

WORKING PAPER 264

Targeted but (not) toxic?
TLTRO and financial stability

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Targeted but (not) toxic? TLTRO and financial stability*

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Abstract

As TLTRO programs provide a direct incentive to increase lending, investigating the level of prudence applied by banks in making lending decisions is of high relevance. Relying on loan-level data, I evaluate the riskiness of lending by applying estimations in a difference-in-differences setting around the cut-off of the TLTRO lending period. Investigating various risk-taking strategies, I show that participation in TLTRO operations is *not* associated with an increase in PDs, defaults or loans overdue. Even banks that only narrowly fulfilled the lending requirements to benefit from the lowest interest rate applied to TLTRO funding did not engage in higher risk-taking.

Keywords: Monetary policy transmission, funding-for-lending, risk-taking channel, financial stability, TLTRO

JEL Codes: E44, E51, E52, E58, G21

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Non-technical summary¹

This paper examines the impact of the European Central Bank's (ECB) Targeted Longer-Term Refinancing Operations (TLTRO) on financial stability, with a focus on whether the program induces banks to engage in riskier bank lending. Given its direct incentive scheme and advantages in the empirical design, the analysis focuses on the second TLTRO program (TLTRO II). Within the TLTRO II program, banks could reduce their borrowing rates with the central bank from the main refinancing operations rate to the deposit facility rate, if banks fulfill their lending requirements.

Using data on the loan-level from two distinct economies, namely Austria and Slovakia, I investigate multiple risk-taking strategies that can be applied to fulfill lending requirements set under the TLTRO program. The findings shows that banks participating in TLTRO did *not* significantly increase their risk appetite. Despite having incentives to lend more aggressively, these banks did not increase lending to high-risk borrowers or experience higher default rates compared to non-participating banks. Even those banks that only narrowly met the TLTRO lending requirements—suggesting a stronger motivation to expand risky lending—did not engage in riskier credit decisions.

Reasons for the non-increase in risk-taking behavior need to be further evaluated. They could be related to the design of the incentive scheme. As the majority of Austrian banks easily fulfilled the TLTRO lending requirements, the incentive to engage in more (risky) lending might be limited. Further research is necessary to understand the optimal program design for funding-for-lending schemes.

¹The non-technical summary was written with the help of a generative artificial intelligence chatbot based on the GPT-4o large language model.

1 Introduction

During its fight against persistently low inflation, the European Central Bank (ECB) has repeatedly adopted new policy tools in a bid to bring inflation back to target. Among the most unconventional measures was the introduction of "funding-for-lending" schemes: To incentivise bank lending to the real economy, the ECB provided more low-cost longer-term funding to banks with higher lending to firms and households, the so-called "Targeted Longer Term Refinancing Operations" (TLTRO).

While many studies have confirmed the effectiveness of the TLTRO programs in stimulating bank lending to the real economy (e.g., Afonso and Sousa-Leite (2020), Laine (2019), Altavilla et al. (2023)), less is known about their potential adverse side effects on financial stability. Since every euro of additional net lending would enhance banks' access to cheap longer-term funding, banks might be inclined to grant loans under less prudent terms. In particular, the studies that also touch upon the implications for loan quality focus on *ex-ante* measures of credit risk (e.g. the probability of default) for *gross* (i.e. only new) loans (Esposito et al. (2020), Benetton and Fantino (2021), Barbiero et al. (2022), Andreeva and García-Posada (2021), Da Silva et al. (2021), Volk (2024))². This leaves two important blind spots that hinder a comprehensive policy evaluation. First, there exists no evidence on *actual* credit events associated with TLTRO-related bank lending, i.e. an evaluation from an *ex-post* perspective. Second, since the provision of TLTRO funding is tied to *net* lending, not only new loan issuance matters, but also banks' decision to maintain or curtail existing credit relationships. This paper addresses both of these gaps.

I study the impact of TLTRO II operations in two Euro area countries with a profoundly different market structure in the banking sector: Austria and Slovakia. In particular, bank-

²While Flanagan (2019) evaluates ex-ante and ex-post measures of risk, the paper only compares the effects within the sample of TLTRO participating banks, distinguishing between less and more capitalized banks. Thus, the effect of TLTRO on risk-taking per se is not estimated. Barbiero et al. (2022) consider a measure of ex-post credit risk, however the measure only refers to the share of arrears for a short period after the increase in lending. Thus, the medium- and long-term time dimension of risk materialization as well as the impact on other credit risk indicators is not considered.

ing market concentration is significantly lower in Austria compared to Slovakia as shown by Maudos and Vives (2019). I evaluate TLTRO II operations as they provide a direct incentive scheme via interest rate reductions for funding to engage in lending to households and firms. The empirical analysis exploits the end of the net lending period of TLTRO II operations as a cut-off to separate loans that contribute and loans that do not contribute to lower bank funding costs (i.e. before and after 31/01/2018) Using loan-level data from the AnaCredit database with information on the inception of the loan on a daily basis, the ex-post credit performance of loans granted before and after the cut-off date will be evaluated. This is carried out by relying on estimations in a difference-in-differences (variation in time and banks) setting. As banks choose to participate in TLTRO, I control for the self-selection bias by applying a mahalanobis distance matching procedure in the most refined specification. Further, as banks differ with respect to the distance to fulfill the lending benchmark, I only consider banks that had a particular incentive to engage in lending to risky clients. I show that for borrowers who received loans during the TLTRO II net lending period, credit events, i.e. defaults or loans overdue, did *not* occur more often compared to borrowers, who received loans after the TLTRO II net lending period. This holds true for lending to both new and existing clients, as well as for banks that only narrowly fulfilled the lending benchmark. Furthermore, banks did *not* reduce the exposures of risky clients less often to increase the eligible outstanding amount for fulfilling the TLTRO lending benchmark.

The paper is structured as follows: Section 2 provides details on the TLTRO program and its incentive scheme. Section 3 describes the identification strategy, the used data and the econometric framework. In section 4, the results on the impact of the TLTRO program on financial stability are summarized. Section 5 concludes.

