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DeNederlandscheBank

EUROSYSTEEM

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* Views expressed are those of the authors and do not necessarily reflect official positions of De Nederlandsche Bank.

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Impact of targeted credit easing by the ECB: bank-level evidence[*]

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Abstract

The interest rate in the second series of ECB targeted longer-term refinancing operations is conditional on a participant-specific lending benchmark. The restrictiveness of this benchmark varies between banks. We employ estimations on a unique micro-dataset and investigate the relationship between the benchmark restrictiveness and net lending. We find that a more restrictive benchmark is associated with more total net lending and net lending to non-financial corporates by relatively large banks. Our findings suggest that the design of targeted lending benchmarks influences bank credit flows and that a more binding benchmark would have been even more effective in stimulating bank lending.

JEL codes: C23, E51, E58, G21

Key Words: TLTRO, monetary policy, refinancing operations, credit easing, bank credit

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1 Introduction

As part of its unconventional policies, the ECB has implemented three series of targeted longer-term refinancing operations (TLTRO-I in 2014, TLTRO-II in 2016 and TLTRO-III in 2019, respectively). The objective of the TLTROs is to stimulate bank lending to the real economy. Bank lending is crucial for the transmission of monetary policy to the real economy (see e.g. Peek and Rosengren, 2012), but reduces during financial crises (Ivashina and Scharfstein, 2010; Gambacorta and Marques-Ibanez, 2011).

TLTROs offer attractive funding to banks for periods up to four years. They are 'targeted' credit easing operations, since the amount that banks can borrow is linked to the stock of loans to non-financial corporates and households; banks with larger claims on the real economy were allowed to borrow more in the TLTROs than banks with smaller claims. Prior to the TLTROs, the ECB also conducted untargeted longer-term refinancing operations to support bank lending.[1]

Recent literature has examined the effectiveness of these ECB operations. Both untargeted (Andrade et al., 2015; Darracq-Paries and De Santis, 2015; Garcia-Posada and Marchetti, 2015; Casiraghi et al., 2016; Boeckx et al., 2017; De Haan et al., 2017; Jasova et al., 2018) and targeted (Altavilla et al., 2016; Balfoussia and Gibson 2016; Benetton and Fantino 2018) long term refinancing operations by the ECB supported bank lending to the real economy. However, untargeted operations also created unintended effects, such as carry trades through government bond purchases (Carpinelli and Crosignani, 2017; Crosignani et al., 2019; De Haan et al., 2019). Untargeted long-term central bank funding can incentivize banks to purchase government bonds, which they can pledge as collateral for central bank loans (Van der Kwaak, 2017). By contrast, De Haan et al. (2019) highlight the benefits of targeted credit easing and show that the TLTRO-I did

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[1]The ECB conducted three 12-month longer-term refinancing operations (LTROs) in 2009 and one 12-month LTRO in 2011, followed by 36-month very long-term refinancing operations (VLTROs) in 2011 and 2012. See Bats et al. (2017) for an overview of all ECB's unconventional liquidity measures in the global financial crisis.

not generate carry trades. The effectiveness of credit easing by the central bank thus depends on its design. Banks may be better incentivized to extend credit when their lending behavior is targeted.

The TLTRO-II and TLTRO-III create an extra incentive for credit easing, since the interest rate is linked to a participant's net lending. An increase in net lending relative to outstanding loans, compared to a participant-specific benchmark, results in a lower interest rate charged by the central bank. The resulting interest rate lies between the rate of the main refinancing operations (MRO) and the deposit facility (DF), respectively 0 and -0.4 percent at the start of the TLTRO-II.[2] Banks that beat the benchmark thus receive cheaper funding for their TLTRO liabilities.[3] Indeed, the ECB (2017b) and Laine (2019) have suggested that the TLTRO-II has supported bank lending to non-financial corporates.[4]

The restrictiveness of the benchmark in the second and third TLTRO series varies between banks. For the same interest rate discount, some banks are required to increase their net lending by more than others, relative to outstanding loans. By implication, the TLTRO-II and TLTRO-III benchmark may impact net lending differently across banks, as a more restrictive benchmark strengthens the incentive to increase net lending. The goal of this chapter is to empirically study the relationship between the restrictiveness of the participant-specific benchmark and net bank lending. The hypothesis tested is that the benchmark restrictiveness is positively associated with net lending by banks and seek to explore whether the design of targeted credit easing operations can influence bank credit flows. The analysis focuses specifically on the TLTRO-II.

Fixed effects regressions are estimated using a unique microdata panel of all par-

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[2]The MRO and DF are, respectively, the one-week liquidity-providing operation and the overnight standing facility for banks.

[3]This is in contrast with the targeted credit easing operation of the Bank of England − the extension of the funding for lending scheme − where participants were penalized for lending declines via interest rate increases (Bank of England, 2016).

[4]The evidence provided by the ECB is based on a comparison of lending behavior between TLTRO participants and non-participants at the aggregate level (European Central Bank, 2017). Laine (2019) compares participants and non-participants at the bank level.

ticipating banks in the TLTRO-II from January 2015 until January 2018. The dataset includes the lending data that participants provided to their national central bank for the calculation of the TLTRO-II interest rates. The results lead to several conclusions. First, a more restrictive benchmark results in more total net lending and net lending to non-financial corporates by relatively large banks. Banks that are relatively large and face the most restrictive benchmark increase their net lending relative to outstanding loans to the real economy with 9 to 16 percentage points. Second, the benchmark restrictiveness does not impact total lending by relatively small banks. Third, there exists a weak positive relationship between the benchmark restrictiveness and net lending to non-financial corporates by relatively small banks. Last, a more restrictive benchmark does not lead to more net lending to households. These results are robust to several alternative specifications.

The rest of this chapter is organized as follows. Section 2 discusses the TLTRO-II benchmark methodology and the calculation of the TLTRO-II interest rate. Section 3 presents the methodology and data. Section 4 offers the results. Section 5 concludes.

2 Benchmark methodology and calculation of the TLTRO-II interest rate

The TLTRO-II interest rate is based on a participant's net lending to non-financial corporates and households relative to a participant-specific lending benchmark. Loans for house purchases are excluded (also in the remainder of this study, unless explicitly mentioned). The benchmark is based on the participant's net lending to non-financial corporates and households in the first reference period from February 2015 to January 2016. The restrictiveness of the benchmark differs between institutions that had positive or negative net lending in the run up to the TLTRO-II. The value of the benchmark equals outstanding loans in January 2016 for participants whose net lending was positive.

