Stealth Recapitalization and Bank Risk Taking: Evidence from TLTROs*

Thomas Flanagan[a]

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Abstract

I study the transmission of unconventional monetary policy through an increase in bank net worth. I examine the ECB's Targeted Long Term Refinancing Operations (TLTROs), which provided interest rate subsidized loans to banks. First, I measure the rate subsidy and document that it results in equity gains for banks facing high borrowing costs in the private market, especially low capitalized banks. Second, using loan-level data from a sample of thirty-three European banks, I show that weakly capitalized banks receiving TLTRO funding subsequently decreased their risky lending. The effect spills-over to asset classes not targeted by TLTROs and is largest for banks receiving higher interest rate subsidies. In contrast to previous evidence, these results support that subsidized funding can boost bank net worth and offset risk-shifting incentives of banks, resulting in improved ex-post stability of the financial sector. The differences in results can be potentially attributed to differences between asset-side and liability-side recapitalizations as well as the different frictions (limited liability/regulatory scrutiny) faced by weakly capitalized banks in each setting.

Keywords: TLTRO, Unconventional Monetary Policy, Credit Risk, Bank Capital
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[a]Ross School of Business, University of Michigan; email: tflan@umich.edu.

1 Introduction

How does unconventional monetary policy affect bank capital and what implications does this have on banks' actions? Classical corporate finance models predict that sufficient equity capital is required to prevent moral hazard in firms (Jensen and Meckling, 1976; Holmström, 1979). The same insight applies to banks. In the aftermath of the financial crisis, many banks' equity was nearly wiped out, creating incentives to sub-optimally lend to risky firms. Central banks responded to the crisis with a wide array of unconventional monetary policies, including large-scale asset purchase programs (LSAPs) and lending facilities. These policies can "stealth recapitalize" (coined by Brunnermeier and Sannikov (2016)) banks by increasing asset values or decreasing funding costs. The empirical evidence so far has found that unconventional monetary policy exacerbates the moral hazard problem by increasing funding available to low capitalized banks (Acharya, Eisert, Eufinger, and Hirsch, 2019; Kandrac and Schlusche, 2017). By boosting bank net worth, however, these policies could also attenuate banks' moral hazard problems (Keeley, 1990). An interesting but unexplored question, therefore, is whether unconventional monetary policy can improve financial stability by reducing bank risk-taking. Understanding this effect is especially important for Europe where banks were not explicitly recapitalized unlike banks in the US.

I study this question in context of the ECB's Targeted Long Term Refinancing Operations (TLTROs). Unlike previous research which focuses on stealth recapitalizations resulting from an appreciation in asset value, TLTROs affect bank capital by lowering their funding costs. Although both are recapitalizations, there are important economic differences. Both policies improve bank net worth, but a reduction in funding costs spreads these gains out over time. For example, Dell'Ariccia, Marquez, and Laeven (2014) develop a model in which low capitalized banks with limited liability respond to lower funding costs with decreased risk-taking. The intuition is simple. While limited liability shields banks in the bad state of the world, lower funding costs provide a relatively better upside in the good state, giving banks an incentive to decrease asset risk to survive and receive the higher payoff.

Indeed, TLTROs provide this incentive structure. The lending facilities consists collateralized four year loans to banks at a subsidized interest rate. This rate subsidy enhances profitability for banks facing high borrowing rates in the private market. Anecdotal industry evidence confirms that TLTROs have improved bank balance sheets (Bloomberg, 2017). Moreover, the four-year maturity of these loans incentivizes banks to increase their survival probability over a long time-horizon. These details make TLTROs a unique setting to explore unconventional monetary policy transmission via changes in bank funding costs and the resulting impact on net worth.

The subsidy from TLTROs is economically significant and largest for low capitalized banks. Using covered bonds as a private market benchmark for the opportunity cost of TLTRO loans, I estimate that high and low capitalized banks received subsidies of .93% and 1.92%, respectively. Banks in the sample borrowed on average €7.1 billion or 3.81% of total assets and experienced approximately a 3.5% increase in equity over the four year maturity of the loans. Low capitalized banks received an even larger boost to equity of 5.2%. These funding subsidies estimates are validated by 10% larger cumulative abnormal stock returns to low capitalized banks in an event window around the TLTRO announcement.

To examine how this net worth boost impacts risk-taking, I follow standard balance-sheet channel identification methodology and examine how TLTROs differentially affected weakly capitalized banks (Bernanke and Blinder, 1988; Bernanke and Gertler, 1989; Jiménez, Ongena, Peydró, and Saurina, 2012; Kashyap and Stein, 2000). That is, I look at how weakly capitalized banks lent differently to high risk firms before and after TLTRO implementation. This test is appropriate as theory predicts a change in risk-taking by weakly capitalized banks that receive boosts to their equity[1](Dell'Ariccia et al., 2014; Keeley, 1990). An advantage of this empirical balance-sheet channel approach is that issues of endogeneous selection into

[1]Of course, an assumption of this theory is that low capital banks are funded by risk-insensitive debt, which in combination with limited liability gives them incentives to risk-shift. This is assumption is valid as banks are funded through government insured deposits.

borrowing from TLTROs are avoided.

The sample consists of loan-level data granted by thirty-three large European banks that received TLTRO funding. I use two datasets for loan-level information. The first is Dealscan merged to Compustat/Amadeus which consists of syndicated loans to large corporate borrowers. In this dataset, I construct ex-ante measures of firm-risk using ROA volatility and interest coverage ratios of borrowers. I also exploit the fact that Dealscan consists of loans with multiple lenders and use firm fixed effects as in Khwaja and Mian (2008) to rule out alternative selection stories of firm demand or borrower-bank matching.

The second dataset is the much richer ECB Loan-Level Data that consists of securitized SME (small and medium-sized enterprises) and residential mortgage loans. The dataset also includes a rich set of ex-post performance variables, which provides another informative measure of bank risk taking since some ex-ante risk-taking may be unobservable. This dataset has only recently been used in academic research, including Ertan, Kleymenova, and Tuijn (2018) and Van Bekkum, Gabarro, and Irani (2017). As of 2013, banks are required to submit loan-level data files for any securitization that they use as collateral for ECB funding (including TLTROs). Since the first TLTRO was announced in June 2014, this provides a sufficient time frame to observe loan originations and performance and results in sample of about 520,000 SME loans.

The main result is that weakly capitalized banks decreased lending to riskier borrowers after TLTRO implementation. The results are economically meaningful and robust to a number of specifications. On average, high risk borrowers are 4.6% less likely to have their loans renewed and receive 12% lower loan volume, or on average $15 million less, from weakly capitalized banks after TLTRO implementation. These estimates are robust to saturated specifications with firm-time and lender-time fixed effects to account for time-varying firm and bank heterogeneity. Furthermore, the result withstands interacting bank characteristics with firm risk to account for correlations of bank capital with other observable measures such as liquidity. Supplementing the analysis with the ECB Loan-Level Data sample, I find that weakly capitalized banks lend to borrowers that are less likely to default by 1.6 percentage points, which corresponds to a 80% decrease in probability of default over the unconditional likelihood. In contrast to these results, weakly capitalized banks ineligible for TLTRO funding do not change their risk taking in the same period.