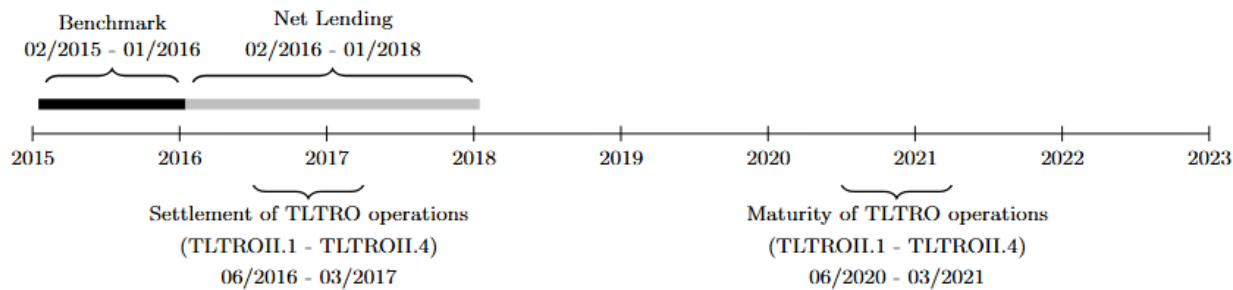
2 Institutional setting

TLTRO are operations within the Euro area that provide long-term financing to banks at attractive conditions. Funding volumes and financing costs are directly linked to the banks' ability to lend to the real economy, thus having a built-in incentive scheme to increase lending. In total, three TLTRO programs (TLTRO I, TLTRO II and TLTRO III) that differed with respect to timing of implementation, applied interest rate for operations and maximum borrowing amount of banks have been initiated by the ECB. Given the distinctive features of each TLTRO program, I discuss the reasons for evaluating financial stability implications of the TLTRO II operations.

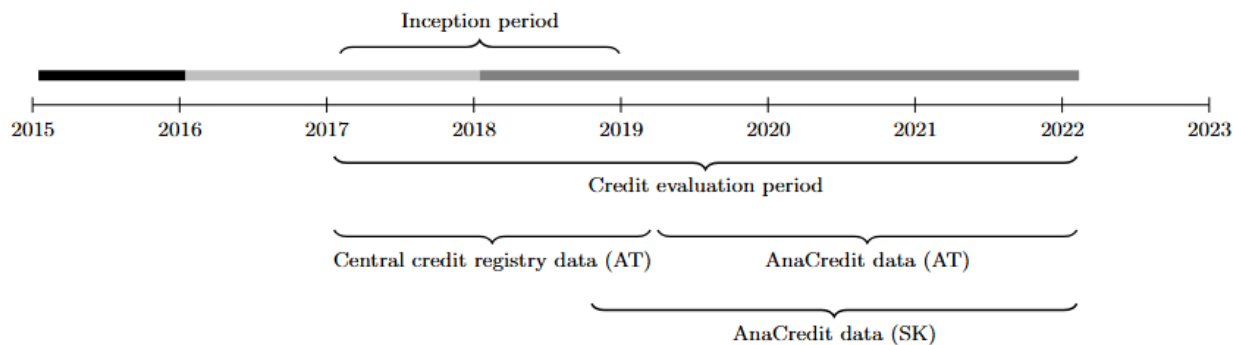
TLTRO I and TLTRO III are not considered for the assessment of financial stability effects due to the timing of implementation which hinders an econometric identification. First, as TLTRO II operations directly followed TLTRO I operations, banks were able to roll over amounts borrowed under the TLTRO I into TLTRO II. Thus, there was no clear cut between a TLTRO period and a non-TLTRO period, which would be necessary to evaluate the impact of TLTRO I. Second, with respect to TLTRO III, as the eligible net lending period fell in the beginning of the COVID-19 pandemic, a disentanglement of TLTRO-related and COVID-19-related effects on credit events is demanding.

TLTRO II operations, however, were timed in a way that enables an evaluation of credit events associated with loans granted during the net lending period. In addition, the design of the TLTRO II operations include a strong incentive to increase lending, as higher net lending reduced the interest rate to be applied for the TLTRO II operations. This was in contrast to TLTRO I, in which the interest rate was fixed with the main refinancing operations rate plus a fixed spread of 10 basis points.

Based on this incentive scheme, banks accessing TLTRO II funds benefited from lower interest rates compared to those available in the broader market. The interest rate applied to TLTRO II was fixed for each operation at the rate applied in the main refinancing operations (MROs) prevailing at the time of allotment. In addition, banks whose eligible net



(a) Timeline of TLTRO II operations



(b) Timeline of empirical strategy

Figure 1: Stylized timeline of TLTRO II operations and empirical strategy.

Note: The black bar denotes the TLTRO II lending benchmark period, the light-gray bar denotes the net lending period and the grey bar denotes the post-TLTRO II period. The inception period is the period in which newly granted loans are considered in the estimation. One year in the TLTRO II net lending period and one year after the net lending period is considered. The credit evaluation period is up to 1095 days after the initial granting of the loan. Thus, credit events are considered until January 2022. For AT, credit data is available since December 2016. For Slovakia, credit data is available since September 2018.

lending in the period between 1st February 2016 and 31st January 2018 exceeded their lending benchmark were charged a lower rate for the entire term of the operation. This lower rate was linked to the interest rate on the deposit facility rate (DFR) valid at the time of the allotment of each operation. Banks received the maximum rate reduction equal to the difference between the MRO rate and the DFR applicable, if they exceeded their benchmark stock of eligible loans by 2.5% as of 31st January 2018. Up to this limit, the size of the decrease in the interest rate was graduated linearly depending on the percentage by which a

bank exceeded its benchmark stock of eligible loans.³ For an overview on the timing of the TLTRO II operations, see Panel (a) in Figure 1.

3 Data & empirical strategy

For the analysis on the impact of TLTRO II on financial stability, I rely on loan-level data from Austria and Slovakia. In general, I use data that is collected based on the harmonized Euro area wide credit and credit risk data collection AnaCredit⁴, which started in September 2018 and March 2019 in Slovakia and Austria, respectively. Relying on data from these jurisdictions entails multiple advantages. Austria has a long history of credit registry data collection which positively influences data quality (Bachmann et al. (2016)). In addition, I am able to rely on national credit registry data from Austria that was collected prior to the implementation of AnaCredit (see below). With respect to Slovakia, the advantage lies in the large coverage of loans. While the reporting threshold for AnaCredit data is 25,000 EUR for the total loan amount vis-à-vis a debtor, Slovakia abolished the reporting threshold. Thus, a full coverage of loans granted by Slovak banks is available.

Based on AnaCredit data, credit information is available starting September 2018, which is *after* the implementation of the TLTRO II operations. In particular, the data collection started after the net lending period for TLTRO II namely between February 2016 and January 2018 (see Section 2). However, given the data field "Inception date" that is available in the AnaCredit data set, I am able to identify all loans where the credit line was contractually agreed in the net lending period of the TLTRO II operations. An overview on the loan volumes granted in Austria (AT) and Slovakia (SK), separated by banks that participated

³For banks that exhibited a positive eligible net lending in the 12-month period prior to 31st January 2016, the benchmark net lending was set at zero. For banks that exhibited a negative eligible net lending in the 12-month period prior to 31st January 2016, the benchmark net lending was equal to the eligible net lending in that period.