For participants whose net lending was negative, the benchmark equals the sum of outstanding loans in January 2016 and the net lending amount in the first reference period (Figure 1 illustrates; Box A.1 in the appendix provides further details). The deviation of a participant's outstanding amount of loans from the benchmark at the end of the second reference period determines the interest rate. The second reference period is from February 2016 to January 2018. There are three possible outcomes:

1. If the outstanding amount of loans at the end of the second reference period does not exceed the benchmark, the interest rate equals the MRO rate.

2. If the deviation from the benchmark is positive, but smaller than 2.5 percent, the interest rate equals a proportionally determined rate between the MRO and the DF rate.

3. If the deviation from the benchmark exceeds 2.5 percent, the interest rate equals the DF rate.

3   Methodology and data

Fixed effects regression models estimate the effect of the restrictiveness of the TLTRO-II benchmark on net lending. Four dependent variables are used. The first three variables are net lending relative to outstanding loans in January 2016 for:

1. households;

2. non-financial corporates;

3. households and non-financial corporates.

The fourth dependent variable is net lending to households relative to total net lending (i.e. including loans for house purchases).
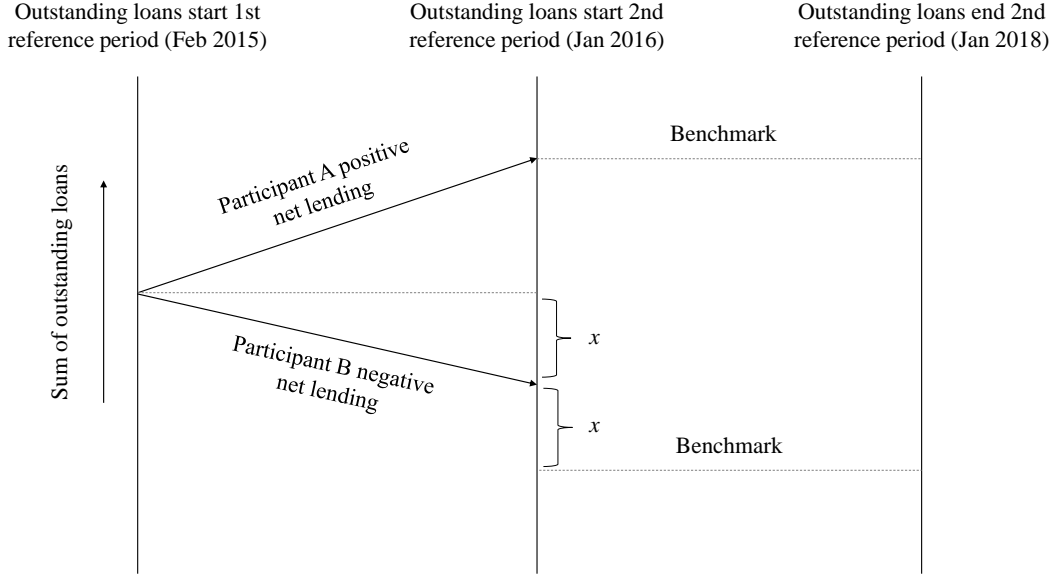
Figure 1: Participant-specific lending benchmark of TLTRO-II

Notes: This figure illustrates the TLTRO-II benchmark methodology for participants experiencing positive and negative net lending in the first reference period. The benchmark is based on the participant's net lending to non-financial corporates and households in the first reference period (February 2015 − January 2016). The value of the benchmark equals outstanding loans in January 2016 for participants whose net lending was positive and equals outstanding loans in January 2016 minus the net lending amount for participants whose net lending was negative.

The following regression models are estimated:

$$HH_{i,j,t} = \beta TLTRO_{i,j,t} + \gamma^{'} X_{j,t} + \zeta Z_{i,j,t} + t_{i,j,t} + \mu_{i,j} + \varepsilon_{i,j,t} \tag{1}$$

$$NFC_{i,j,t} = \beta TLTRO_{i,j,t} + \gamma^{'} X_{j,t} + \zeta Z_{i,j,t} + t_{i,j,t} + \mu_{i,j} + \varepsilon_{i,j,t} \tag{2}$$

$$T_{i,j,t} = \beta TLTRO_{i,j,t} + \gamma^{'} X_{j,t} + \zeta Z_{i,j,t} + t_{i,j,t} + \mu_{i,j} + \varepsilon_{i,j,t} \tag{3}$$

$$HP_{i,j,t} = \beta TLTRO_{i,j,t} + \gamma^{'} X_{j,t} + \zeta Z_{i,j,t} + t_{i,j,t} + \mu_{i,j} + \varepsilon_{i,j,t} \tag{4}$$

where $HH_{i,j,t}$ represents net lending to households as a ratio of outstanding household loans in January 2016; $NFC_{i,j,t}$ is net lending to non-financial corporates as a ratio of outstanding non-financial corporate loans in January 2016; $T_{i,j,t}$ represents the total

sum of net lending to households and non-financial corporates as a ratio of the total sum of outstanding non-financial corporate and household loans in January 2016; $HP_{i,j,t}$ is net lending to households as a ratio of total net lending to households (including loans for house purchases) and indicates the extent to which loans included in the benchmark increase more than loans excluded from the benchmark.; $TLTRO_{i,j,t}$ represents the indicator for the TLTRO-II benchmark restrictiveness; $X_{j,t}$ comprises the set of country-specific controls; $Z_{i,j,t}$ are bank-specific control variables; $t_{i,j,t}$ represents a bank-specific linear time trend; $\mu_{i,j}$ are time-invariant fixed effects; $\varepsilon_{i,j,t}$ is the error term and the subscripts i, j, t denote the participating bank, country and the two reference periods, respectively.

The benchmark restrictiveness indicator equals 0 in the first reference period. This is because the TLTRO-II benchmark is not yet binding in the first reference period, de facto implying zero restrictiveness. In the second reference period, the indicator equals the ratio of the benchmark value to the sum of outstanding non-financial corporate and household loans at the end of the first reference period; the value lies between 0 and 1 (higher values indicate a more binding constraint). Note that the indicator is a predetermined regressor, since the benchmark's restrictiveness is based on a bank's past performance in terms of credit supply (see Section 2). This implies that the effects are underestimated, i.e. the effects are generally larger than the models suggest (see Box A.2 in the appendix).

As the benchmark restrictiveness is based on a bank's past amount of net lending, an omitted variable bias can occur when a bank's net lending is (partially) determined by its net lending behavior in the past. To control for this, the regressions include two control variables that take account of bank-specific trend growth in credit supply. The first variable is a linear time trend that is positive for banks with positive net lending in the first reference period and negative for banks with negative net lending in the first reference period. The second variable is a bank's 1-year growth rate in outstanding

loans to households and non-financial corporates, lagged by one year per reference period (captured by $Z_{i,j,t}$).[5]

Also note that the calculation of the benchmark restrictiveness differs between banks with positive and negative net lending before the start of the TLTRO-II; while the restrictiveness varies for banks with negative net lending in the first reference period, the restrictiveness equals 1 for all banks with positive net lending in the first reference period, independent of their net lending size in the first reference period. This difference is eliminated in a separate robustness check that assumes a bank's benchmark restrictiveness proportionally rises above 1 according to the bank's positive amount of net lending (Figure 5 in section 5 illustrates this).