To better understand the transmission channel, I employ two additional tests. First, I look at banks that receive the largest subsidy from TLTROs. In line with predictions, the decrease in risk-taking is larger for low capitalized banks with greater estimated cost subsidies. Secondly, I present evidence of spillovers to an asset class not "targeted" by TLTROs. Only certain asset classes are "targeted" by TLTROs. For instance, originating residential mortgages, unlike corporate loans, does not increase a bank's borrowing amount under TLTROs. In line with the net worth channel, lowering bank funding costs will encourage banks to survive, which involves reducing risk along all asset classes – not just targeted asset classes. I find that residential mortgages originated by weakly capitalized banks post-TLTRO are less likely to become delinquent. This spillover lends further support to the proposed channel.

In addition to the allocation of risk across banks of different levels of capitalization, the dataset also allows analysis of the allocation of risk across countries. With low net worth and limited liability, banks can maximize risk-shifting by investing in firms highly correlated with bank distress. Low capital banks may therefore over-invest in risky firms in their own country at the expense of the stability of the financial sector. In additional tests, I explore whether TLTROs encourage diversified risk-sharing across countries. Since the Khwaja and Mian (2008) estimator looks *within* banks, reduced risk taking can be interpreted as the reallocation of risk from one bank to others. Given this interpretation, I find that GIIPS firms are reallocated from weakly capitalized GIIPS bank balance sheets to well capitalized non-GIIPS banks. Together, the results imply that restoring bank equity can optimize risk-sharing in both dimensions of bank capitalization and default correlations within countries.

What set of alternate mechanisms could explain the findings? As explained above, the spillover to a non-targeted asset class is a very stylized prediction of the proposed channel. It is economically unclear what alternative explanations might be consistent with the findings. For instance, the results cannot be explained by moral suasion, which predicts that domestic governments encourage riskier lending to prevent firms from defaulting in fear of political backlash (Acharya and Steffen, 2015; Ongena, Popov, and Horen, 2018). Instead, I find that banks lend to less risky firms – in conflict with political objectives.

One potential concern is that the coinciding introduction of negative rates imposes a tax on reserves held at the central bank, resulting in weaker bank balance sheets. However, I find that the magnitude of the TLTRO rate subsidy (1.2%) is substantially larger than change in the ECB deposit facility rate at the TLTRO announcement (0% to -.2%). While lower bank profitability would predict increased bank risk-taking through the net worth channel, instead, I find a reduction in risky bank lending. Moreover, there is only a tax burden insofar as banks are funded with depositors reluctant to accept below zero rates (Heider, Saidi, and Schepensi, 2018). In contrast with this explanation, I find that bank risk-taking decisions by low capital banks in the sample cannot be explained by bank deposits. Without this sticky behavior of depositors, the maturity mismatch of long term assets funded by short-term liabilities implies that lower rates results in improved bank balance sheets (Bernanke and Blinder, 1988; Bernanke and Gertler, 1989). As a result, the effect of negative rates is likely quantitatively small in comparison to the incentives offered by TLTROs.

The results may be consistent with a searching-for-yield mechanism (Rajan, 2006; Jimenez, Ongena, Peydro, and Saurina, 2014; Becker and Ivashina, 2015). The necessary condition for this interpretation is that banks hold short term assets while funding themselves with long term liabilities. When rates fall, they must find higher yielding assets to meet their obligations. An interpretation of this model consistent with the findings is that TLTROs' long-term cheap funding alleviates searching-for-yield by banks in a low or negative interest rate environment. While the model's implication is consistent with the findings, it less plausible given banks primarily fund long term assets with short-term liabilities.

The findings of this paper are in contrast to previous evidence that funding windfalls to weakly capitalized banks increases moral hazard. With this prior, one might suspect that TLTROs encourage new risk-taking. Similar to insured deposits, TLTRO funding is price insensitive to which bank is borrowing, permitting banks with low net worth to risk-shift onto this funding (Keeley, 1990; Dam and Koetter, 2012; Gropp, Gruendl, and Guettler, 2013). If the net worth boost resulting from the TLTRO subsidy is large enough, however, then the insensitive pricing effect is dominated. Indeed, this is what I find in the evidence.

Overall, the results suggest that stealth recapitalization can undo bank lending distortions and have positive ex-post outcomes in line with the goal of explicit bailout regimes[2]. In contrast to the previously documented negative unintended consequences, the findings in this paper suggest that stealth recapitalization can have a positive stabilizing effect through an improvement in banks capital and funding costs. While risky borrowers receive the same level of funding, the tests demonstrate that the outcome of the policy is an improved risk-sharing arrangement, in which risky loans go to more resilient banks and banks loan portfolios become more diversified.

1.1 Related Literature

This paper makes important contributions to several bodies of literature. First, I contribute to the literature on monetary policy and bank risk-taking (Dell'Ariccia, Laeven, and Suarez, 2017; Jimenez et al., 2014; Boyd and De Nicolo, 2005; De Nicolo, Dell'Ariccia, Laeven, and Valencia, 2010). This literature has studied the channels through which policy rates affect bank risk-taking. I contribute by showing which channels prevail when central banks transmit monetary policy through targeted lending facilities as opposed to simply lowering policy rates. In particular, I find evidence of the bank risk-shifting channel transmitted by unconventional

[2]For instance, Berger, Bouwman, Kick, and Schaeck (2016) finds that bailout regimes in Germany decreased bank risk-taking.

monetary policy (Dell'Ariccia et al., 2014; De Nicolo et al., 2010). In contrast, empirical evidence of policy rate changes mostly finds evidence consistent with portfolio-rebalancing or searching-for-yield (Dell'Ariccia et al., 2017; Jimenez et al., 2014). Understanding these effects in context of targeted lending facilities is important as lowering rates below zero is ineffective at boosting bank net worth (Heider et al., 2018). TLTROs demonstrate a way to circumvent this problem and transmit monetary policy. Additionally, the results provide evidence that unconventional policy can transmit risk-taking channels differently across countries as the policy subsidizes some banks more than others.

Second, I contribute to the literature on stealth recapitalization of banks (Brunnermeier and Sannikov, 2016). For instance, the capital constraints channel shows that increases in asset values from quantitative easing improves banks' capital positions and restores bank lending ability (Maggio, Kermani, and Palmer, 2016; Rodnyansky and Darmouni, 2017; Gertler and Karadi, 2011). This paper shows how restoring bank capital is also important for financial stability via bank-risk taking.

The most similar paper in this literature is Acharya et al. (2019), which shows that a capital windfall from the Outright Monetary Transactions (OMT) announcement encouraged undercapitalized banks to engage in "zombie lending". This setting examines the same fundamental tradeoff in this paper: can a boost in net worth offset the incentive of banks to engage in more risk-taking? The difference in this paper is that I find, to the contrary, that the net worth channel dominates and banks decrease risk taking after receiving TLTRO funding. The differences in results can be potentially explained by the differences in analyzed policies. TLTROs impacted the liability-side of bank balance sheets by lowering funding costs. Lowering funding costs may better spread incentives for bank risk-taking out over time while appreciation to asset values provide immediate gains to banks. Dell'Ariccia et al. (2014) provides a model in which lower funding costs provides strong incentives for weakly capitalized banks to reduce risk-taking. Another difference is that Acharya et al. (2019) examines low capital banks' incentives to evergreen zombie loans due to regulatory scrutiny whereas this paper considers the incentive of these banks to invest in firms with high default risk because of limited liability. The incentive to evergreen is different from the risk-taking incentives stemming from limited liability. Together, the contrasting findings provide valuable insight into the effects of different types of stealth recapitalization policies as well as their impact on different types of bank lending.