⁴AnaCredit stands for analytical credit datasets. Based on the AnaCredit regulation, banks resident in the Euro area need to report detailed information on bank loans.

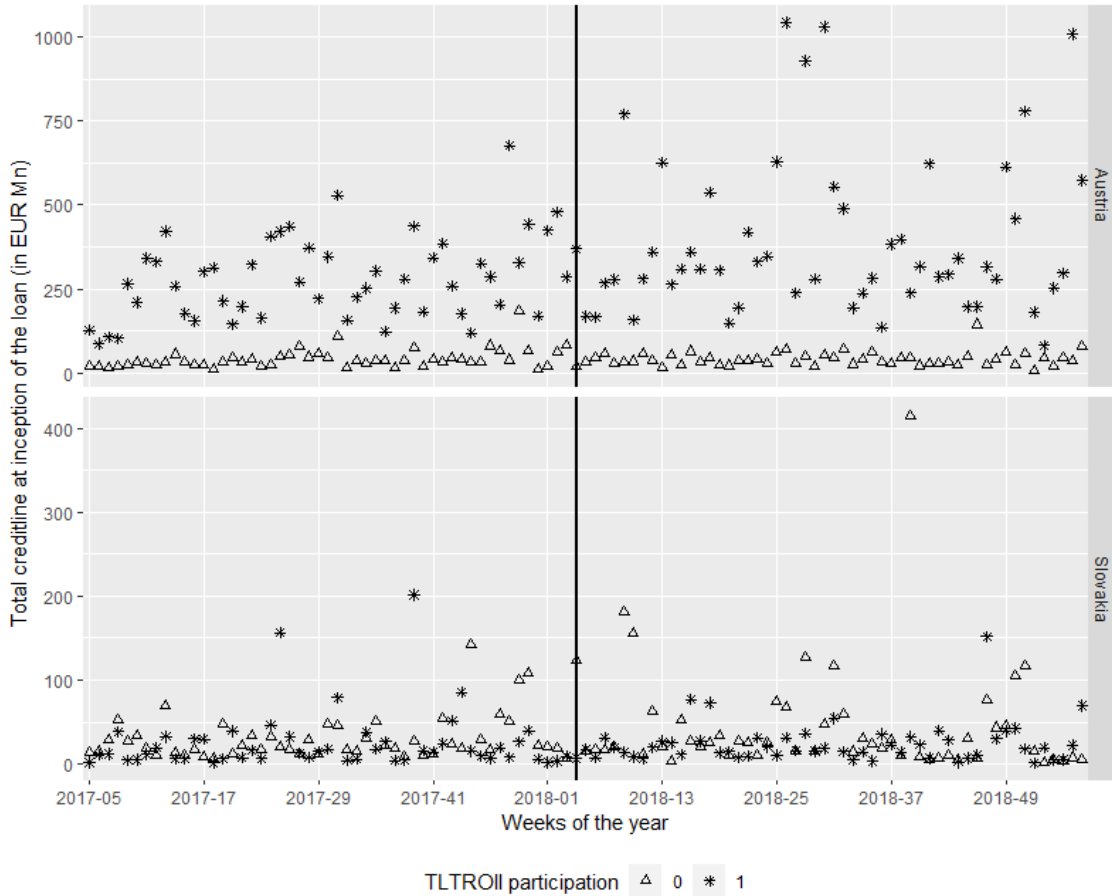


Figure 2: Volume of newly granted loans reported by AT & SK banks after excluding unreliable inception dates.

Note: Loan volumes for each inception date between 02/2017 and 02/2019 are grouped into weeks. The black vertical line represents the end of the TLTRO II net lending period. Source: OeNB, NBS.

in the TLTRO II operations is available in Figure 2.⁵

This approach comes with the drawback that I only observe loans from the TLTRO II net lending period that were still mandatory to be reported once the AnaCredit data collection came into force. Reasons why loans might not be reported in AnaCredit include short

⁵It could be the case that loans were contractually agreed, but no funds were dispersed. Thus, I only considered new loans where funds were also transferred within the same month. Specific dates for inception dates of credit are more often reported than expected (i.e. based on the average number of new credits reported by a bank for each date). This is probably driven by incorrect reporting of inception dates as this is skewed towards specific dates, e.g. month-end dates. Thus, credits are removed where the following conditions are fulfilled: (i) A bank reports more than 10 credits that are contractually agreed at the specific date and (ii) a bank reports at the date more than 20 times the average number of credits reported per date. For Slovakia, a bank was entirely disregarded as the reported inception dates were unreliable.

maturities, (early) repayments, sales as well as write-offs. I deal with this "credit survival bias" in further estimation specifications, relying on national credit registry data from Austria that was reported during the TLTRO II net lending period (reporting period December 2016 till February 2019).⁶ Relying on the national credit registry in Austria prior to the implementation of AnaCredit has the additional advantage that changes in the credit supply on the intensive margin, i.e. increase in loan amounts on existing credit relationships, can be observed. Relying on AnaCredit data, only changes in the credit supply on the extensive margin, i.e. granting of loans to new debtors, can be observed.

For evaluating the financial stability implications of loans granted during the TLTRO II net lending period, the loans are classified as risky based on different risk indicators, considered at the time of granting and after the granting of the loan. The following risk indicators are taken into consideration: probability of default (PD), classification as non-performing and classification as overdue. For the latter two indicators, loans are tracked for up to three years to observe whether any credit events have occurred. Summary statistics of the banks operating in Austria and Slovakia are presented in Table 1. The table shows the differences in the banking sector in Austria and Slovakia: (1) The number of banks is much lower in Slovakia (15 banks in the sample) compared to Austria (303 banks in the sample). (2) The participation in the TLTRO II operations is skewed towards larger banks in Austria and Slovakia. (3) For a higher share of newly granted loans in Slovakia a credit event is observed within three years after the granting of the loan.

Based on confidential data from the TLTRO reporting and monetary statistics in Austria, I evaluated whether banks that have a larger distance to exceeding their benchmark outstanding amounts are more incentivized to engage in riskier lending. The data sources provide an overview of the outstanding amounts and net lending volumes of the 32 TLTRO II bank groups on a monthly basis from October 2016 to January 2018. Figure 4 shows the excess of the lending benchmarks of the TLTRO II bank groups in Austria. The following observations

⁶The reporting is based on the "Zentralkreditregistermelldungsverordnung" (central credit registry reporting regulation). The reporting threshold for the national credit registry data in Austria is 350,000EUR.