In addition, the regressions address demand-effects and indexation by including country-specific control variables: the quarterly-average of GDP growth, the monthly-average of growth in the total industrial production index (excluding construction; seasonally adjusted), the monthly-average of an economic sentiment indicator and the monthly-average of HICP inflation. Financial shocks are controlled for by including a country-specific sovereign risk (SRSK) variable that proxies a sovereign's default probability. The regressions also control for real economic demand by including the monthly-average of bank-specific lending interest rates on 1- to 5-year bank loans. Last, bank fixed effects are included to take account of differences between banks, such as their corporate structure, bank capitalization, funding stress and the amount borrowed under TLTRO-II.[6] The bank fixed effects are substituted with country fixed effects in a separate robustness check.

The analysis relies on different data sources. For data on lending to the first three groups of borrowers and the calculation of the participant-specific benchmark, the data

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[5]This implies that model (3) is to some extent dynamic, since the dependent variable in model (3) is the total sum of net lending to households and non-financial corporates as a ratio of the total sum of outstanding non-financial corporate and household loans in January 2016.

[6]Bank fixed effects prevent a potential underestimation of the effects of the benchmark restrictiveness indicator; a less restrictive benchmark may incentivize banks to increase their total take-up amount in the TLTRO-II, de facto resulting in larger net lending increases.

that participants provided to their national central bank for the calculation of the TLTRO-II interest rates are used. This dataset allows for calculating the benchmark restrictiveness of all participating banks in the TLTRO-II. Data for the last group of borrowers are obtained from the ECB's Individual Balance Sheet Items (IBSI) database, since loans for house purchases are excluded from the benchmark calculation (see Section 2). Data for the growth rates in outstanding loans prior the two reference periods are also taken from the IBSI database, since participants were not required to provide this data to their national central bank for the calculation of the TLTRO-II interest rates. All country-specific variables that control for demand-effects and indexation are obtained from Eurostat. The country-specific variable SRSK is provided by Bloomberg. The bank-specific lending rates are obtained from the ECB's interest rates statistics (IMIR) database.

The total panel includes all 755 participating banks and the two reference time periods. However, bank-specific control variable data that stem from the IBSI and IMIR database are only available for 116 banks. This is because not all participants report in the IBSI and IMIR database. Regression models without controlling for bank-specific control variables are therefore also estimated. There are no missing values for models (1), (2) and (3) when the bank-specific control variables are excluded.[7] The sample is split into small and large banks, based on the median of banks' outstanding loans in January 2016.[8] Figure 2 shows that the size of participating banks is highly skewed.[9] Therefore, the top 50 largest banks are also analyzed separately; they have balance sheet

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[7]Note that the values of $HH_{i,j,t}$, $NFC_{i,j,t}$, $T_{i,j,t}$ are set to 0 when their denominators and numerators are both equal to 0. For 2 observations of $HH_{i,j,t}$ however, the denominator equals 0 while the numerator is positive. This is because two banks experience positive net lending to households in the second reference period while they had no loans outstanding to households by the end of the first reference period. As these banks did in fact increase their net lending to households relative to their outstanding households loans, these ratios are set to 10 (i.e. 1000%). However, leaving these observations undefined (i.e. excluding these observations from the sample), does not change the results.

[8]Outstanding loans are used as an indicator for banks' balance sheet size, as data on total assets is not provided for all participating banks.

[9]The y-axis represents the sum of a bank's outstanding loans to households and non-financial corporates. The actual values are not shown due to confidentiality.

sizes larger than 40 billion euros and make up 57 percent of the panel's outstanding loans in January 2016.
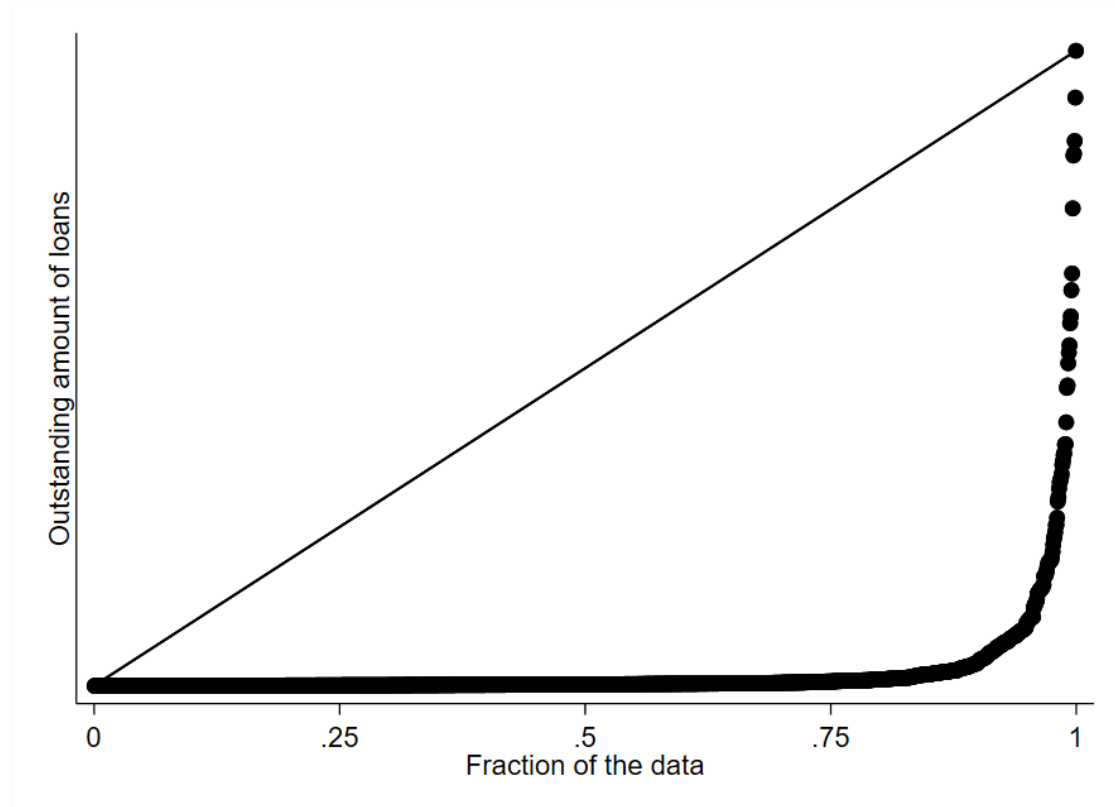

Figure 2: Quantile plot of banks' size

Notes: This figure shows the distribution of the sum of bank's outstanding loans to households and non-financial corporates between February 2015 and January 2018. The straight line represents an equal distribution. The distribution has 1,510 observations and includes all 755 banks.