Third, the paper relates to the well-developed literature on moral hazard and lender of last resort (LOLR) studied in context of LTROs (TLTRO predecessors) (Van Bekkum et al., 2017; Carpinelli and Crosignani, 2017; Drechsler, Drechsel, Marques-Ibanez, and Schnabl, 2016; Crosignani, Faria-e-Castro, and Fonseca, 2019; Acharya and Steffen, 2015). LTROs stealth recapitalized banks by providing risk-insensitive liquidity to participate in carry-trades. Closer to this paper, Van Bekkum et al. (2017) shows that loosening haircut requirements for LTRO funding enables risk-shifting by banks to originate riskier mortgages. In contrast, I contribute by showing a setting where a lending facility induces to banks decrease risky lending. TLTROs go beyond acting as lender of last resort by offering an interest rate subsidy (LTROs offered a penalty rate). Only a rate subsidy encourages reductions in risk-taking via lower interest rate payments and higher bank net worth. This paper shows these differences are potentially important for regulating the moral hazards faced by banks.

More broadly, this paper relates to a theme of the role bank capital in lending decisions. This paper focuses on one dimension, bank risk-taking. Stealth recapitalization and other policies affecting bank capital will have important implications for influencing other bank lending decisions as well. For instance, Chakraborty, Goldstein, and Mackinlay (2019) show that asset purchases of MBS crowds out C&I loans. How stealth recapitalization creates or resolves distortions will determine which borrowers banks choose to fund.

Finally, I contribute to a fledging literature that examines the effect of TLTROs on lending. For instance, Benetton and Fantino (2018) find that TLTROs boost lending and lower interest rates by exploiting the variations in borrowing limits permitted by TLTROs. I contribute by showing the cost advantage of TLTRO has important implications for bank lending decisions. This is the first paper in this literature to examine how TLTRO affects the quality and composition of bank lending as well as how it differentially affects poorly capitalized banks.

The paper proceeds as follows. Section 2 describes the policy background of TLTROs. Section 3 describes the data and samples. Section 4 documents evidence on the gains of TLTRO subsidy. Section 5 contains the results on how the policy affected bank risk-taking. Section 6 discusses the difference in results with previous findings. Section 7 concludes.

2 TLTROs and Policy Background

In response to the financial crisis, the ECB provided liquidity facilities, Long Term Refinancing Operations (LTROs), to banks in order to avoid asset fire sales. In June 2014, the ECB replaced the original LTROs with a new set of funding facilities, Targeted LTROs (TLTROs), which offer banks incentives to lend to the real economy. TLTROs provide subsidized four year loans to banks in an amount proportional to their lending to euro area borrowers. While the collateral framework is the same as LTROs, TLTROs offer an interest rate subsidy relative to the private market and a borrowing amount that increases in a bank's net lending. Together, these terms are aimed at boosting lending to the real economy and transmitting rate cuts at zero-lower bound, which would otherwise threaten banks net interest margins (Bloomberg, 2017).

This paper primarily examines the first series of TLTROs[3]. The first series (TLTRO-I) was announced in June 2014, began in September 2014, and involved a total uptake of approximately €400 billion. The TLTRO-I operations in September 2014 and December 2014 allowed banks to borrow 7% of outstanding loans to euro area non-financial corporations and households excluding mortgages as of April 2014. In the next six operations of the TLTRO-I

[3]I briefly examine the effects of TLTRO-II later in the paper. TLTRO-III began in 2019.

series (January 2015 - June 2016), the additional lending allowance was a function of net lending since the start of the programs. The interest rate on these loans was the marginal refinancing rate (MRO) of .05% for all banks and types of collateral. All TLTRO-I loans matured in September 2018 unless forced repayment was triggered in the event banks failed to meet pre-specified lending targets (banks must increase their loan growth rate).

The design of the LTROs was modeled to follow the classic prescription of the Lender of Last Resort (LOLR): lend against good collateral at high rates (Bagehot, 1875; Drechsler et al., 2016). In theory, this structure supports illiquid but not insolvent banks (Kanatas, 1986). By offering an interest rate subsidy, TLTROs abandons the high rate prescription and implicitly offers support to weak and insolvent banks. In particular, the key friction of TLTROs is the interest rate offered on the loan facilities is the same for all borrowing banks regardless of what collateral they provide. Distressed banks with high yield covered bonds backed by poor collateral could benefit the most from the facility. By offering this collateral to the ECB, banks could reduce their funding costs and subsequently improve their net worth.

Anecdotal evidence from industry specialists confirms TLTRO had this effect. While TLTRO-I may not have helped boost lending, it served to strengthen the balance-sheets of intermediaries who took up the funding (Bloomberg, 2017). Although the intention of the TLTRO was primarily to boost lending, the ECB Bank Lending survey indicates "participation in the first TLTRO was largely driven by profitability motives" (ECB, 2014). In particular, southern European banks stood to improve their net interest margins the most due to their high funding costs (Fitch Ratings, 2014). In addition to their low rate, the four year maturity of the TLTRO offered substantial improvement in banks' funding positions as the ECB estimates banks taking out TLTROs increased their weighted average maturity of ECB borrowings from 130 days to 800 days (ECB, 2016). In a frictionless world, loan maturity is irrelevant, but the risk-insensitive subsidy offered by these loans generates larger value at longer maturities (Carpinelli and Crosignani, 2017).

The theory and industry evidence suggests that TLTRO benefited distressed banks facing high funding costs. In the following sections, I estimate size of magnitude of the TLTRO subsidy and empirically examine how it impacted bank risk-taking behavior.

3 Data, Sample, and Methodology

The data in this paper comes primarily from i) Bloomberg Terminal, ii) SNL Financial, iii) Dealscan, and iv) the ECB Loan-Level Initiative. Bloomberg provides data on all publicly announced TLTRO loans at the bank level. Banks that participate in TLTROs are hand matched to SNL Financial at the parent level for balance sheet financials. The first set of loan level data is taken from Thomson Reuters Dealscan, which consists of private and public borrowers in the syndicated loan market. The second loan level data used is the ECB ABS Loan Level Initiative provided by European Datawarehouse. This dataset consists of the underlying loans of all securitizations that are eligible as ECB collateral and consists of SME and residential mortgage loans to Euro Area countries. Both loan-level data sets are hand matched to the sample of TLTRO-recipient banks from the Bloomberg sample.

3.1 Bank Sample

The sample formation begins with banks that publicly disclosed TLTRO-I loans[4]. Of these banks, I restrict the sample to banks active in loan market[5] covered by Dealscan in the time window around TLTRO-I. This results in a sample of thirty-three European banks[6]. The primary measure of low capitalization is the tier 1 capital ratio which measures risk-adjusted leverage and – in line with the theoretical net worth channel – captures how close banks are

[4]The baseline line tests focus on the TLTRO-I series since there was no TLTRO in place prior to it's implementation. Therefore, the language in this section refers to TLTRO-I by default; however, TLTRO-II is examined in some specifications.

[5]I require that a lender makes least 30 loans to European borrowers in the relevant time window.

[6]See Appendix B for a list of these banks and their tier 1 ratios

to insolvency. Banks are classified as *Low Tier* 1 if their 2014Q1 (immediately prior to the TLTRO announcement) tier 1 capital ratio is in the bottom quartile[7].

