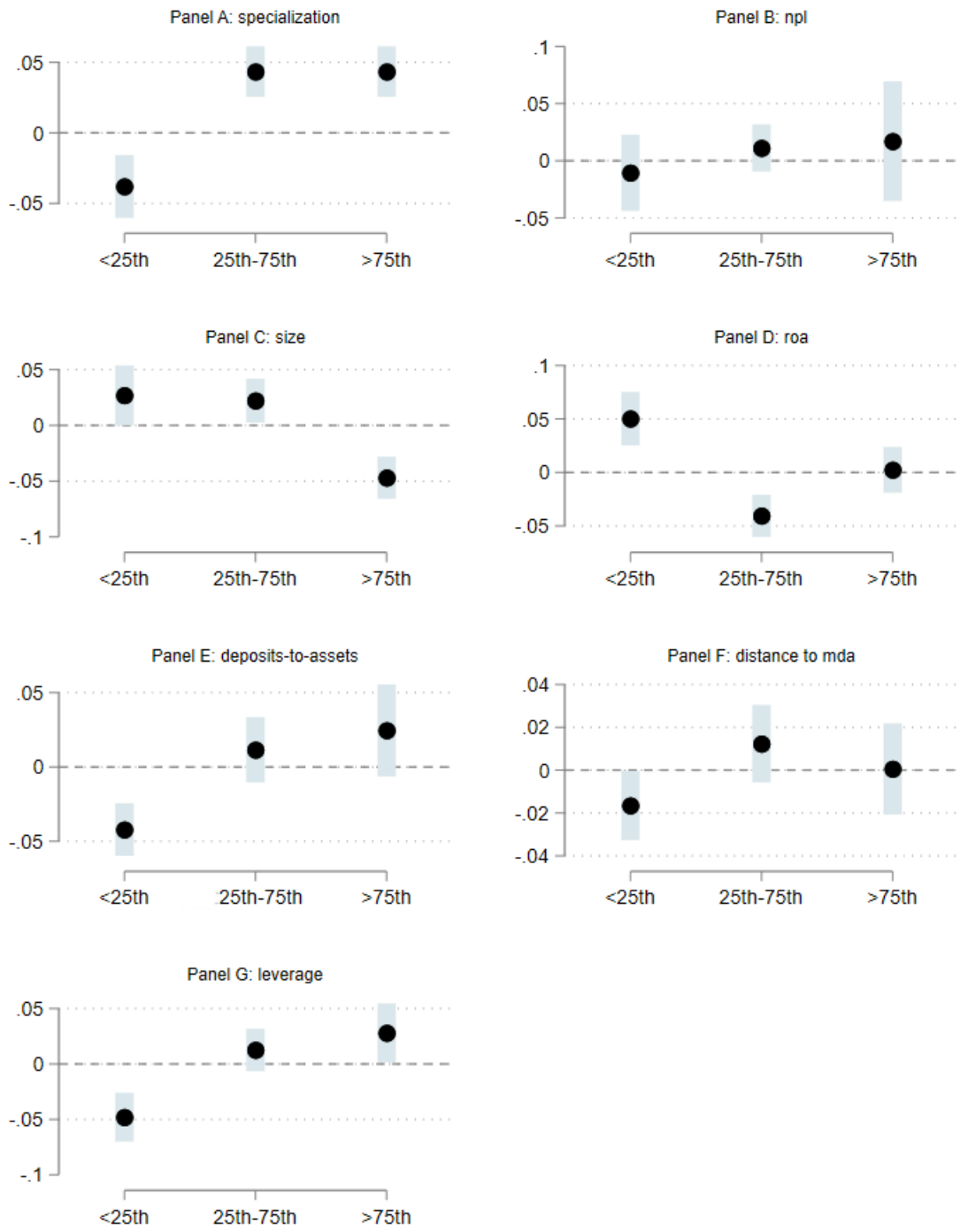
where $characteristic_i$ corresponds to a dummy variable representing the relevant bank characteristic of interest. For this exercise, we use the existing $bank\_controls_{it-1}$ from eq.(1) and a proxy for the banks' specialization expressed as the share of mortgage lending over total assets. To investigate the impact of these bank characteristics, we introduce three dummy variables that represent specific quantiles within each characteristic's distribution. More specifically, we construct three binary indicators for each variable: the first

is equal to 1 below the 25th percentile, and 0 otherwise; the second is equal to 1 within the interquartile range (25th-75th percentiles), and 0 otherwise, and the third is equal to 1 above the 75th percentile, and 0 otherwise. We then estimate eq.(5) using sequentially the aforementioned indicator variables as $characteristic_i$. This transformation allows us to sequentially compare groups of banks, relative to the omitted reference group. The remaining variables, including $\widehat{TLTRO}_{it}$, are defined as in eq.(1).