	Austria		Slovakia	
	Non-TLTRO II banks	TLTRO II banks	Non-TLTRO II banks	TLTRO II banks
Bank-level				
Number of banks	138	165	12	3
Tier 1 capital ratio (in %)	9.2%	9.4%	8.4%	9.5%
Securities ratio (in %)	5.2%	4.2%	5.9%	7.0%
Balance sheet total (in tsd)	264,388	425,977	934,749	5,622,617
Loan-level				
Number of instruments granted in 12/2017	381	1,036	359	294
Loan volume granted in 12/2017 (in mio)	306	1,646	280	80
Time to default (in days)	857	1,064	548	1,173
Time to overdue (in days)	767	570	444	301
Share of loan volume with default within 1095 days (in %)	0.3%	1.6%	1.7%	1.4%
Share of loan volume with overdue within 1095 days (in %)	16.3%	11.6%	57.9%	57.7%

Table 1: Summary statistics for AT & SK banking sector as of December 2017.

Note: The table includes banks where at least one loan was newly granted during December 2017. The bank level statistics are as of 31/12/2017 while the instrument level statistics include all loans that were granted in December 2017. For AT: The banks participate via 32 TLTRO II bank groups. For SK: One bank that participated in TLTRO II had to be disregarded due to unreliable reporting of inception dates. Source: OeNB, NBS

are noteworthy: Almost 75% of the TLTRO II bank groups have already met the criteria to receive the lowest borrowing rates one year before the end of the net lending period. With the end of the net lending period on January 2018, 94% of the TLTRO II bank groups (30 of 32 TLTRO II bank groups) exceeded the lending benchmark by 2.5%. In addition, most of the TLTRO II bank groups clearly exceeded the lending benchmark. The median excess of the lending benchmark was 10.9% (25% quantile: 5.8%, 75% quantile: 18.7%).

To estimate the impact of TLTRO II on credit events, loan data is separated into an inception period and a credit evaluation period. The inception period is the time range in which newly granted loans are considered. In the estimation, the inception period is from February 2017 to January 2019 and considers one year of loans granted within the TLTRO II net lending period and one year of loans granted after the TLTRO II net lending period.⁷

⁷Loans that were granted during the beginning of the TLTRO II net lending period are not considered. Although a longer inception period would increase the number of loans considered for the estimation, this would limit the identification of a causal relationship, as other confounding factors could impact banks' risk-taking behavior. In a robustness check, the inception period was shortened to six months within the TLTRO net lending period and six months after the TLTRO net lending period. Results are available upon request.

In the credit evaluation period, the newly granted loans are tracked for 730 days and 1095 days to observe whether the loans become default or overdue. Panel (b) of Figure 1 provides a stylized representation of the periods and the data available for Austria and Slovakia.

3.1 Econometric models

The following baseline two-way fixed effects model is estimated:

$$Loan\ volume_{ijt}^{risk} = \beta_0 TLTRO\ II_t * Treated_i + \gamma X_{it-1} + \eta_i + \theta_t + \epsilon_{ijt} \quad (1)$$

where $Loan\ volume_{ijt}^{risk}$ is the total credit line⁸ of risky loans granted by bank i to debtor j at date t . The definition of riskiness of the loan differs depending on evaluating the extensive or intensive margin of loans. For the evaluation on the extensive margin, the riskiness of the loan is defined via an experience of a default or an overdue status up to 1095 after the inception of the loan. On the intensive margin, the probability of default at the time of loan granting is also considered. $TLTRO\ II_t$ is a dummy variable that is 1, if credit was granted within the net lending period of TLTRO II and 0, otherwise. $Treated_i$ is a dummy variable that is 1, if a bank participates in TLTRO II and 0, otherwise. X_{it-1} are lagged bank-level controls (balance sheet total, Tier 1 capital ratio, securities ratio and NPL ratio)⁹ η_i are bank-fixed effects. θ_t time-fixed effects.

This estimation comes with multiple drawbacks. Firstly, an increase in granted loans might not be driven by an increase in loan supply, but loan demand. Thus, it is necessary to control for credit demand, when estimating the effects of TLTRO on lending to risky debtors. As suggested by Degryse et al. (2019), I use industry-location-size-time (ILST) fixed effects μ_{ILSt} to capture loan demand, assuming that firms from the same industry, the same region

⁸The total credit line includes drawn and undrawn facilities. While the eligible lending for fulfilling TLTRO lending requirements only include drawn facilities, also undrawn facilities are also considered in the estimations. This is driven by data availability.

⁹As in the standard literature (e.g., Kashyap and Stein (1995)), bank variables are lagged to control for potential endogeneity between bank balance sheet items and bank lending. For Slovakia, the NPL ratio is not available.

and with a similar size have the same credit demand. Industry, location and size clusters are based on the level 2 NACE codes (division level), first digit of the postal code and the firm's total assets (grouped in quintiles). Thus, the following model will be estimated to control for credit demand:

$$Loan\ volume_{ijt}^{risk} = \beta_0 TLTRO\ II_t * Treated_i + \gamma X_{it-1} + \eta_i + \mu_{ILSt} + \epsilon_{ijt} \quad (2)$$

Secondly, the TLTRO program is designed as such that banks self-select themselves into treatment and control group, i.e. non-random treatment assignment. In particular, Table 1 shows that TLTRO participation is skewed towards larger banks. Thus, estimating equation (1) might lead to biased estimations. The evaluation of lending to risky debtors may be biased upwards, if banks with less lending opportunities to safer firms choose to participate in TLTRO II, or biased downwards, if banks with sufficient access to cheap funding opportunities lend to less-risky firms. To address this self-selection problem some studies have used an instrument-variable approach (Kwapil and Rieder (2021), Benetton and Fantino (2021)) or a matching procedure. I apply a mahalanobis distance matching procedure to reduce the differences in bank characteristics between banks in the control and treatment group. For this purpose, I estimate the following logistic regression:

$$Treated_i = \alpha_0 + \alpha_1 * Size_i + \alpha_2 * Z_i + \epsilon_i \quad (3)$$

Where dependent variable $Treated_i$ is a binary variable which is 1 if bank i participated in TLTRO II and 0 otherwise, $Size_i$ is the log of total assets and Z_i are other bank characteristics, such as share of securities over total assets, share of liabilities over total assets, share of loans over total assets and return on assets.

As performed by Barmeier et al. (2023), I use ten different control group selections, since choosing only one selection could lead to results that are affected by one specific bank composition. For selecting the ten different control groups, I estimate in total 72 different models

that differ with respect to the bank characteristics Z_i included in the estimation, the number of control banks that are matched to the banks in the treatment group (ratio varies between 2 and 7) and whether control banks are allowed to be matched to several treated banks, i.e., with or without replacement. Given the 72 results from the estimation, I only use those control group selections that reduce the imbalances measured by the sum of standardized mean differences to the largest extent.¹⁰ For each of the ten control group selections, equation (1) is estimated.