Table 1 shows key bank summary statistics split by the *Low Tier* 1 classification. The sample consists of 9 low capitalized banks (Panel A) and 24 high capitalized banks (Panel B). Prior to TLTROs, low capitalized banks have an average tier 1 ratio of 9.97% compared to high capitalized banks with an average of 12.90%. Thus, low capitalized banks are very close to the 9% binding minimum capital regulation in place by the European Banking Authority (EBA)[8]. Moreover, a few of the banks in the sample were not affected by the 2011 EBA capital regulation, meaning they are permitted to hold even less than 9% tier 1 capital. Overall, low capitalized banks are smaller, less liquid, and have more non-performing loans compared to high capitalized banks, but these differences are small. Post-TLTRO, both low and high capitalized banks have about 2% higher tier 1 capital compared to the pre-TLTRO period.

Table 2 summarizes the bank sample by countries. The *Low Tier* 1 sample consists primarily of banks headquartered in GIIPS countries: five are from Italy and three are from Spain. There is only one non-GIIPS bank from Austria in the *Low Tier* 1 sample. In contrast, the *High Tier* 1 sample consists of 13 GIIPS and 11 non-GIIPS banks. The low capitalization of GIIPS headquartered banks is consistent with the narrative that these banks were left distressed post-financial crisis as these countries were the most severely affected.

3.2 Loan Sample

The Dealscan sample consists of loans to Euro Area borrowers. For measures of firm riskiness, I retrieve borrower characteristics from Compustat Global and Bureau van Dijk's Amadeus. First, I merge public firms from this sample to Compustat Global using the mapping file from Chava and Roberts (2008). Of the unmatched firms, I follow the approach in Acharya, Eisert, Eufinger, and Hirsch (2018) and apply a fuzzy string matching algorithm

[7]Main results are qualitatively similar using below median.

[8]See Gropp et al. (2013) for more details on the post-crisis EBA capital requirements.

to match Dealscan borrower names to Amadeus firms. I manually confirm the matches. Since Dealscan coverage of loan shares of lenders is limited, I apply the Chodorow-Reich (2013) imputation method which exploits syndicate structure to infer the loan shares. Furthermore, I restrict the sample to borrowers-lender pairs with at outstanding loan volume in the period prior to TLTRO announcement. Finally, I drop firms in financial, real estate, service, and energy industries. Together, this results in a sample of 1124 firms with non-missing measures of ex-ante firm risk.

Since I do not observe firm defaults in Dealscan, I rely on ex-ante measures of firm riskiness in the spirit of classic corporate default models (e.g. (Merton, 1974)). I use two measures to capture the distance of a firm to default. I define *Firm Risk* as equal to 1 if the return-on-asset (ROA) volatility is above sample median and interest coverage ratio is below median[9]. Together, *Firm Risk* identifies firms with both low capacity to service debt and volatile profitability. Classic corporate default models predict that these firms are most likely to default.

Table 3 presents summary statistics of the Dealscan panel, which consists of active loans around the TLTRO-I announcement. The unit of observation is a lender-borrower's outstanding loan amount in the pre- (2014Q2) or post- (2015Q2) TLTRO period. The average loans outstanding are very large amounts of about \$122.2 million pre- and \$135.8 million post-TLTRO[10]. As a result, the average log change in loan volume is positive, at 4%. The number and size of these loans suggests the economic magnitude of risk-taking detectable in this sample is large. Indeed, 22% of the sample consists of high risk borrowers, which have low debt servicing capacity and volatile profitability.

Dealscan consists primarily of syndicated loans. As such, a single borrower in the sample receives funding from, on average, about five TLTRO lenders. This feature enables the

[9]For examples in literature, Heider et al. (2018) employs ROA volatility as a measure of firm risk while Acharya et al. (2019) uses interest coverage ratio.

[10]This is slightly modified from Grosse-Rueschkamp, Steffen, and Streitz (2019) who use define the outcome variable as new loan issuance. Outstanding loan volume better captures the economic variable of interest since looking at new loan issuance ignores that loans are of varying maturities.

inclusion of borrower-fixed effects to control for any unobserved demand shocks.

The second loan dataset is ECB Loan-Level Data (LLD) provided by European Datawarehouse[11]. The submission of this data is required by banks using securitizations as collateral at the ECB starting as of 2013 (for MROs, LTROS, TLTROs). Unlike Dealscan, which consists of loans to large corporate borrowers, ECB LLD consists of loans to small & medium enterprises (SME) and residential mortgages.

Table 4 contains summary statistics of the ECB Loan-Level Data SME panel. In stark contrast to the Dealscan panel, this dataset (in the TLTRO-I time window) consists of roughly 520,000 loans to Euro Area borrowers in amounts of about €116 thousand on average. Furthermore, almost all the loans come from a single originator, sixteen of which are mapped back to the original sample of banks. Unlike the analysis in the Dealscan panel which relies on ex-ante measures of firm risk, the ECB data includes ex-post loan performance measures such as delinquency and default. The average delinquency and default rates in the panel are 5% and 2%, respectively. Conditional on default, the average default loss is about 43% of the original loan balance.

4 Bank Capital and Gains from TLTROs

In this section, I document how low capitalized banks differentially gain from TLTROs. First, I compute a measure that captures the funding benefit provided by the policy. Under TLTROs, all banks are able to borrow at the marginal refinancing rate (.05%). Relative to each bank's private market benchmark, TLTROs offer a larger subsidy to some banks more than others. To estimate how much each bank gains, I construct an empirical private market benchmark using covered bond yields that are eligible as ECB collateral.

Using the eligible collateral ISIN file provided on the ECB's website, I compile a list

[11]This dataset has been previous used in academic research, including Ertan et al. (2018) and Van Bekkum et al. (2017)

of all covered bonds issued by banks in the sample that are eligible at the time of the TLTRO-I implementation. I then map this list to Thomson Reuters Datastream to retrieve yield-to-maturity and other bond characteristics. I limit the sample to covered bonds with three to seven years remaining maturity (at the time of TLTRO implementation). Of the remaining covered bonds, I take the average of the yield for each bank after adjusting the yield for the valuation haircut from the ECB[12]. The rate subsidy estimate is simply average adjusted covered bond yield minus the marginal refinancing rate (MRO) of .05%.

Using this estimation procedure, the rate subsidy of TLTRO-I is about .93% and 1.92% for high capitalized and low capitalized banks, respectively. Accordingly, TLTRO uptake is also larger for low capitalized banks who take out an average of 4.3% of total assets. Next, I combine the subsidy and uptake measures to define $TLTRO\ Windfall$, which summarizes the impact of the TLTRO on bank equity:

$$TLTRO\ Windfall = \frac{Rate\ Subsidy \times TLTRO\ Uptake}{Total\ Equity} \tag{1}$$

Low capitalized banks receive a larger subsidy from TLTROs. The average windfall is .70% and 1.27% for high and low capitalized banks, respectively. Combined with the four year maturity of these loans, a back of the envelope calculation suggests TLTRO-I funding boosts low capital and high capital equity by 2.8% and 5.2% of total equity[13]. The magnitude of this net worth boost is similar but slightly smaller to that of the OMT announcement found in Acharya et al. (2019) and Crosignani et al. (2019).

Overall, the evidence suggests that low capitalized banks received a larger equity gains from TLTROs. Figure 1 summarizes the TLTRO gains by low (25th percentile) and high

[12] The ECB requires overcollateralization in exchange for loans. As a result, the covered bond yields must be adjusted for collateral haircuts required by the ECB since a €100 of covered bonds grants a bank less than €100 in loans.

[13] Crosignani et al. (2019) argue that a maturity extension has an added benefit over and above rolling over short-term debt. This is especially true in the case of TLTRO when the rate pricing is risk-insensitive to the borrowing bank.