For brevity, we only report the coefficients β_3 of the augmented interactions in Figure 2. Looking at different types of banks' characteristics reveals an interesting pattern. The correlation is positive for banks more specialized in mortgage lending, i.e. banks which were already significantly exposed to real estate risks before pandemic (Panel A). There is no evidence of a difference among banks with different level of asset quality, as the NPL ratio is not significant for any of the threshold levels (Panel B). Small and medium-sized banks appear to have rebalanced their portfolios more than larger and very small banks (Panel C). In addition, only the least profitable banks appear to have rebalanced towards more mortgage exposures (Panel D). In terms of liquidity and solvency position of banks, both characteristics have played a role in deterring the rebalancing when banks were close to requirements or had low ratios. With respect to the former, less liquid banks have increased less than others their share of mortgage lending (Panel E). The distance from solvency requirements is also an important moderating factor. Looking at the distance to the MDA threshold, only banks very close to the MDA threshold appear to have rebalanced less than other banks (panel F). The leverage of banks has discouraged the unintended use of TLTRO III funding and it seems to have had a linear impact on the rebalancing of banks, as the coefficient is significant and negative for banks with low leverage ratios. At the same time, banks with a more comfortable headroom with respect to the leverage ratio ahead of the pandemic, rebalanced more toward mortgage lending (Panel G).

Overall, these results indicate that the observed unintended effect of the easing of TLTRO III conditions on banks loan portfolio rebalancing may have not significantly increased financial stability risks as it affects affected more resilient banks. However, less profitable banks and/or banks more specialized in mortgage lending appear to have increased relatively more their share of mortgage lending share, which might indicate a higher concentration of risks in some banks already exposed to RRE vulnerabilities.

Figure 2: This figure presents the coefficients, β_3, of the interaction term in Eq. (5). The bars represent the 90% confidence interval. For each bank characteristics the coefficient β_3 is reported for the different binary indicators.



6 Conclusion

In this paper, we assess the impact of changes in TLTRO III conditions at the beginning of the COVID-19 pandemic on the loan portfolio composition of euro area banks, using ECB internal data on market operations and bank-level supervisory data. Our empirical analysis suggests some potential unintended effects arising from the relaxation of TLTRO III conditions in 2020. More specifically, we find that TLTRO III participating banks increased the share in mortgage lending in their overall loan portfolio after the change in the TLTRO conditions and that this effect is driven by banks located in countries where RRE vulnerabilities had already built up ahead of the pandemic.

Hence, beyond supporting banks' lending to firms and households in liquidity needs, our findings suggest that the targeted funding instrument, under the relaxed pandemic conditions, might to some extent have contributed to further fuelling RRE vulnerabilities in these countries. Therefore our findings also contribute to the discussion on policy design and the preservation of the targeted nature of such support measures going forward.

From a financial stability perspective, these findings highlight side effects of a specific accommodative monetary policy tool, namely TLTROs under relaxed pandemic conditions, which had not been put in the context of RRE vulnerabilities thus far. Concerning the characteristics and vulnerabilities of banks engaged in this rebalancing of loan portfolios towards mortgage loans, the evidence is, however, quite mixed: banks that rebalanced towards mortgage lending are, on the one hand, more resilient banks (with higher liquidity and more capitalized) and, on the other hand, also smaller and less profitable banks, as well as those more specialized in mortgage lending. The engagement of smaller and less profitable banks suggests a potential increase in pockets of risk among banks already highly exposed to RRE vulnerabilities.