4 TLTRO & financial stability

In general, threats to financial stability resulting from TLTRO operations emerge mainly from two channels: the *funding channel* and the *lending channel*. The *funding channel* is related to the risks that banks do not have a sustainable long-term funding base to fund credit activities, or as Vergote and Sugo (2020) phrase it "TLTROs can be seen as blurring the real underlying liquidity situation at banks". In particular, risks may emerge from cliff-effects related to the maturity of central bank funding (Kowalewski and Lepczyński (2023)). This risk may be amplified as shown by Fudulache and Goetz (2023). They find that banks that have less-stable long-term funding are more likely to demand longer-term funding via TLTROs. Additionally, risks to financial stability loom via an increase in asset encumbrance stemming from the collateral requirements for the TLTRO operations (Ahnert et al. (2019), Cardillo et al. (2023)).

Regarding the *lending channel*, risks to financial stability from TLTRO operations emerge from the built-in-incentive scheme to increase lending to households and non-financial corporations. In order to fulfill the set lending benchmarks, banks might loosen credit standards and therefore, take-on higher levels of risk. So far, the literature has not supported the view on an increase in risk-taking via lending to riskier clients (e.g., Barbiero et al. (2022)). However, an analysis incorporating levels of riskiness via lending on the extensive and in-

¹⁰For details on the approach, please refer to Barmeier et al. (2023).

tensive margin (considering new lending and lending limits to existing clients) as well as a consideration of ex-ante *and* ex-post risk indicators is missing. This section closes this gap. Applying the estimation approach and measures of risk as defined in Section 3, two alternatives emerge. On the one hand, the non-risk-increasing character of loan granting during the TLTRO programs could be confirmed, expecting $\hat{\beta}_0 \leq 0$. On the other hand, given comprehensive assessment of various risk-taking strategies, the estimation results may show a different picture with respect to the risk-taking behavior of banks associated with a participation in the TLTRO program. This would suggest $\hat{\beta}_0 > 0$.

4.1 Extensive margin of loan granting: new debtors

The results of estimating equation (1) and (2) for Austria and Slovakia are shown in Table 2. The estimated coefficients in the table evaluate whether banks that participated in TLTRO II provided more loans to debtors that experienced a default or an overdue 730 days or 1095 days after the loan granting. The estimated coefficients suggest that this is not the case. As shown in the table, none of the estimated coefficients in the estimation specifications are significantly positive. For Slovakia, some of the estimated values are even significantly negative which would indicate a reduction in lending to risky borrowers. However, taking the 1095-day-horizon and ILST-fixed effects to control for credit demand into account, the negative relation between TLTRO and risky lending is not confirmed.¹¹

The results might be driven by the treatment and control group selection as discussed in section 3. Thus, equation (1) is re-estimated only with banks that are similar based on the results from mahalanobis distance matching. Figure 3 shows the range of estimated coefficients for the ten different banks selections in the treatment and control group for Austria and Slovakia. While the estimated coefficients are negative for the 730 days horizon, they are more often positive in the 1095 days horizon. However, none of the positive estimations

¹¹When controlling for credit demand, the standard errors for the estimation in Austria become large. Given the small sample size driven by low coverage of balance sheet information, the informative value is limited in this specification.

Dependent Variables:	<i>Loan volume^{risk}</i> (730 days)			<i>Loan volume^{risk}</i> (1095 days)		
	(1)	(2)	(3)	(4)	(5)	(6)
<i>Panel I: Austria</i>						
TLTRO II*Treated	-0.1597 (0.1485)	-0.0624 (0.1629)	0.6331 (2.049)	-0.0403 (0.1344)	0.0464 (0.1382)	-0.0361 (1.261)
Bank controls	No	Yes	Yes	No	Yes	Yes
<i>Fixed-effects</i>						
Bank	Yes	Yes	Yes	Yes	Yes	Yes
Time	Yes	Yes	No	Yes	Yes	No
ILST	No	No	Yes	No	No	Yes
<i>Fit statistics</i>						
Observations	4,276	3,982	1,466	6,078	5,520	2,012
R ²	0.14012	0.14381	0.95602	0.13043	0.13345	0.93755
Within R ²	0.00021	0.00080	0.02988	0.00001	0.00055	0.01502
<i>Panel II: Slovakia</i>						
TLTRO II*Treated	-0.2583** (0.1052)	-0.3108* (0.1490)	0.0135 (0.2973)	-0.1434 (0.1216)	-0.1348 (0.1404)	0.0622 (0.2460)
Bank controls	No	Yes	Yes	No	Yes	Yes
<i>Fixed-effects</i>						
Bank	Yes	Yes	Yes	Yes	Yes	Yes
Time	Yes	Yes	No	Yes	Yes	No
ILST	No	No	Yes	No	No	Yes
<i>Fit statistics</i>						
Observations	5,979	4,601	4,112	7,048	5,361	4,793
R ²	0.10878	0.08524	0.81668	0.10522	0.08426	0.81694
Within R ²	0.00146	0.00431	0.00189	0.00047	0.00371	0.00300

Standard errors clustered on the bank level in parentheses

*Signif. Codes: ***: 0.01, **: 0.05, *: 0.1*

Table 2: Baseline results on the extensive margin estimating equations (1) and (2).
Note: For Model (3) and Model (6) in Panel I, the standard errors are large. This is driven by the small sample size due to the low coverage of balance sheet information in Austria.