(75th percentile) tier 1 capitalized banks. The pattern is that low capitalized banks benefit along all dimensions: larger subsidies, larger windfalls, and larger uptake. Additionally, low capitalized banks gained nearly 10% higher cumulative abnormal stock returns around the TLTRO announcement window. The strong market reaction by low capitalized banks substantiates the validity of the estimated rate subsidy and windfall measures

Table 5 more formally tests these relationships in a regression setting. The key explanation variable is a bank's tier 1 capitalization. The results find strong statistically significant evidence consistent with the picture in Figure 1. Low capitalized banks have larger funding subsidies, take out larger TLTRO loans, experience larger increases in return on assets, and have larger stock returns upon TLTRO announcement. Together, the evidence shows TLTROs significantly improved the financial conditions of low capitalized banks.

5 Bank Lending and Risk Taking

Having documented substantial gains for low capitalized banks, this section studies how the policy transmits to bank lending behavior. In particular, I explore whether this boost to net worth impacts bank risk-taking decisions. Unlike Benetton and Fantino (2018) which examines how TLTRO receiving banks react differently to non-TLTRO banks, the sample only includes banks that receive TLTRO funding. Given the strong case that TLTROs differentially benefited low capitalized banks, I exploit this variation for the identification of bank lending effects. Moreover, the theory explicitly predicts the gains matter more for low capitalized banks for risk-taking decisions. One advantage of this empirical approach is that endogeneity of choosing to borrow from TLTRO is avoided.

The main empirical specification therefore follows standard balance-sheet channel identification by looking at how low and high capitalized banks reacted differently to the policy[14]

[14]The identification assumption required is that level of bank capital prior to the policy announcement is exogenous to future lending behavior.

(Jiménez et al., 2012; Kashyap and Stein, 2000). Although each TLTRO series consists of several allotments, I simplify the analysis by looking at the effect from before (2014Q2) to after (2015Q2) the TLTRO announcement. Since the key economic variable is bank net worth, the announcement/anticipation (as opposed to the policy implementation in 2014Q3) of the policy is sufficient to alter banks' risk taking calculus. As described in Section 3, the dependent variable is the log change in outstanding loan volume from the pre- to post-period[15]. Given this setting, I estimate the following equation:

$$Ln(1 + Loan^{ij}_{Post}) - Ln(Loan^{ij}_{Pre}) = \beta LowTier1_j \times FirmRisk_i + v_i + u_j + \epsilon_{ij} \qquad (2)$$

This specification follows Jimenez et al. (2014) and interacts $LowTier1_j$ with $FirmRisk_i$ in order to capture how low capitalized banks differently change their lending to risky firms. An interpretation of a positive β coefficient is that low capitalized banks lend more to high risk firms after the TLTRO announcement. The model is flexible and allows for borrower fixed effects, v_i, which control for time-varying borrower demand to eliminate demand shock biases (Khwaja and Mian, 2008). Although a typical borrower-time fixed effect model does not permit a bank-time fixed effect, the interaction with $FirmRisk$ enables the inclusion of a bank fixed effect, u_j to control for average bank changes in overall lending for high and low risk borrowers. Finally, as standard for difference in difference regressions, standard errors are clustered at the treatment (bank) level (Bertrand, Duflo, and Mullainathan, 2004).

Figure 2 plots the outstanding risky loan volume by low and high capitalized banks. A clear pattern emerges. Both types have a very stable pre- shock parallel trend but after the TLTRO policy announcement, low capitalized banks sharply decrease funding to risky borrowers. This preliminary picture supports the predictions of the net worth channel.

Table 6 presents the formal regression results. Column (1) estimates equation (2) using

[15] Removing this difference makes exposition of the econometrics simpler but is numerically equivalent to including a post interaction term with two periods per firm-lender. This approach is also implemented in Chodorow-Reich (2013) and Rodnyansky and Darmouni (2017).

only bank fixed effects. The regression confirms that the key coefficient on the interaction is negative and statistically different than zero. Columns (2) introduce industry $\times$ country fixed effects in order to control for unobserved demand shocks. The key coefficient remains negative, significant and increases in magnitude.

The baseline Dealscan model for the rest of the paper is Column (3). The key interaction term remains negative and highly significant. The coefficient is -0.12. The economic interpretation is that low capitalized banks lend 12% less to high risk firms post-TLTRO. Evaluated at the sample average loan amount of $122 million, this corresponds to a $14.6 million decrease in funding. Despite the relatively small number of firms in the sample, the magnitude of the change in risky funding is economically large and has implications for the change in risk composition of bank balance sheets.

Columns (4) & (5) investigate the extensive and intensive margins of the baseline model, respectively. Both extensive and intensive margins are statistically significant and negatively driving the main effect. On average, low capitalized banks are 4.6% less likely to renew a loan for high risk firms post-TLTRO. Conditional on renewing a loan, low capitalized banks make loans that are 5.4% smaller post-TLTRO to high risk borrowers.

Column (6) econometrically tests the the pre-TLTRO trends by falsely assuming the shock occurs in March 2013 and estimating the same model around this time window. The interaction coefficient in this model is positive but not statistically different from zero. While the parallel trends assumption is never completely testable, this placebo test is able to rule out any pre-trend differences that drive the results.

Column (7) estimates the model around the TLTRO-II announcement in March 2016 but finds no statistically significant results. Although the rate subsidy and borrowing limits of TLTRO-II is larger than TLTRO-I, banks had lower capital ratios close to the minimum regulatory requirement at the time of the TLTRO-I announcement. A muted TLTRO-II response is therefore consistent with that only sufficiently low capitalized banks face risk-shifting incentives. Moreover, the announcement of TLTRO-I may have signaled future governmental support and generated bank expectations of additional lending programs down the road. Overall, the results suggest the announcement of TLTRO-I was more important in changing bank risk-taking behavior.

5.1 Rate Subsidies and Bank Lending

So far the results indicate that low capitalized banks receiving TLTRO funding decrease funding to risky firms. To better understand the mechanism behind this result, I employ another testable implication of the net worth channel: banks with larger funding subsidies from TLTROs should receive a larger net worth boost and decrease their risk-taking. I implement this test by estimating Equation (2) with an additional interaction with the estimated rate subsidy described in Section 4[16].

Table 7 contains the results. Column (1) contains the baseline specification. The coefficient on the triple interaction is negative and statistically significant. The economic interpretation of a negative coefficient on this interaction is that low capitalized banks with the largest TLTRO rate benefit decrease risk taking more. This is exactly what the theory predicts. Columns (2) & (3) decompose this effect by extensive and intensive margins. While the extensive and intensive margins have significant negative effects, the relative magnitude of the intensive margin coefficient suggests that the intensive margin drives this result. The economic interpretation is that low capitalized banks with high rate subsidies reduce their outstanding loan volume to risky borrowers relative to other banks.

In addition to supporting the theoretical predictions, this test also provides reassuring evidence that the differences in bank lending to high risk firms is driven by a response to the incentives offered by TLTROs and not time-series differences in low capitalized bank lending. Overall, the results suggest that the change in net worth introduced by TLTRO has powerful

[16]An obvious caveat is that bank capital and rate subsidy are correlated. The test is only powerful insofar there is variation with low capitalized banks with varying levels of rate subsidies.

incentives to alter bank-risk taking.

5.2 Bank Capital and Liquidity

One potential concern is that the results could be driven by differences in bank liquidity not capitalization. That is, the liquidity injected by TLTRO could alter the lending decisions of illiquid banks. Since the sample of low capitalized banks are less liquid than high capitalized banks, this could theoretically be an issue. Given the excess liquidity injected by the banking sector through LTROs, however, this is practically less of a concern. Moreover, it is not theoretically clear why lending to high risk firms would decrease. The the opposite might also be expected: a positive liquidity shock encourages banks to lend to risky firms, which would otherwise be credit rationed.