To illustrate the evolution of net lending, Figure 3 presents the sum of all participants' net lending to non-financial corporates and households in the first and second reference period by country, as well as the total sample sum. Due to confidentiality of the data, the sum of net lending of participants in Cyprus, Estonia, Lithuania, Latvia and Malta are plotted under 'Other'. The figure shows that net lending to non-financial corporates and households increased in most countries. There are two exceptions. First, the sum of net lending to non-financial corporates decreased in some or all of the countries under 'Other'. Second, net lending to households decreased in Greece.
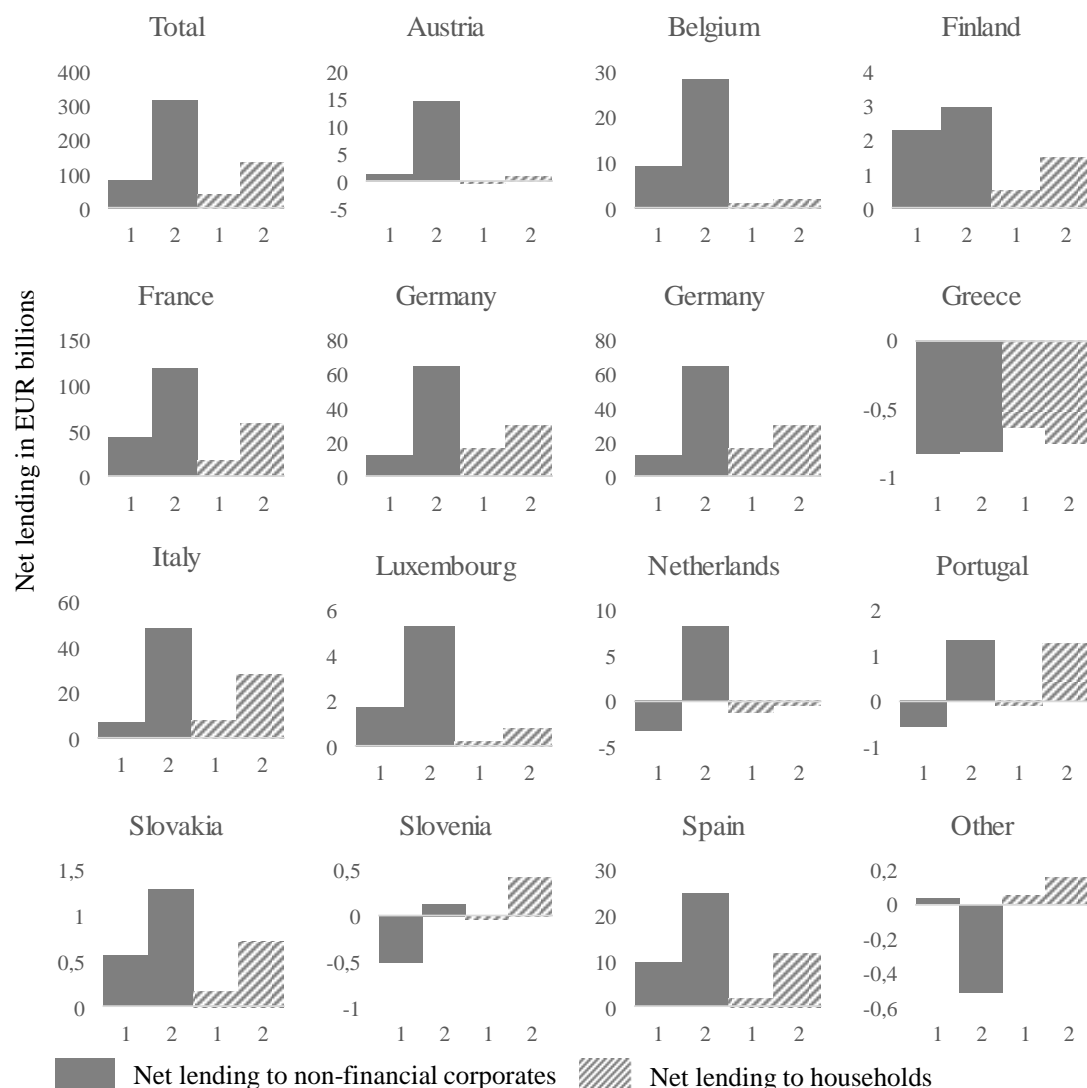
Figure 3: Net lending per reference period by country

Notes: This figure shows evolution of the sum of all participants' net lending to non-financial corporates and households by country, as well as the total sample sum. The x-axis represents the two reference periods. The y-axis represents the net lending volumes in EUR billions. Due to confidentiality of the data, the sum of net lending of participants in Cyprus, Estonia, Lithuania, Latvia and Malta are plotted under 'Other', which ensures a minimum of 4 participating banks per chart.

Of all participants, 530 banks have experienced positive net lending in the first reference period and thus face the most restrictive benchmark; their benchmark restrictive-

Table 1: The benchmark restrictiveness for banks with negative net lending in the 1st reference period

Variable	Obs	Mean	Std. Dev.	Min	Max
Benchmark restrictiveness indicator	225	0.917	0.167	0.000	0.999

Notes: This table presents the descriptive statistics of the benchmark restrictiveness indicator in the second reference period for banks with negative net lending in the first reference period. Of the 755 participants, 225 banks experienced negative net lending in the first reference period and have a benchmark restrictiveness indicator that is smaller than 1.

ness indicator equals 1 in the second reference period. The benchmark restrictiveness indicator is smaller than 1 for the other 225 banks in the second reference period. Table 1 shows the descriptive statistics of the benchmark restrictiveness indicator for banks with negative net lending in the first reference period (additional descriptive statistics are not provided due to data confidentiality issues). The descriptive statistics show that the restrictiveness indicator varies between 0 and 0.99.

While a selection effect emerges when banks have only participated in the TLTRO-II if they knew ex ante that they were likely to beat the benchmark, the results are not subject to this selection bias; the estimations examine the relationship between the benchmark restrictiveness and bank net lending within the group of TLTRO-II participants. This study does not analyze the effectiveness of the TLTRO-II by comparing participants and non-participants. Moreover, in terms of bank credit size, more than 70 percent of all Eurosystem monetary financial institutions participated in the TLTRO-II.[10] Any selection effect is therefore likely to be small. Also, deviations from the benchmark tend to be much larger than the required 2.5 percent for participants receiving the DF rate (see Figure 4).[11] This suggests that the benchmark was not a major hurdle for banks to receive the DF rate.