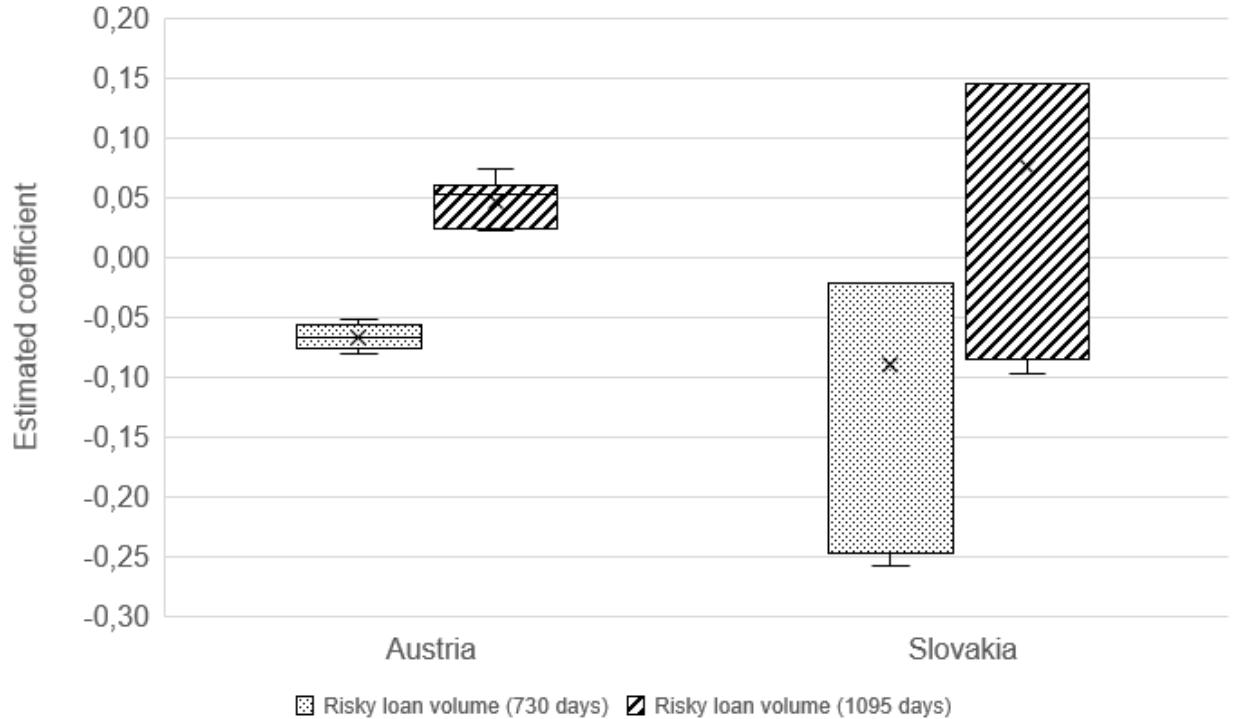


Figure 3: Range of estimated coefficients $\hat{\beta}_0$ for ten different models based on mahalanobis distance matching

Note: Only one of the estimated coefficients is significantly negative on the 10% level. All others are insignificant. Source: OeNB, NBS.

are significantly positive on the 10% interval. Thus, also when controlling for differences between the banks in the treatment and control group, no significant increase in lending to risky debtors by banks that participated in TLTRO II is observed.

As a final check for loans granted on the extensive margin, only those banks are considered that narrowly fulfilled the lending benchmark set-out in the requirements for TLTRO II. As shown in Figure 4, many banks in Austria met the lending benchmark already one year prior to the end of the net lending period or exceeded the lending benchmark significantly. Thus, these banks might not had an incentive to engage in higher risk-taking behavior. To examine whether the estimation results discussed in the first part of this section are driven by banks that easily fulfilled the lending benchmark, only a fraction of the banks in the sample is considered. In more detail, I consider only banks that participated in TLTRO II.

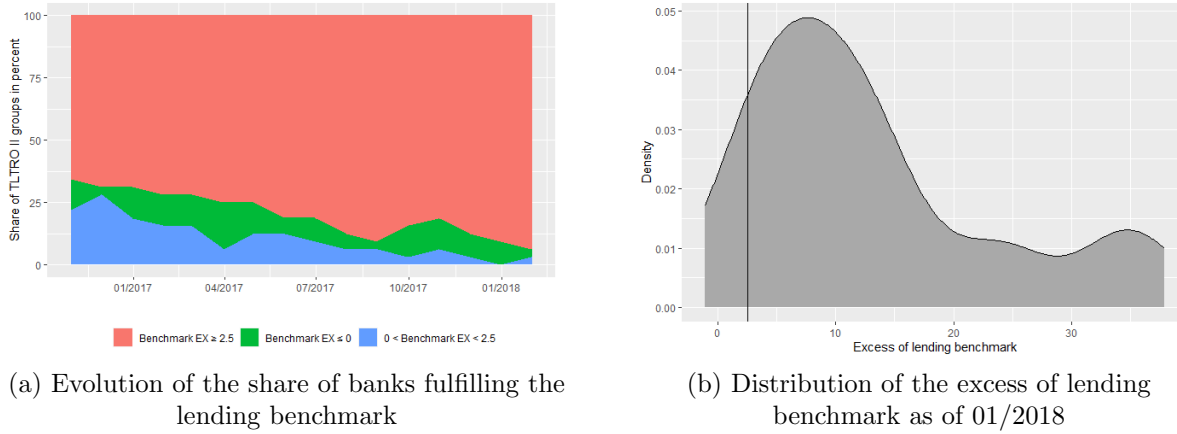


Figure 4: Excess of lending benchmarks of TLTRO II bank groups in Austria.

Note: Panel (a) shows the share of banks that exceed their benchmarks outstanding amount by at least 2.5% (red), that exceed their benchmarks outstanding amount by less than 2.5% (green) and that do not exceed their benchmarks outstanding amount (blue) over time. Panel (b) shows the distribution of excess of lending benchmark as of January 2018. For illustrative purposes, one bank with a very high excess of lending benchmark (528.5%) is excluded in Panel (b). Source: OeNB.

Then, I classify banks that had a direct incentive to engage in higher risk-taking behavior based on their fulfillment status of the lending requirement, i.e. $Benchmark_{01/17} = 1$ or $Benchmark_{01/18}^{marginal} = 1$, where the indicators are defined as follows:

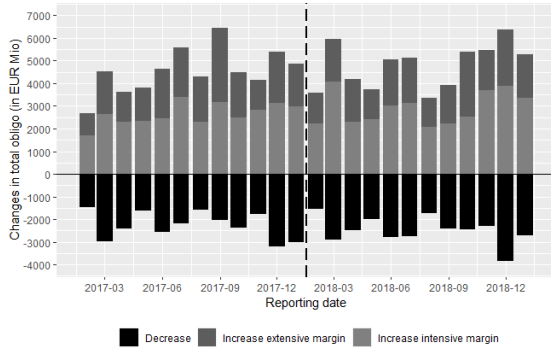
$$\begin{aligned}
 Benchmark_{01/17} &= \begin{cases} 1, & \text{if the TLTRO group has } \textit{not} \text{ exceeded its benchmark} \\ & \text{outstanding amount by at least 2.5\% as of 01/2017} \\ 0, & \text{otherwise} \end{cases} \\
 Benchmark_{01/18}^{marginal} &= \begin{cases} 1, & \text{if the TLTRO group has exceeded its benchmark out-} \\ & \text{standing amount by at least 2.5\% \& has a below median} \\ & \text{excess benchmark as of 01/2018} \\ 0, & \text{otherwise} \end{cases}
 \end{aligned}$$

Based on the sample of banks that participated in TLTRO II, I compare whether banks that only narrowly fulfilled their lending benchmarks engaged in higher risk-taking behavior compared to banks that easily fulfilled their lending benchmarks. The estimation results