Table 8 tests this alternative explanation by estimating Equation (2) with additional interaction terms which measure bank liquidity. Column (1) interacts bank liquid assets with $Firm\ Risk$ and finds an insignificant coefficient. Moreover, the interaction of $ln(Tier1)$ and $Firm\ Risk$ is positive and highly significant even when controlling for liquidity. The results are similar in Columns (3) & (4) which use bank deposits as a measure of liquidity. The results strongly favor that bank capital, and not other bank characteristics, drives in the differences in post-TLTRO lending patterns.

5.3 SME Lending and Ex-Post Default

The following tests utilize ECB Loan Level Initiative data. One immediate advantage of this dataset is it can test if the results are generalizable to smaller non-financial firms. The primary advantage, however, is that the data includes a rich set of ex-post loan performance information. Using loan-level data submissions (as of August 2019), I look at how loans originated before and after TLTRO perform in terms of delinquency and default. Similar to

Equation (3), I estimate:

$$Performance_{ijt} = \gamma LowTier1_j \times Post_t + Controls + v_j + u_t + z_t + \epsilon_{ijt} \quad (3)$$

The dependent variable in Equation (4) measures the ex-post performance of loans originated by banks at a given point in time. The economic coefficient of interest is γ which measures how the loans originated by low capitalized banks perform post-TLTRO relative to those originated by high capitalized banks. SME loans are not syndicated like the Dealscan sample, and therefore I can not make use of firm-time fixed effects as in Equation (2). Instead, the model includes industry × time, country × time, and bank fixed effects in order to control for time varying demand shocks and unobserved bank heterogeneity.

Figure 3 provides a visualization of this test using the SME loan sample. The figure plots the time series difference between low and high capitalized banks' loan default rates (controlling for country × time and lender fixed effects). While the difference in loan default rates is relatively stable prior to the TLTRO announcement, it substantially drops afterwards. Similarly, Figure 4 plots the same figure but for loan interest rates which fall following the TLTRO announcement. Both pieces of evidence point to less risky lending by low capitalized banks.

Table 9 presents the results from formally estimating equation (4) on the SME loan sample using loan performance metrics[17]. In all columns, the interaction of $LowTier1$ and $Post$ is negative and highly significant. The interpretation is that low capitalized originate better performing loans post-TLTRO . The decrease in probability delinquency and default (Columns 1 & 4) for low capitalized banks is 2.3% and 1.6%, respectively. These are very large economic magnitudes as the unconditional probabilities of delinquency and default are 5% and 2%. Column (2) finds low capitalized banks decrease the number of days that a borrower's account remains delinquent. Column (3) finds a reduction in delinquency amounts

[17]Table A3 in Appendix A presents a placebo test of the estimates in this table

conditional on delinquency. Finally, Column (5) finds that low capitalized banks make loans with lower interest rates. The change in rates can be interpreted either as the origination of loans to less risky borrowers or cheaper credit to borrowers of the same quality. Although there is no test for this distinction, the decreased loan delinquency suggests that part of this interest rate decrease is due at least in part to less risky lending.

Together, these findings add several enrichments upon existing results. (1) The ECB LLD estimates do not rely on proxies for ex-ante firm riskiness and allow for a more precise estimate of the magnitude of decrease in risk by low capitalized banks. (2) They show that the drop in risky lending holds true for smaller non-financial corporate borrowers. Studies that rely primarily on Dealscan are vulnerable to the critique that samples consists of very large corporate borrowers and are not generalizable to smaller corporate borrowers. (3) The increase in sample size of loans from roughly 4,000 to 520,000 removes concerns that the results are be driven by a small set of borrowers in sample. This larger sample is also generally more representative of bank's corporate loan portfolio.

5.4 Spillovers to Other Asset Classes

The analysis so far has focused on non-financial corporate loans, which are explicitly "targeted" by TLTROs. That is, increasing lending to non-financial corporates boosts the maximum bank borrowing amount from TLTROs. To further test the net worth channel, I look for spillovers to non-targeted asset classes since this channel should not depend on which assets are targeted. If banks decrease risky lending in non-targeted asset classes, this confirms a unique prediction of the net worth channel.

In Table 10, I repeat the ex-post performance analysis but using ECB data for residential mortgages, which are explicitly excluded from loans eligible for TLTRO borrowing. The findings are highly significant and similar to banks' SME lending. Low capitalized banks originate residential mortgages less likely to become delinquent and default post-TLTRO.

5.5 Aggregate Effect on Borrowers

The evidence shows that low capitalized decrease funding to risky borrowers. A key economic question ignored so far is: "what happens to these borrowers?" There are two possibilities. First, they could be rationed out of the market and receive less or no additional funding. The second possibility is that other lenders substitute in and provide borrowers funding in lieu of low capitalized banks. Which reaction occurred matters for the real implications of TLTROs on the European economy.

These two effects can be potentially disentangled by exploiting that I observe loans to a single borrower from multiple lenders in Dealscan. Equation (2) estimates the relative change in lending by comparing low and high capitalized banks, but it does not capture the aggregate change in lending to borrowers. Jiménez, Mian, Peydró, and Saurina (2019) provides an estimation procedure for estimating this aggregate effect. The procedure is as follows. First, sum the loans to a borrower from all lenders, $Loan^i$, and take the average of the lenders' tier 1 capital, $\overline{ln(Tier1)}_i$. Using these firm level measures, the economic model of interest is:

$$Ln(1 + Loan^i_{Post}) - Ln(Loan^i_{Pre}) = \hat{\beta}\overline{ln(Tier1)}_i + \epsilon_i \tag{4}$$

For simplicity, I drop the interaction term with $FirmRisk$ and consider the model separately for high and low risk firms. $\hat{\beta}$ from (4) captures the aggregate change in funding due to differential responses of banks with low capitalization. OLS estimation of (4) yields $\hat{\beta}_{OLS}$, which is biased since it cannot account for firm demand shocks as in the Khwaja and Mian (2008) estimator. Jiménez et al. (2019) proposes an unbiased estimator that adjusts $\hat{\beta}_{OLS}$ for demand shocks. The adjustment term consists of $(\beta_{OLS} - \beta_{FE})$, the difference in the OLS and firm fixed effects estimates obtained in the borrower-lender panel. The next step in the procedure, therefore, is to estimate the following equation with and without firm fixed effects:

$$Ln(1 + Loan^{ij}_{Post}) - Ln(Loan^{ij}_{Pre}) = \beta ln(Tier1)_j + v_i + \epsilon_{ij} \tag{5}$$

After calculating β_{OLS} and β_{FE} from (5), the bias corrected estimator is:

$$\hat{\overline{\beta}} = \hat{\beta}_{OLS} - (\beta_{OLS} - \beta_{FE}) \times \frac{var(ln(Tier1)_j)}{var(\overline{ln(Tier1)}_i)} \tag{6}$$

Put simply, if β_{FE} finds that β_{OLS} is downward biased due to a positive demand shock, Equation (6) revises $\hat{\beta}$ upwards after for adjusting for the variance of the covariates.