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[10]Aggregated Balance Sheet Items (BSI) data from the ECB statistical data warehouse shows that relative to total outstanding loans to non-financial corporates in the Eurosystem, the percentage of participants' outstanding loans to non-financial corporates equals 73 percent.

[11]More than 75 percent of all participants have fully beaten the benchmark.
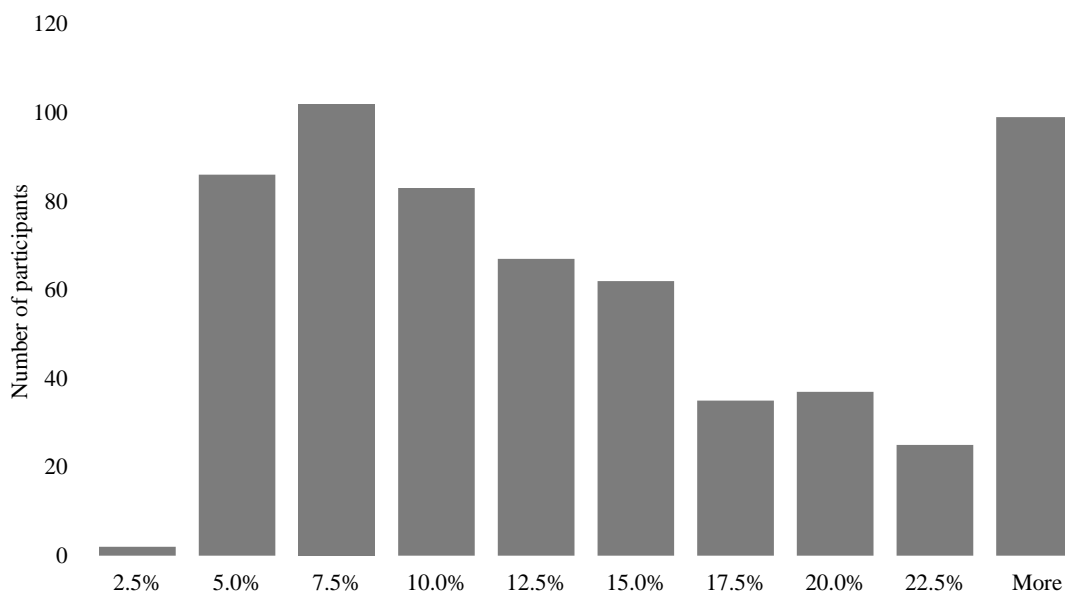
Figure 4: Benchmark deviations for participants receiving DF rate
Notes: This figure shows the benchmark deviations for participants receiving the interest rate on the central bank's deposit facility (i.e. participants that have deviated by more than 2.5 percent from the TLTRO-II benchmark). There are in total 596 participants that fully beat the benchmark.

4 Results

The estimations are employed for all participating banks, for banks with outstanding loans below and above the sample median, and for the 50 largest banks. All regressions include HAC standard errors. The results suggest that a more restrictive TLTRO-II benchmark is associated with more total net lending and net lending to non-financial corporates by relatively large banks (see Tables 1 and 2). Relatively large banks that face the most restrictive benchmark increase their total net lending relative to outstanding loans with 9 to 13 percentage points. Net lending to non-financial corporates by relatively large banks increased with 13 to 16 percentage points relative to outstanding loans. These effects are significant at the 1 percent confidence level.[12]

Despite the positive evolution of net lending to households (as illustrated in Figure

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[12]Similar results are found when bank fixed effects are substituted with country fixed effects in these estimations (available upon request).

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3), the results suggest that the benchmark restrictiveness indicator is not related to net lending to households by relatively large banks. The estimations show no positive significant effects on net lending to households by large banks, both as a ratio of outstanding loans to households and relative to net lending to households including loans for house purchases (see Tables 2 and 3). The insignificant effects on net lending to households may be explained by a potential difference between the interest rate elasticities of bank credit for non-financial firms and households. Banks are more likely to increase their net lending to non-financial corporates than to households in case the interest rate elasticity of credit is lower for households than for non-financial corporates.

For banks with outstanding loans below the sample median, the results show a positive relationship between the benchmark restrictiveness and net lending to non-financial corporates exists, significant at the 10% level (see Table 4). Conversely, the results show that the benchmark restrictiveness is negatively associated with net lending to households by relatively small banks. For the entire sample, the positive effects on total net lending and net lending to non-financial corporates relative to outstanding loans in January 2016 remain statistically significant and increase to 12 and 27 percentage points, respectively (see Table 5).

The heterogeneous calculation of the benchmark's restrictiveness between banks with positive and negative net lending in the first reference period is resolved in a separate robustness check (see the methodology for an explanation). It is assumed that the benchmark restrictiveness indicator proportionally rises above 1 when net lending in the first reference period is positive. This indicator thus controls for a potential net lending trend across all participating banks homogeneously (see Figure 5). The results are similar (see Tables 6-8). A more restrictive benchmark is associated with more total net lending and net lending to non-financial corporates, even when banks are required to beat their own positive net lending trend. For the top 50 largest banks, the effects are statistically significant at the 1% level in all columns. For the other samples, the

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Table 2: Results for banks with outstanding loans above the sample median

Regressors	$HH_{i,j,t}$	$HH_{i,j,t}$	$NFC_{i,j,t}$	$NFC_{i,j,t}$	$T_{i,j,t}$	$T_{i,j,t}$	$HP_{i,j,t}$	$HP_{i,j,t}$
				Dependent variable				
Benchmark	-0.043	0.024	0.156***	0.139***	0.088***	0.115***	-102.636	-332.240
restrictiveness	(0.079)	(0.054)	(0.040)	(0.041)	(0.027)	(0.029)	(106.539)	(311.174)
Country controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Bank controls	No	Yes	No	Yes	No	Yes	No	Yes
Bank fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Time trend	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R-sqr(within)	0.015	0.133	0.072	0.317	0.098	0.316	0.025	0.121
N	754	212	754	212	754	212	211	203

Notes: This table presents fixed effects estimations for models (1), (2), (3) and (4) for banks with outstanding loans above the sample median. The dependent variables are net lending to households as a ratio of outstanding household loans in January 2016 ($HH_{i,j,t}$), net lending to non-financial corporates as a ratio of outstanding non-financial corporate loans in January 2016 ($NFC_{i,j,t}$), the total sum of net lending to households and non-financial corporates as a ratio of the total sum of outstanding non-financial corporate and household loans in January 2016 ($T_{i,j,t}$) and net lending to households as a ratio of net lending to households including loans for house purchases in January 2016 ($HP_{i,j,t}$). HAC standard errors are given in parentheses. The following country-specific control variables are included in all columns: the quarterly-average of GDP growth, the monthly-average of a total industrial production index growth (excluding construction; seasonally adjusted), the monthly-average of an economic sentiment indicator, the monthly-average of HICP inflation and the monthly-average of an indicator for a sovereign's default probability. In addition, the regressions control for bank-specific linear trend growth in all columns. Columns 2, 4, 6 and 8 also control for real economic demand by including the monthly-average of bank-specific lending interest rates on 1- to 5-year bank loans and for bank-specific 1-year growth rates in outstanding loans, lagged by one year per reference period. All columns include bank fixed effects. Significance levels: * p<0.1, ** p<0.05, *** p<0.01.