Appendix A

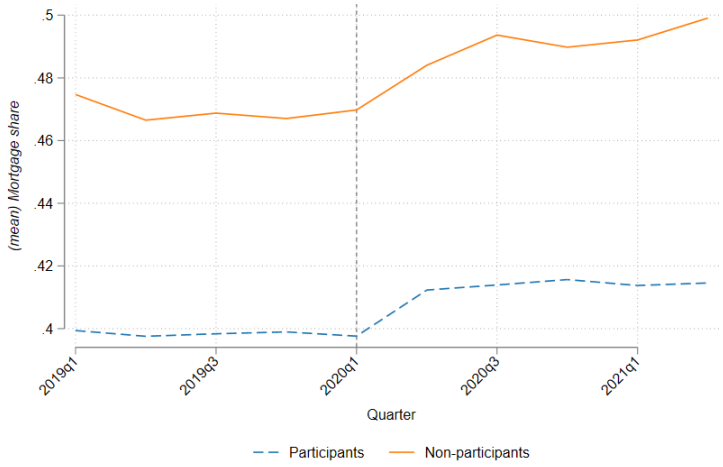
List of main variables used in the regressions

- *roa* return on assets
- *npl_ratio* non-performing loans over total assets
- *dep_assets*: customer deposits to assets
- *cet*1*_to_mda*: Common Equity Tier 1 capital minus Minimum Distributable Amount threshold divided by risk weighted assets
- *leverage*: Tier 1 divided exposure amounts
- *size*: natural logarithm of total assets
- *mortgage share*: mortgages as a share of loans to households and non-financial corporations
- *NFC share*: loans to non-financial corporations as a share of loans to households and non-financial corporations
- $TLTRO_{it}$: dummy variable equal 1 if a bank participated in TLTRO III in June and/or September 2020 (in the main specification)

Appendix B

The validity of our econometric setup relies of the parallel trend assumption. We evaluate this assumption in two different ways. First, we examine the evolution of the dependent variable before the easing of TLTRO III conditions in June 2020, comparing treated and non-treated banks. In each quarter, we plot the average share of mortgage lending for banks participating to TLTRO III in June 2020 and/or in September 2020 (to save notation, we call these banks 'participants' in the charts) and of other banks. Figure B.1 shows that the average values in the two groups follow almost parallel trends before Q2 2020 and the two groups are therefore comparable.

Figure B.1: Evolution of share of mortgage lending around the easing of TLTRO III conditions



Second, we formally test the parallel trend assumption, and we run an event study specification. More specifically, we augment eq.(1), and we estimate eq.(6):

$$Y_{it} = \beta_0 + (\sum_{\kappa=-3}^{-2} \beta_\kappa quarter\ to\ TLTRO_\kappa + \sum_{\kappa=0}^{6} \beta_\kappa quarter\ to\ TLTRO_\kappa) + bank\_controls_{it-1} + bankFE + timeFE + country \times timeFE + \epsilon_{it}, \quad (6)$$

where the dependent variables are, in turn, the share of mortgage lending of bank i at time t. The term $quarter\ to\ TLTRO_\kappa$ corresponds to our treatment variable interacted with a set of binary indicator variables for each of the time period in our sample, indicating κ quarters to and from the TLTRO announcement in Q2 2020, $controls_{it-1}$ are lagged bank controls as in eq.(1), and $bankFE$ are bank fixed effects, $timeFE$ are time fixed effects and $country \times timeFE$ are country - time fixed effects. In the above specification, we do not

include the quarter before the announcement, where $\kappa = -1$. All β_κ parameters indicate the relative lending by treated banks relative to Q1 2020 - insignificant coefficients before the TLTRO III changes would suggest that the lending behavior of treated and control banks in the period before the TLTRO III announcement are similar, and that there is no pre-trend. Figure B.2 shows that across both specifications, there are no significant differences between banks participating to TLTRO III and other banks. That is, before the easing of TLTRO III conditions, treated and control banks perform similarly. In addition, we see that after Q2 2020, there is the jump in the coefficient, reaching approximately the level of 1.5-2 %– an effect that remains relatively stable in the following quarters. Taken together these graphs confirm the results of the 2SLS regression.