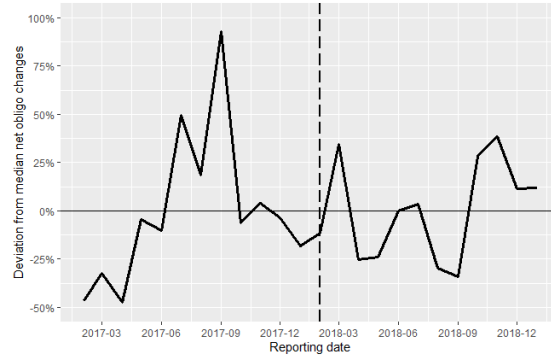
Dependent Variables:	<i>Loan volume^{risk}</i> (730 days)			<i>Loan volume^{risk}</i> (1095 days)		
	(1)	(2)	(3)	(4)	(5)	(6)
Panel I: Benchmark_{01/17}						
TLTRO II* <i>Benchmark_{01/17}</i>	-0.5329 (0.4161)	-0.4821 (0.3642)	2.249 (2.465)	-0.3773 (0.3360)	-0.3584 (0.2969)	1.152 (1.530)
Bank controls	No	Yes	Yes	No	Yes	Yes
<i>Fixed-effects</i>						
Bank	Yes	Yes	Yes	Yes	Yes	Yes
Time	Yes	Yes	No	Yes	Yes	No
ILST	No	No	Yes	No	No	Yes
<i>Fit statistics</i>						
Observations	3,222	3,041	1,134	4,432	4,085	1,502
R ²	0.12108	0.12537	0.95721	0.11365	0.11775	0.94461
Within R ²	0.00127	0.00241	0.05259	0.00067	0.00146	0.03293
Panel II: Benchmark_{01/18}^{marginal}						
TLTRO II* <i>Benchmark_{01/18}^{marginal}</i>	0.0987 (0.1960)	0.0168 (0.1990)	0.4026 (3.124)	0.0943 (0.1449)	-0.0039 (0.1429)	0.5740 (2.354)
Bank controls	No	Yes	Yes	No	Yes	Yes
<i>Fixed-effects</i>						
Bank	Yes	Yes	Yes	Yes	Yes	Yes
Time	Yes	Yes	No	Yes	Yes	No
ILST	No	No	Yes	No	No	Yes
<i>Fit statistics</i>						
Observations	3,187	3,007	1,120	4,386	4,042	1,484
R ²	0.11174	0.11544	0.95707	0.10545	0.10870	0.94562
Within R ²	0.00010	0.00131	0.02732	0.00009	0.00117	0.02374
<i>Standard errors clustered on the bank level in parentheses</i>						
<i>Signif. Codes: ***: 0.01, **: 0.05, *: 0.1</i>						

Table 3: Robustness results on the extensive margin estimating equations (1) and (2) with focus on banks that had a direct incentive to engage in higher risk-taking for Austria.

Note: Only banks that participated in TLTRO II are considered. TLTRO banks that did not fulfill the lending benchmark in 01/2017 (Panel I) or banks that only marginally exceeded the lending benchmark in 01/18 (Panel II) are compared to the other TLTRO-participating banks. For Model (3) and Model (6), the standard errors are large. This is driven by the small sample size due to the low coverage of balance sheet information in Austria. Due to data availability, the estimation is only performed for Austria.



(a) Absolute changes of total credit line



(b) Deviations from the median net changes in total credit line on intensive margin

Figure 5: Changes in total credit line of Austrian banks that participated in TLTRO II. *Note:* The total credit line consists of drawn and undrawn facilities of the debtor. The dotted vertical lines represent the end of the TLTRO II net lending period. Panel (a) shows the contribution of decreases in total credit line and increases in total credit line, separated by intensive and extensive margin to the net changes in total credit line. Panel (b) shows the deviation from median net changes without considering increases on the extensive margin. Source: OeNB

are shown in Table 3.¹² The results confirm the non-increase in lending to high-risk borrowers by TLTRO-participating banks. Even banks that had a particular incentive due to their fulfillment status of TLTRO lending requirements did not engage in higher risk-taking. Therefore, it can be concluded that there was no increase in risk-taking in the granting of loans to new debtors associated with the participation in the TLTRO program.

4.2 Intensive margin of loan granting: existing debtors

Besides the granting of loans to new debtors (extensive margin), banks can also extend or refrain from limiting the loans to existing debtors (intensive margin) to fulfill the lending benchmark of TLTRO II. The relative importance of new lending to existing debtors is presented in Figure 5. Panel (a) shows that the majority of new lending of Austrian banks that participated in TLTRO II is associated with lending to existing customers (58% of new lending during the period from February 2017 to January 2018). In addition, a contributing

¹²Information about the fulfillment of the TLTRO II lending benchmark is only available for Austrian banks. Thus, Table 3 shows only the estimation for Austria.

Dependent Variables:	<i>Loan volume^{risk}</i> (High PD)			<i>Loan volume^{risk}</i> (730 days)			<i>Loan volume^{risk}</i> (1095 days)		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
TLTRO II*Treated	-0.0102 (0.0238)	-0.0153 (0.0230)	-0.0092 (0.0245)	0.0102 (0.0238)	0.0115 (0.0231)	-0.0464* (0.0272)	0.0118 (0.0225)	0.0167 (0.0217)	-0.0047 (0.0228)
Bank controls	No	Yes	Yes	No	Yes	Yes	No	Yes	Yes
<i>Fixed-effects</i>									
Bank	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Time	Yes	Yes	No	Yes	Yes	No	Yes	Yes	No
ILST	No	No	Yes	No	No	Yes	No	No	Yes
<i>Fit statistics</i>									
Observations	282,236	280,795	184,287	295,415	291,899	184,097	349,818	345,602	221,852
R ²	0.11389	0.11364	0.49919	0.13695	0.13667	0.53754	0.14400	0.14351	0.52985
Within R ²	0.00001	0.00009	0.00020	0.00000	0.00009	0.00018	0.00001	0.00011	0.00009

Standard errors clustered on the bank level in parentheses
*Signif. Codes: ***: 0.01, **: 0.05, *: 0.1*

Table 4: Baseline results on the intensive margin estimating equations (1) and (2) for Austria. *Note:* Ex-ante (PD) and ex-post (default and overdue status) risk indicators are considered. Due to data availability, the estimation is only performed for Austria.

factor in fulfilling the net lending benchmark can be attributed to the decrease of loan volumes. Banks might be reluctant to cut a credit line of a debtor in order to receive the full subsidy on the interest rate applied to the TLTRO program. The observation that banks have actually increased their net lending on the intensive margin is shown in Panel (b). Particularly from July 2017 to September 2017, Austrian banks increased their lending to existing customers. At the same time, the volume of outflows, i.e. decreases in the total credit line was below-average.