Table 3: Results for the 50 largest banks

Regressors	$HH_{i,j,t}$	$HH_{i,j,t}$	$NFC_{i,j,t}$	$NFC_{i,j,t}$	$T_{i,j,t}$	$T_{i,j,t}$	$HP_{i,j,t}$	$HP_{i,j,t}$
				Dependent variable				
Benchmark	-0.036	-0.070	0.137***	0.160***	0.118***	0.130**	-150.680	-981.884
restrictiveness	(0.046)	(0.055)	(0.039)	(0.042)	(0.032)	(0.038)	(180.828)	(696.272)
Country controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Bank controls	No	Yes	No	Yes	No	Yes	No	Yes
Bank fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Time trend	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R-sqr(within)	0.134	0.156	0.522	0.551	0.469	0.474	0.047	0.356
N	100	93	100	93	100	93	91	91

Notes: This table presents fixed effects estimations for models (1), (2), (3) and (4) for the 50 largest banks. The dependent variables are net lending to households as a ratio of outstanding household loans in January 2016 ($HH_{i,j,t}$), net lending to non-financial corporates as a ratio of outstanding non-financial corporate loans in January 2016 ($NFC_{i,j,t}$), the total sum of net lending to households and non-financial corporates as a ratio of the total sum of outstanding non-financial corporate and household loans in January 2016 ($T_{i,j,t}$) and net lending to households as a ratio of net lending to households including loans for house purchases in January 2016 ($HP_{i,j,t}$). HAC standard errors are given in parentheses. The following country-specific control variables are included in all columns: the quarterly-average of GDP growth, the monthly-average of a total industrial production index growth (excluding construction; seasonally adjusted), the monthly-average of an economic sentiment indicator, the monthly-average of HICP inflation and the monthly-average of an indicator for a sovereign's default probability. In addition, the regressions control for bank-specific linear trend growth in all columns. Columns 2, 4, 6 and 8 also control for real economic demand by including the monthly-average of bank-specific lending interest rates on 1- to 5-year bank loans and for bank-specific 1-year growth rates in outstanding loans, lagged by one year per reference period. All columns include bank fixed effects. Significance levels: * p<0.1, ** p<0.05, *** p<0.01.

Table 4: Results for banks with outstanding loans below the sample median

Regressors	$HH_{i,j,t}$	$NFC_{i,j,t}$	$T_{i,j,t}$
	Dependent variable		
Benchmark	-0.922**	0.492*	0.227
restrictiveness	(0.460)	(0.274)	(0.252)
Country controls	Yes	Yes	Yes
Bank controls	No	No	No
Bank fixed effects	Yes	Yes	Yes
Time trend	Yes	Yes	Yes
R-sqr(within)	0.279	0.105	0.051
N	756	756	756

Notes: This table presents fixed effects estimations for models (1), (2) and (3) for banks with outstanding loans below the sample median. The dependent variables are net lending to households as a ratio of outstanding household loans in January 2016 ($HH_{i,j,t}$), net lending to non-financial corporates as a ratio of outstanding non-financial corporate loans in January 2016 ($NFC_{i,j,t}$) and the total sum of net lending to households and non-financial corporates as a ratio of the total sum of outstanding non-financial corporate and household loans in January 2016 ($T_{i,j,t}$). Net lending to households as a ratio of outstanding household loans including loans for house purchases is not depicted as there are almost no observations for banks with outstanding loans below the sample median. HAC standard errors are given in parentheses. The following country-specific control variables are included in all columns: the quarterly-average of GDP growth, the monthly-average of a total industrial production index growth (excluding construction; seasonally adjusted), the monthly-average of an economic sentiment indicator, the monthly-average of HICP inflation and the monthly-average of an indicator for a sovereign's default probability. In addition, the regressions control for bank-specific linear trend growth in all columns. The regressions do not control for bank-specific lending interest rates, since there are too little observations for small banks. All columns include bank fixed effects. Significance levels: * p<0.1, ** p<0.05, *** p<0.01.

Table 5: Results for total panel

Regressors	$HH_{i,j,t}$	$HH_{i,j,t}$	$NFC_{i,j,t}$	$NFC_{i,j,t}$	$T_{i,j,t}$	$T_{i,j,t}$	$HP_{i,j,t}$	$HP_{i,j,t}$
	Dependent variable							
Benchmark	-0.312*	0.057	0.273***	0.129***	0.123*	0.114***	-102.438	-301.792
restrictiveness	(0.189)	(0.056)	(0.080)	(0.042)	(0.069)	(0.031)	(106.029)	(287.263)
Country controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Bank controls	No	Yes	No	Yes	No	Yes	No	Yes
Bank fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Time trend	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R-sqr(within)	0.127	0.182	0.076	0.333	0.051	0.331	0.023	0.101
N	1510	218	1510	218	1510	218	215	207

Notes: This table presents fixed effects estimations for models (1), (2), (3) and (4) for the total panel. The dependent variables are net lending to households as a ratio of outstanding household loans in January 2016 ($HH_{i,j,t}$), net lending to non-financial corporates as a ratio of outstanding non-financial corporate loans in January 2016 ($NFC_{i,j,t}$), the total sum of net lending to households and non-financial corporates as a ratio of the total sum of outstanding non-financial corporate and household loans in January 2016 ($T_{i,j,t}$) and net lending to households as a ratio of net lending to households including loans for house purchases in January 2016 ($HP_{i,j,t}$). HAC standard errors are given in parentheses. The following country-specific control variables are included in all columns: the quarterly-average of GDP growth, the monthly-average of a total industrial production index growth (excluding construction; seasonally adjusted), the monthly-average of an economic sentiment indicator, the monthly-average of HICP inflation and the monthly-average of an indicator for a sovereign's default probability. In addition, the regressions control for bank-specific linear trend growth in all columns. Columns 2, 4, 6 and 8 also control for real economic demand by including the monthly-average of bank-specific lending interest rates on 1- to 5-year bank loans and for bank-specific 1-year growth rates in outstanding loans, lagged by one year per reference period. All columns include bank fixed effects. Significance levels: * p<0.1, ** p<0.05, *** p<0.01.