Figure B.2: Dynamic effects

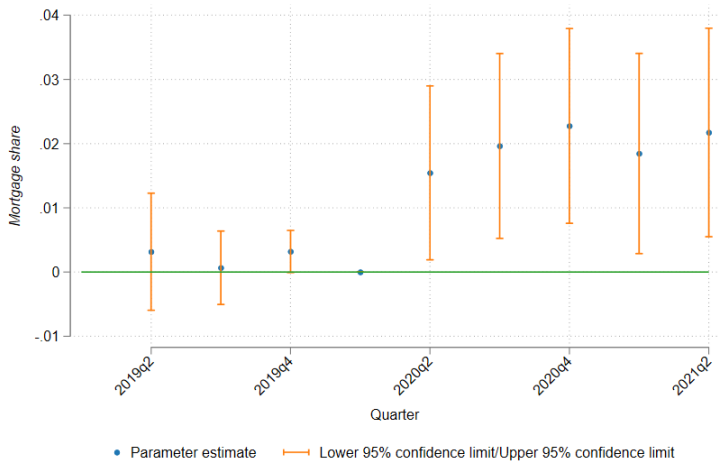
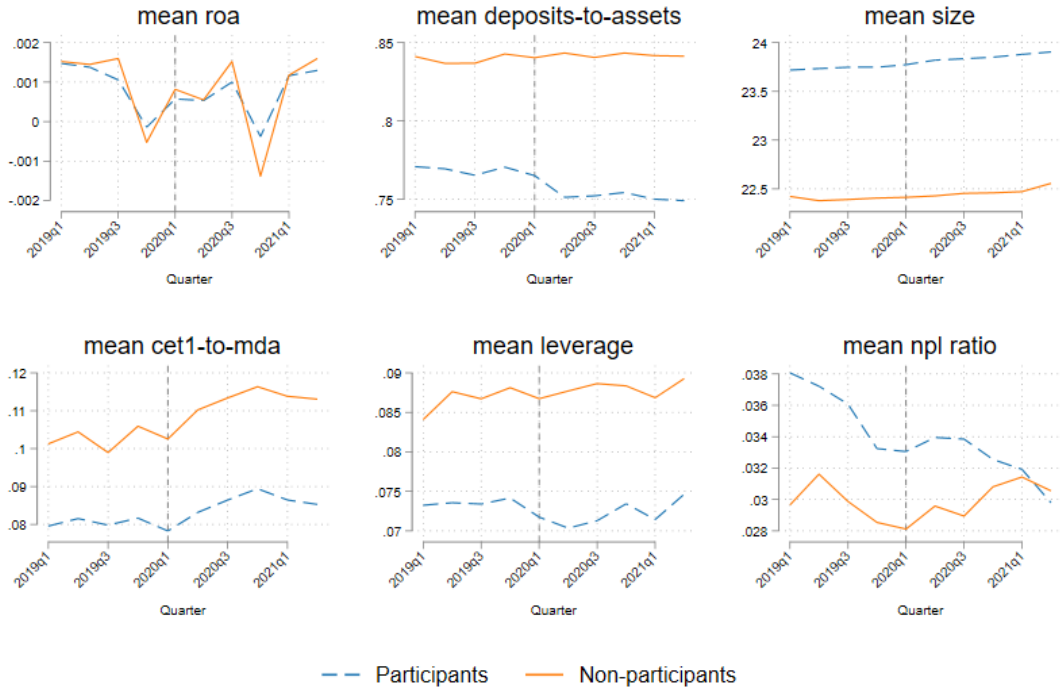


Figure B.3 shows that also looking at the control variables across the two group of banks, there are no significant differences between banks participating to TLTRO III and other banks before Q2 2020.

Figure B.3: Mean control variables over time for banks participating in the June/September 2020 TLTRO III and other banks



Appendix C

Table C1: This table reports the results from the 2SLS regression in eq.(2) and eq.(3) under different assumptions on treatment variable $TLTRO_{it}$. While in the main regressions we use a dummy variable, here we use a continuous variable corresponding to the TLTRO III uptake in the respective quarter divided total assets in 2019.

	$TLTRO_{it}$	Mortgage Share
	Stage 1	Stage 2
	(1)	(2)
$\widehat{TLTROcont}_{it}$		0.3491**
		(0.1701)
$IV_i \times post\_TLTRO_t$	0.3185***	
	(0.0570)	
roa_{it-1}	0.1722	-0.8236***
	(0.2475)	(0.3031)
npl_ratio_{it-1}	-0.1720	0.1395
	(0.1488)	(0.1718)
dep_assets_{it-1}	-0.3791***	0.2413***
	(0.0845)	(0.0933)
$cet1\_to\_mda_{it-1}$	0.0614	-0.0144
	(0.1301)	(0.1273)
$leverage_{it-1}$	-0.6571**	-0.0569
	(0.2805)	(0.2648)
$size_{it-1}$	0.0904***	-0.0872**
	(0.0308)	(0.0388)
Within R^2	.	.
Bank fixed effects	Yes	Yes
Time fixed effects	Yes	Yes
Country time fixed effects	Yes	Yes
No of banks	246	246
No of countries	19	19
Sample	2019q2 - 2021q2	2019q2 - 2021q2