Thus, in this section, the banks' treatment of existing debtors is analyzed. Firstly, the estimation approach discussed in Section 3 is performed for loans on the intensive margin, i.e. equation (1) and (2) are re-estimated for loan-level data in the Austrian credit registry. As information on the probability of default of the debtor is available in this dataset, this risk indicator is additionally considered. Thus, the estimation allows for a distinction between *ex-ante* risk indicators (probability of default) and ex-post risk indicators (overdue and default status up to 1095 days later). Estimation results are shown in Table 4. The results from

examining the extensive margin of loan granting are confirmed. Banks that participated in TLTRO did not increase the loan volume towards debtors with higher PDs. Additionally, from an ex-post perspective, TLTRO-participating banks did not increase the total credit lines of debtors with a default or an overdue status after the loan granting.

Secondly, I examine whether banks have decreased the credit lines of existing customers less often, even though banks have observed or could expect a deterioration in credit quality. This indicates an increase in risk appetite by allowing high-risk debtors to have access to (additional) credit from the bank. For this purpose, the following logistic regression is estimated:

$$\begin{aligned}
\text{Decrease credit line}_{ijt} = & \alpha_0 \text{Risk dummy}_{ijt} + \alpha_1 \text{Risk dummy}_{ijt} * \text{TLTRO II}_t + \\
& + \alpha_2 \text{Risk dummy}_{ijt} * \text{Treated}_i + \alpha_3 \text{TLTRO II}_t * \text{Treated}_i + \\
& + \alpha_4 \text{Risk dummy}_{ijt} * \text{TLTRO II}_t * \text{Treated}_i + \\
& + \gamma X_{it-1} + \eta_i + \theta_t + \epsilon_{ijt} \quad (4)
\end{aligned}$$

$\text{Decrease credit line}_{ijt}$ is a dummy variable that is 1, if the credit line of the loan granted from bank i to debtor j was decreased by the bank at time t and 0, otherwise. To identify decreases in the credit line that are initiated by the bank, only decreases were considered for which no decrease in the outstanding amount occurred in the same month. Risk dummy_{ijt} is a dummy variable that is 1, if the loan is classified as risky and 0, otherwise. Both, ex-ante (PD) and ex-post risk indicators (default and overdue status up to 365 days later) are considered. The remaining variables are defined as in equation (1). Estimation equation (4) evaluates whether the probability that a TLTRO-participating bank decreases a credit line of a risky debtor during the TLTRO net lending period is lower compared to banks that did not participate in TLTRO II. The estimated coefficient of interest is $\hat{\alpha}_4$. The estimation results are shown in Table 5. For none of the evaluated risk indicators (PD increase, default and overdue status) the estimated coefficient $\hat{\alpha}_4$ is statistically different from zero. Thus,

banks that participated in TLTRO II did not engage in strategic credit line management to keep access to credit for risky debtors. Thus, to conclude, participation in TLTRO is also not associated with an increase in risk-taking on the intensive margin of loan granting.

5 Conclusion

Evaluating the riskiness of lending behavior of banks participating in TLTRO operations does not show an increase in risk-taking. This is the case for banks from different jurisdictions, relying on various risk indicators and by investigating different possible risk-taking strategies. Even banks that only narrowly fulfilled the TLTRO lending benchmark, and therefore, had a particular incentive, did not increase their risk appetite to benefit from the interest rate reduction for the TLTRO operations. Potential reasons for the non-increase in risk-taking are manifold: (i) The demand for credit of less-risky households and non-financial corporations could have been sufficient. Thus, no loosening of lending standards were needed by banks to fulfill net lending benchmarks. (ii) The period under investigation is characterized by an overall low number of credit events. Therefore, risk materialization may only occur in a turning financial cycle as seen since the interest rate increases in 2022. Thus, the results could be driven by an inability to measure the associated risk due to the favourable financing conditions. (iii) As in Austria nearly all banks (94% of the TLTRO groups) have fulfilled the excess of lending benchmark to receive the full subsidy on interest rates, the built-in incentive scheme might not be designed in a way that fulfillment would require extensive new lending. A recent study by Sigmund et al. (2024) confirms this channel. The authors show that the effect of TLTRO on new lending might be overestimated. Thus, if the TLTRO program does *not* lead to an increase in lending, changes in the risk appetite of lending might also not be necessary.

The analysis has caveats. I only investigate the risk-taking behavior of banks participating in the TLTRO II operations. External validity for other TLTRO operations or other funding-

for-lending schemes in general, as they were introduced by a number of central banks with different program designs (Casanova et al. (2021)) is limited. Thus, further research could focus on the different design elements that might encourage higher risk-taking behavior.

Dependent Variable: Model:	Decrease creditline					
	(1)	(2)	(3)	(4)	(5)	(6)
<i>Variables</i>						
TLTRO II*Treated	0.0051 (0.0227)	0.0099 (0.0229)	0.0049 (0.0163)	0.0132 (0.0178)	0.0194 (0.0198)	0.0305 (0.0213)
PD increase	-0.0207 (0.0695)	0.0045 (0.0714)				
PD increase*Treated	0.1408* (0.0778)	0.1160 (0.0817)				
PD increase*TLTRO II	-0.0231 (0.0955)	-0.0459 (0.0899)				
PD increase*TLTRO II*Treated	0.0326 (0.1069)	0.0563 (0.1044)				
Default			-0.0891 (0.1285)	-0.0745 (0.1385)		
Default*Treated			0.1006 (0.1871)	0.0797 (0.2098)		
Default*TLTRO II			0.0264 (0.1407)	0.0398 (0.1460)		
Default*TLTRO II*Treated			0.1018 (0.1754)	0.0948 (0.1893)		
Overdue					0.2354*** (0.0287)	0.2044*** (0.0314)
Overdue*Treated					0.0942** (0.0388)	0.1156*** (0.0420)
Overdue*TLTRO II					-0.6391*** (0.1071)	-0.6046*** (0.1073)
Overdue*TLTRO II*Treated					0.0750 (0.1292)	0.0496 (0.1298)
Bank controls	No	Yes	No	Yes	No	Yes
<i>Fixed-effects</i>						
Bank	Yes	Yes	Yes	Yes	Yes	Yes
Time	Yes	Yes	Yes	Yes	Yes	Yes
<i>Fit statistics</i>						
Observations	751,187	714,702	1,314,589	1,241,812	1,314,589	1,241,812
Pseudo R ²	0.02491	0.02451	0.02298	0.02230	0.02386	0.02305

Standard errors clustered on the bank level in parentheses

*Signif. Codes: ***: 0.01, **: 0.05, *: 0.1*

Table 5: Results on the intensive margin estimating equation (5) regarding decreases in credit lines in Austria.

Note: Ex-ante risk indicator: Increase in the probability of default. Ex-post risk indicator: Default status and overdue status one year after the reporting date. Due to data availability, the estimation is only performed for Austria.

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