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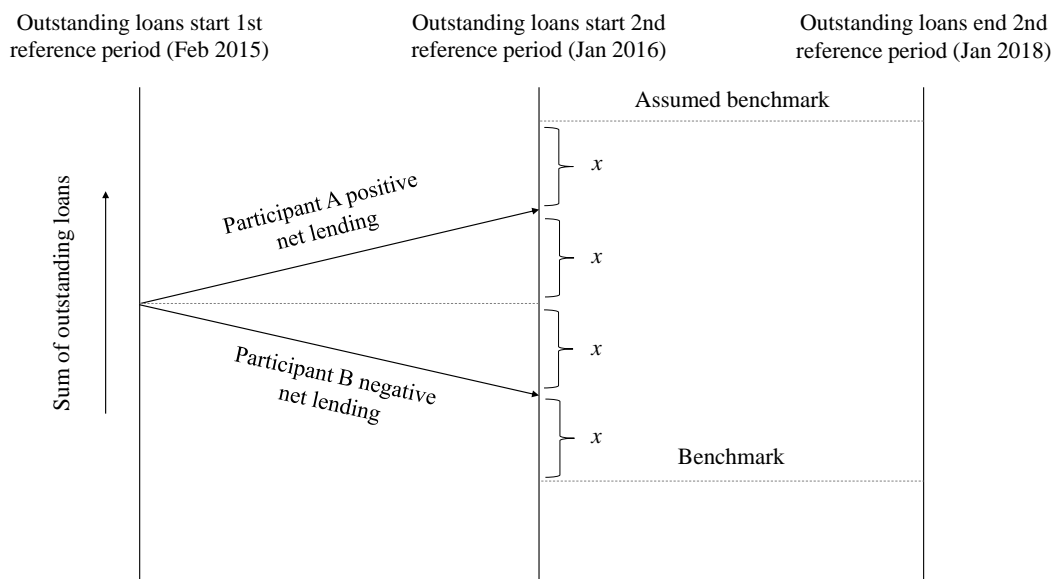statistical significance varies between the 1 to 5 percent confidence level.

Figure 5: Homogenous participant-specific lending benchmark of TLTRO-II

Notes: This figure illustrates the robustness check approach to account for the heterogeneous calculation of the benchmark's restrictiveness between banks with positive and negative net lending in the first reference period (see the methodology for an explanation). The difference between the groups of banks is eliminated by assuming a bank's benchmark restrictiveness proportionally rises above 1 according to the amount of the bank's positive net lending in the first reference period. The benchmark is based on the participant's net lending to non-financial corporates and households in the first reference period (February 2015 − January 2016). The value of the benchmark equals outstanding loans in January 2016 plus the net lending amount for both groups.

Table 6: Results for banks with outstanding loans above the sample median (Robustness check)

Regressors	Dependent variable			
	$NFC_{i,j,t}$	$NFC_{i,j,t}$	$T_{i,j,t}$	$T_{i,j,t}$
Benchmark	0.417**	0.214**	0.246**	0.194**
restrictiveness adjusted	(0.203)	(0.091)	(0.111)	(0.086)
Country controls	Yes	Yes	Yes	Yes
Bank controls	No	Yes	No	Yes
Bank fixed effects	Yes	Yes	Yes	Yes
Time trend	Yes	Yes	Yes	Yes
R-sqr(within)	0.184	0.408	0.209	0.430
N	754	212	754	212

Notes: This table presents the results of the robustness check as described in the methodology for banks with outstanding loans above the sample median. The fixed effects estimations use an alternative specification for the benchmark restrictiveness indicator in models (2) and (3). The dependent variables are net lending net lending to non-financial corporates as a ratio of outstanding non-financial corporate loans in January 2016 ($NFC_{i,j,t}$) and the total sum of net lending to households and non-financial corporates as a ratio of the total sum of outstanding non-financial corporate and household loans in January 2016 ($T_{i,j,t}$). HAC standard errors are given in parentheses. The following country-specific control variables are included in all columns: the quarterly-average of GDP growth, the monthly-average of a total industrial production index growth (excluding construction; seasonally adjusted), the monthly-average of an economic sentiment indicator, the monthly-average of HICP inflation and the monthly-average of an indicator for a sovereign's default probability. In addition, the regressions control for bank-specific linear trend growth in all columns. Columns 2 and 4 also control for real economic demand by including the monthly-average of bank-specific lending interest rates on 1- to 5-year bank loans and for bank-specific 1-year growth rates in outstanding loans, lagged by one year per reference period. All columns include bank fixed effects. Significance levels: * p<0.1, ** p<0.05, *** p<0.01

Table 7: Results for the 50 largest banks (Robustness check)

Regressors	Dependent variable			
	$NFC_{i,j,t}$	$NFC_{i,j,t}$	$T_{i,j,t}$	$T_{i,j,t}$
Benchmark	0.138***	0.159***	0.119***	0.130***
restrictiveness adjusted	(0.037)	(0.040)	(0.031)	(0.035)
Country controls	Yes	Yes	Yes	Yes
Bank controls	No	Yes	No	Yes
Bank fixed effects	Yes	Yes	Yes	Yes
Time trend	Yes	Yes	Yes	Yes
R-sqr(within)	0.542	0.571	0.482	0.487
N	100	93	100	93

Notes: This table presents the results of the robustness check as described in the methodology for the 50 largest banks. These fixed effects estimations use an alternative specification for the benchmark restrictiveness indicator in models (2) and (3). The dependent variables are net lending net lending to non-financial corporates as a ratio of outstanding non-financial corporate loans in January 2016 ($NFC_{i,j,t}$) and the total sum of net lending to households and non-financial corporates as a ratio of the total sum of outstanding non-financial corporate and household loans in January 2016 ($T_{i,j,t}$). HAC standard errors are given in parentheses. The following country-specific control variables are included in all columns: the quarterly-average of GDP growth, the monthly-average of a total industrial production index growth (excluding construction; seasonally adjusted), the monthly-average of an economic sentiment indicator, the monthly-average of HICP inflation and the monthly-average of an indicator for a sovereign's default probability. In addition, the regressions control for bank-specific linear trend growth in all columns. Columns 2 and 4 also control for real economic demand by including the monthly-average of bank-specific lending interest rates on 1- to 5-year bank loans and for bank-specific 1-year growth rates in outstanding loans, lagged by one year per reference period. All columns include bank fixed effects. Significance levels: * p<0.1, ** p<0.05, *** p<0.01

Table 8: Results for total panel (Robustness check)