Table 11 presents the results from the adjustment procedure. Panels A and B estimate the procedure for high and low risk borrowers separately. Columns (1) & (2) present the lender-borrower level results. For high risk borrowers, the fixed effects coefficient on tier 1 capital is smaller than the OLS estimate. Column (3) contains OLS estimate of the aggregate change in firm lending. The coefficient is positive and statistically significant and much larger in magnitude to the fixed effects estimate. Column (4) presents the bias adjusted estimate. Since $\beta_{OLS} > \beta_{FE}$, the adjusted estimator is smaller than the effect in Column (3). The sign of the coefficient is consistent with a decrease in funding to high risk firms that rely more on low capitalized banks.

To test if this effect is statistically different from zero, I need to compute the standard errors of (6). To do this, I calculate the covariance matrix of $\hat{\beta}_{OLS}$, β_{OLS}, β_{FE}, $var(ln(Tier1)_j)$, and $var(\overline{ln(Tier1)}_i)$ using influence functions and cluster at the firm level (Erickson and Whited, 2002). Then I apply the delta method to (6) to get asymptotic standard errors/ t statistics. I find that the adjusted coefficient is not statistically different from zero. The effect for low risk firms is also indistinguishable from zero.

To summarize, the above results show that firms in the Dealscan sample do not experience any change in funding due to shocks from low capitalized banks. Instead, the substitution effect prevails. In aggregate, borrowers receive the same amount of funding, but high risk borrowers are shifted from low capitalized bank to high capitalized banks. The correct economic interpretation of the main results is that low capitalized banks reallocate their balance sheet towards safer borrowers.

5.6 Country-Wise Reallocation of Risk

In addition to bank capital, another important dimension of bank risk-sharing is the correlation of firm defaults within a given country. With low net worth and limited liability, banks can maximize risk-shifting by investing in firms highly correlated with bank distress. Restoring bank equity, therefore, can encourage low capitalized banks diversify its lending. I explore this hypothesis by examining how much reallocation of bank risk occurs across countries.

To see how much of the earlier results are driven by reallocation across country, I re-run the baseline specification but only include low capitalized GIIPS banks and high capitalized non-GIIPS banks in the sample. This classification is driven by the experience from the recent financial crisis, in which GIIPS countries and banks experienced the greatest distress. The working assumption in the following analysis is that distress of banks and borrowers within these countries is likely to be highly correlated.

Table 12 presents the results. In Columns (1) & (2), the coefficients on *Low Tier* 1 are negative and significant for high risk firms and insignificant for low risk firms. Given the sample restriction, the interpretation is that high risk borrowers move from the balance sheet of low capital GIIPS banks to high capital non-GIIPS. Columns (3) & (4) run the same analysis but for a subsample of GIIPS borrowers. The sign of the coefficients are similar but the interpretation is different. High risk GIIPS borrowers move to well capitalized non-GIIPS banks and low risk GIIPS borrowers move to low capitalized GIIPS banks. Together these results show that bank risks are not stationary in a given country but move in response to a boost to bank equity in line with risk-shifting theory.

6 Discussion of Results

The existing empirical literature finds that stealth recapitalizations led to increased risk-taking by banks, the opposite of my results (Acharya et al., 2019; Drechsler et al., 2016; Kandrac and Schlusche, 2017). What can explain the difference in findings? I examine three compelling explanations of the contrasting results: 1) the differences in analyzed policies, 2) differences in types of lending and 3) differences in general state of the economy and financial sector at the time of policy implementation.

First, TLTROs recapitalize banks in a way not previously studied. The existing literature primarily examines LSAPs, which affect bank capital by increasing the value of their assets. In contrast, TLTROs recapitalize banks through the liability side by directly lowering the banks' funding costs. Unlike appreciations in asset values, which provide immediate gains to banks, decreases in funding costs only pay off to banks in the world where they do not fail. Given the risk-shifting calculus faced by banks with limited liability, offering banks a higher payoff in the good state through lower funding costs gives them an incentive to decrease asset risk and avoid failure (Dell'Ariccia et al., 2014). Combined with the four year maturity of TLTRO loans, the lending facilities further spread bank incentives out over time. Even if appreciations in asset values lower bank credit risk, the spillover to bank funding cost is indirect compared to the direct funding subsidy offered by TLTROs. Drechsler et al. (2016) studies the effects of LTRO as a stealth recapitalization and finds increased risk-taking. Unlike TLTROs, which offer a rate subsidy that maximizes payoffs in the good state, LTROs offer collateral haircut subsidies which minimizes losses in the bad state.

Secondly, this paper focuses on the idea that banks with low capital and limited liability have an incentive to lend to firms with high default risk. In contrast, Acharya et al. (2019)

examines banks incentive to evergreen zombie loans due to regulatory scrutiny of low capital banks. The incentive to evergreen is different from the risk-taking incentives stemming from limited liability. Similarly, Drechsler et al. (2016) analyzes risk-taking in sovereign bonds, which cannot be disentangled from moral suasion. As a result, stealth recapitalization policies can have different effects on these types of lending depending on the incentives involved.

Finally, TLTROs were introduced later in the post-crisis period (June 2014) than other stealth recapitalization policies such as QE, LTROs, and Outright Monetary Transactions (OMT) which were implemented in the immediate aftermath of the global financial crisis. As a result, banks were severely undercapitalized at the time of policy implementation and any stealth recapitalization may have been insufficient to align incentives with proper risk-taking. TLTROs were implemented in 2014 when stability had been returned to the bank sector. Moreover, interest rate spreads were more compressed at the time of TLTRO implementation. These factors mean that the same magnitude of recapitalization may have greater impact on bank risk-taking incentives in 2014 than they would have in the aftermath of the financial crisis.

7 Conclusion

Banks face a moral hazard problem when their equity capital is low, especially after financial crises. Unconventional monetary policy can affect bank's moral hazard problem by stealth recapitalizing banks. In this paper, I document an unconventional monetary policy that boosted bank capital and reduced bank risk-taking. The results are consistent with unconventional monetary policy having a positive ex-post stabilizing effect on the financial sector similar to that of an explicit bailout regime. These findings are in contrast to previous research that have shown appreciation in asset values resulting from unconventional monetary policy increases banks' moral hazard problem.

Unlike asset-side stealth recapitalizations, the policy I study boosts bank capital through a reduction bank funding costs. Although both theoretically can discourage risk-taking by banks, a reduction in funding costs can potentially offer stronger incentives by offering equity holders a larger upside in the state where the bank does not fail. The economic differences in these stealth recapitalization policies have important implications for the ex-post effects.

These results are important to understand monetary policy transmission at the zero lower bound. Central banks have introduced programs like TLTROs to offset the low intermediation margins from negative rates. There has been very little research on understanding policy transmission when negative rates are coupled with lending facilities. In terms of risk-taking channels of monetary policy, I find that lowering policy rates in combination with a lending facility has the opposite effect on risk-taking than when only the policy rate changes.

Broadly, this paper relates to how bank capitalization affects bank lending allocations. This paper only focuses on one dimension, bank risk-taking. Future research should examine how changes in bank capital affects other bank lending decisions. Which policy is optimal for ensuring allocation of bank capital to the most productive borrowers? In this paper, however, I find that borrower funding in aggregate does not change, but rather risk is reallocated across banks in a manner that better reflects tier 1 capital and bank stability. This finding relates to a broader question of how risk is distributed in the financial system. What is the optimal allocation of risk across banks? Tier 1 capital offers one, albeit imperfect, answer. Does this change in financial sector integrated across multiple countries? These are some questions future research should attempt to address.