Standard errors are clustered at the bank level. * p < 0.10, ** p < 0.05, *** p < 0.01

Table C2: This table reports the results from the 2SLS regression in eq.(2) and eq.(3) under different assumptions on the sample time. First, we shorten the time horizon to Q2 2019 - Q4 2020 (columns 1, 2). Second, we use the original sample, but exclude Q1 2020 (columns 3, 4).

	Shorter window (2019q2 2020q4)		2019q4 2021q2 excl. 2020q1	
	$TLTRO_{it}$ Stage 1	Mortgage Share Stage 2	$TLTRO_{it}$ Stage 1	Mortgage Share Stage 2
	(1)	(2)	(3)	(4)
$IV_i \times post\_TLTRO_t$	2.0258***		1.9457***	
	(0.4878)		(0.4894)	
$\widehat{TLTRO_{it}}$		0.0476**		0.0585**
		(0.0237)		(0.0265)
roa_{it-1}	-2.4771	1.3383***	1.1736	-1.6853***
	(3.4198)	(0.3702)	(2.6432)	(0.3622)
npl_ratio_{it-1}	-0.0902	0.0726	-0.0039	0.0322
	(1.2249)	(0.1347)	(1.0771)	(0.1596)
dep_assets_{it-1}	-1.8953***	0.1662**	-1.9003***	0.2171**
	(0.6088)	(0.0823)	(0.6766)	(0.0893)
$cet1\_to\_mda_{it-1}$	-0.6900	0.2162*	-1.2825	0.0523
	(1.1301)	(0.1307)	(1.0482)	(0.1402)
$leverage_{it-1}$	-1.1817	-0.2737	-1.1065	-0.2107
	(1.7582)	(0.2400)	(1.6321)	(0.2350)
$size_{it-1}$	0.7097***	-0.0815**	0.6087***	-0.0903**
	(0.2391)	(0.0366)	(0.2091)	(0.0418)
Within R^2	.	.	.	.
Bank fixed effects	Yes	Yes	Yes	Yes
Time fixed effects	Yes	Yes	Yes	Yes
Country time fixed effects	Yes	Yes	Yes	Yes
No of banks	245	245	246	246
No of countries	19	19	19	19

Standard errors are clustered at the bank level. * p < 0.10, ** p < 0.05, *** p < 0.01

Appendix D

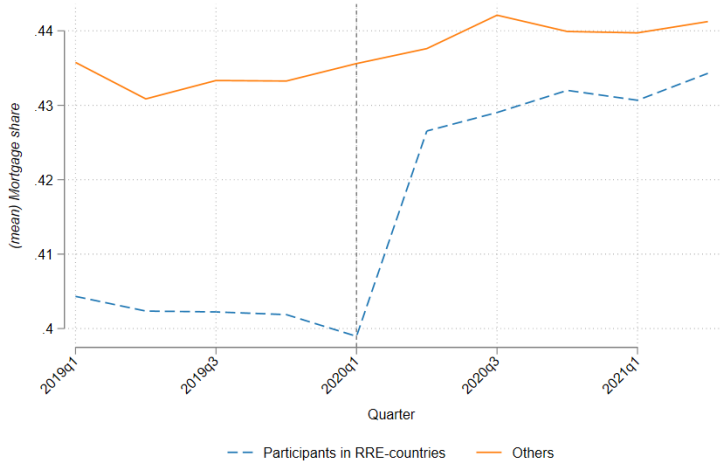
Table D1: This table reports the results from 2SLS regressions similar to in eq.(2) and eq.(3), but using as dependent variables the share of loans to non-financial corporations (nfc), the share of loans to households for consumption (cc) and their sum (nfc+cc). First stage results are the same as in Table 2