Regressors	Dependent variable			
	$NFC_{i,j,t}$	$NFC_{i,j,t}$	$T_{i,j,t}$	$T_{i,j,t}$
Benchmark	0.397***	0.200**	0.311***	0.188**
restrictiveness adjusted	(0.147)	(0.092)	(0.120)	(0.087)
Country controls	Yes	Yes	Yes	Yes
Bank controls	No	Yes	No	Yes
Bank fixed effects	Yes	Yes	Yes	Yes
Time trend	Yes	Yes	Yes	Yes
R-sqr(within)	0.107	0.419	0.118	0.437
N	1510	218	1510	218

Notes: This table presents the results of the robustness check as described in the methodology for the total panel. These fixed effects estimations use an alternative specification for the benchmark restrictiveness indicator in models (2) and (3). The dependent variables are net lending net lending to non-financial corporates as a ratio of outstanding non-financial corporate loans in January 2016 ($NFC_{i,j,t}$) and the total sum of net lending to households and non-financial corporates as a ratio of the total sum of outstanding non-financial corporate and household loans in January 2016 ($T_{i,j,t}$). HAC standard errors are given in parentheses. The following country-specific control variables are included in all columns: the quarterly-average of GDP growth, the monthly-average of a total industrial production index growth (excluding construction; seasonally adjusted), the monthly-average of an economic sentiment indicator, the monthly-average of HICP inflation and the monthly-average of an indicator for a sovereign's default probability. In addition, the regressions control for bank-specific linear trend growth in all columns. Columns 2 and 4 also control for real economic demand by including the monthly-average of bank-specific lending interest rates on 1- to 5-year bank loans and for bank-specific 1-year growth rates in outstanding loans, lagged by one year per reference period. All columns include bank fixed effects. Significance levels: * $p<0.1$, ** $p<0.05$, *** $p<0.01$

5 Conclusion

This study uses a unique micro-dataset and sheds light on the success of the lending benchmark in the ECB's TLTRO-II. A more restrictive lending benchmark results in more total net lending and net lending to non-financial corporates, especially by relatively large banks. The large banks make up the largest share in total bank credit supply and are most relevant for the bank lending channel. Providing interest rate discounts on the basis of participant-specific lending benchmarks is thus an effective credit easing instrument.

The findings are relevant for monetary policy makers. The design and restrictiveness of targeted lending benchmarks can influence bank credit flows. Increasing the restrictiveness of participant-specific lending benchmarks stimulates net lending. The restrictiveness of the TLTRO-II benchmark did not impact net lending to households, however. Lending benchmarks targeted specifically on households may resolve this. Central banks that engage in targeted refinancing operations can change the borrowing

composition of bank credit by targeting specific group of borrowers. Moreover, negative lending benchmarks which penalize credit flows to certain groups of borrowers may even restrict bank lending to particular borrowers, but this cannot be tested.

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7   Appendix

A. The TLTRO-II benchmark and calculation of the interest rate

A participant's TLTRO-II interest rate is conditional on the following outstanding amount benchmark:

$$Benchmark_i = OL_{i,Jan16} + min(NL_{i,Feb15-Jan16}, 0) \tag{A.1}$$

where $Benchmark_i$ represents the outstanding amount benchmark; $OL_{i,Jan16}$ is the amount of eligible loans outstanding in January 2016; $NL_{i,Feb15-Jan16}$ is the amount of eligible net lending during the first reference period (Feb 2015 − Jan 2016) and the subscript i represents the TLTRO-II participant.

The performance of a TLTRO-II participant is measured by summing $OL_{i,Jan16}$ and a participant's eligible net lending in the second reference period between February 2016 and January 2018. This is defined as:

$$LS_i = OL_{i,Jan16} + NL_{i,Feb16-Jan18} \tag{A.2}$$

where LS_i represents the amount of eligible loans outstanding after the second reference period (Feb 2016 − Jan 2018) and $NL_{i,Feb16-Jan18}$ is eligible net lending during the second reference period.

A performance measure calculates the percentage deviations of LS_i from $Benchmark_i$, and is defined as:

$$PM_i = \frac{(LS_i - Benchmark_i)}{Benchmark_i} * 100 \tag{A.3}$$

where PM_i is the performance measure. Ratio (A.3) does not hold when $Benchmark_i$ equals zero. PM_i is then assumed to equal 2.5.[13]

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[13]In the data, this only applies to two banks, however.

Finally, the TLTRO-II interest rate is calculated on the basis of PM_i and has three outcomes:

1. If PM_i 0, then $r_i = r_{MRO}$

2. If $PM_i \geq 2.5$, then $r_i = r_{DF}$

3. If $0 < PM_i < 2.5$, then $r_i = r_{MRO} - \frac{(r_{MRO} - r_{DF}) * PM_i}{2.5}$

where r_i is the TLTRO-II interest rate, and r_{MRO} and r_{DF} respectively represent the rate on the main refinancing operation (MRO) and deposit facility (DF) of the ECB.

B. Proof of an underestimation of the results

Consider a simplified form of the fixed effects model in this chapter:

$$Y_{i,j,t} = \beta TLTRO_{i,j,t} + \mu_{i,j} + \varepsilon_{i,j,t} \tag{B.1}$$

Fixed effects estimations over two periods implies that we are de facto employing cross-sectional regressions in first differences:

$$\Delta Y_{i,j,t} = \beta \Delta TLTRO_{i,j,t} + \Delta \varepsilon_{i,j,t} \tag{B.2}$$

The covariance between the benchmark indicator and the dependent variable can be defined as:

$$
\begin{aligned}
Cov(\Delta TLTRO_{i,j,t}, \Delta \varepsilon_{i,j,t}) &= Cov(TLTRO_{i,j,2} - TLTRO_{i,j,1}, \varepsilon_{i,j,2} - \varepsilon_{i,j,1}) \\
&= Cov(TLTRO_{i,j,1}, \varepsilon_{i,j,2}) - Cov(TLTRO_{i,j,2}, \varepsilon_{i,j,1})
\end{aligned}
\tag{B.3}
$$

where $Cov(TLTRO_{i,j,1}, \varepsilon_{i,j,2}) = 0$. The second benchmark indicator's outcome in the second period, $TLTRO_{i,j,2}$, depends on the dependent variable in the first period; the benchmark's restrictiveness increases with a bank's net lending (see Section 2). $TLTRO_{i,j,2}$ is thus a predetermined regressor and the covariance between these two is positive:

$$Cov(TLTRO_{i,j,2}, Y_{i,j,1}) > 0 \tag{B.4}$$

By implication, the covariance between the benchmark indicator in the second period and the error term in the first period is positive:

$$Cov(TLTRO_{i,j,2}, \varepsilon_{i,j,1}) > 0 \tag{B.5}$$

The results are thus underestimated:

$$Cov(\Delta TLTRO_{i,j,t}, \varepsilon_{i,j,t}) < 0 \tag{B.6}$$

Previous DNB Working Papers in 2019