	nfc loans share Stage 2 (1)	cc loans share Stage 2 (2)	nfc+cc loans share Stage 2 (3)
$\widehat{TLTRO}_{it}$	-0.0122	-0.0133	-0.0354
	(0.0114)	(0.0144)	(0.0149)
roa_{it-1}	0.5464***	0.1985	0.7449**
	(0.1681)	(0.2857)	(0.3168)
npl_ratio_{it-1}	-0.1745	0.0941	-0.0804
	(0.1273)	(0.1379)	(0.1649)
dep_assets_{it-1}	-0.0199	-0.1731***	-0.1930**
	(0.0519)	(0.0661)	(0.0772)
$cet1\_to\_mda_{it-1}$	-0.0109	-0.0450	-0.0558
	(0.0811)	(0.1045)	(0.1277)
$leverage_{it-1}$	0.2150	0.0218	0.2368
	(0.1545)	(0.1586)	(0.2372)
$size_{it-1}$	0.0767***	0.0122	0.0889**
	(0.0202)	(0.0276)	(0.0403)
Within R^2	.	.	.
Bank fixed effects	Yes	Yes	Yes
Time fixed effects	Yes	Yes	Yes
Country time fixed effects	Yes	Yes	Yes
No of banks	246	246	246
No of countries	19	19	19
Sample	2019q2 - 2021q2	2019q2 - 2021q2	2019q2 - 2021q2

Standard errors are clustered at the bank level. * p < 0.105, ** p < 0.05, *** p < 0.01

Appendix E

Figure E.1: Evolution of share of mortgage lending around the easing of TLTRO III conditions for banks in RRE countries and other banks



Appendix F

Table F1: This table reports the results from $Y_{it} = \beta_0 + \beta_1 nonRRE_i \times \widehat{TLTRO}_{it} + \beta_2 \widehat{TRLTRO}_{it} + \theta bank\_controls_{it-1} + bankFE + timeFE + country \times timeFE + \epsilon_{it}$, where Y_{it} is the share of loans to non-financial corporations and differently form eq.(4) the TLTRO participation dummy is interacted with the variable $nonRRE_i$, which takes value 1 for banks in non-RRE countries and 0 otherwise

	Share of nfc loans in non-RRE countries
$\widehat{TLTRO}_{it} \times nonRRE_i$	-0.0100
	(0.0249)
$\widehat{TLTRO}_{it}$	-0.0102
	(0.0119)
roa_{it-1}	0.5535***
	(0.1763)
npl_ratio_{it-1}	-0.1782
	(0.1325)
dep_assets_{it-1}	-0.0239
	(0.0543)
$cet1\_to\_mda_{it-1}$	-0.0082
	(0.0800)
$leverage_{it-1}$	0.2039
	(0.1700)
$size_{it-1}$	0.0783***
	(0.0199)
$constant$	-1.3995***
	(0.4640)
Within R^2	0.0881
Bank fixed effects	Yes
Time fixed effects	Yes
Country time fixed effects	Yes
No of banks	246
No of countries	19
Sample	2019q2 - 2021q2

Standard errors are clustered at the bank level. * p < 0.10, ** p < 0.05, *** p < 0.01

Appendix G

Table G1: This table reports the results from $Y_{it} = \beta_0 + \beta_1 RRE_i \times \widehat{TLTRO}_{it} + \beta_2 \widehat{TRLTRO}_{it} + \theta bank\_controls_{it-1} + bankFE + timeFE + country \times timeFE + \epsilon_{it}$, where Y_{it} is the share of mortgage loans and differently form eq.(4) the TLTRO participation dummy is the fitted value of the first stage regression from Appendix C, where the participation of a bank is measured by the share of actual TLTRO III uptake over total assets in 2019.

	Share of mortage loans
$\widehat{TLTRO}_{it} \times RRE_i$	0.4545**
	(0.2012)
$\widehat{TLTRO}_{it}$	-0.0158
	(0.1720)
roa_{it-1}	-0.7212**
	(0.3064)
npl_ratio_{it-1}	0.0816
	(0.1596)
dep_assets_{it-1}	0.1996**
	(0.0857)
$cet1\_to\_mda_{it-1}$	0.0269
	(0.1222)
$leverage_{it-1}$	-0.2123
	(0.2784)
$size_{it-1}$	-0.0749**
	(0.0350)
$constant$	2.0279**
	(0.8152)
Within R^2	0.0556
Bank fixed effects	Yes
Time fixed effects	Yes
Country time fixed effects	Yes
No of banks	246
No of countries	19
Sample	2019q2 - 2021q2

Standard errors are clustered at the bank level. * p < 0.10, ** p < 0.05, *** p < 0.01

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