Figure 1: TLTRO Gains by Capitalization

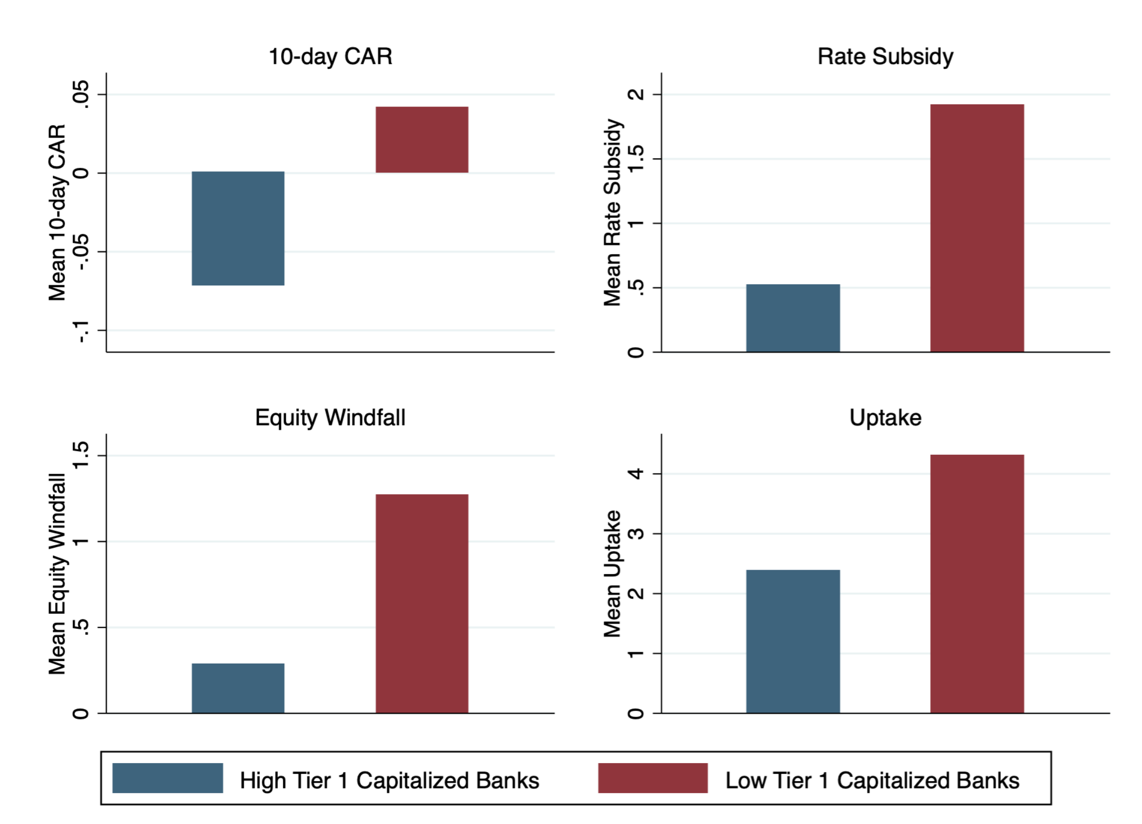

Figure 2: Change in Risk Composition by Net Worth

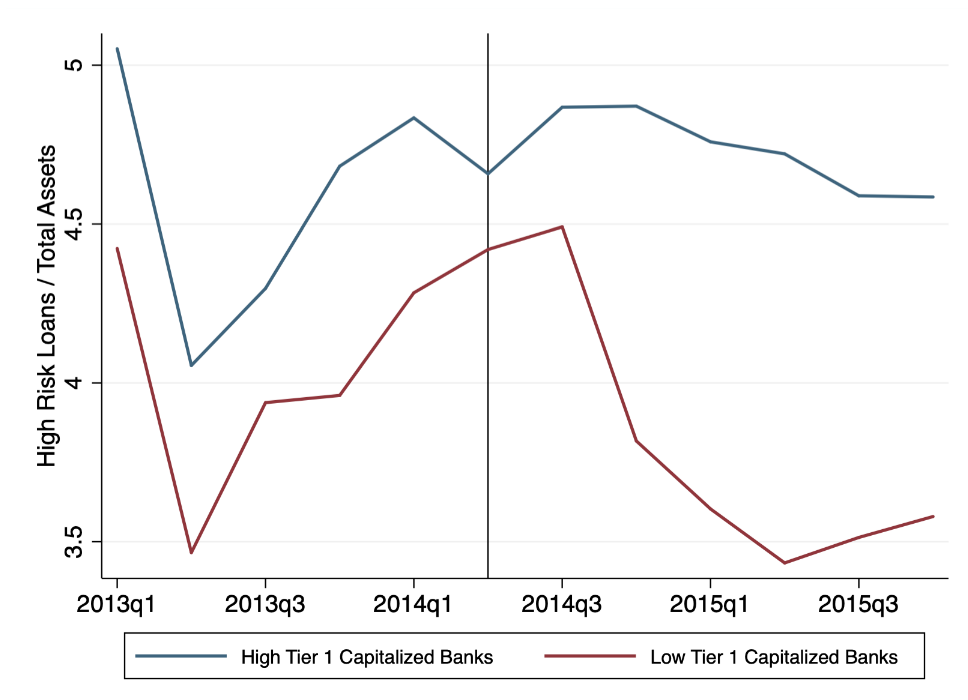

Figure 3: Low v. High Tier 1: Difference in Loan Default Rate

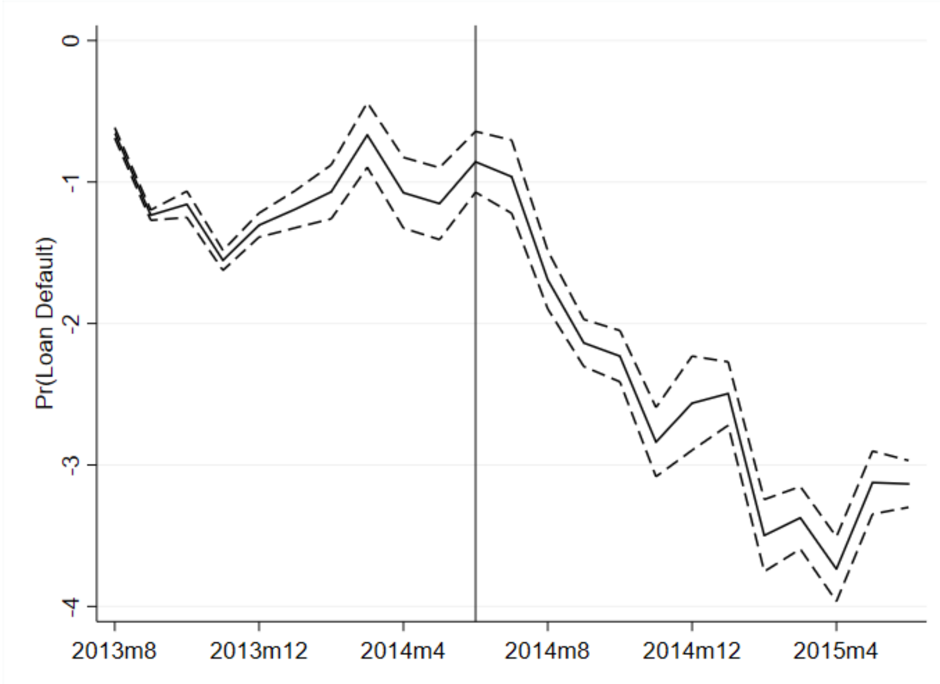

Figure 4: Low v. High Tier 1: Difference in Loan Interest Rate

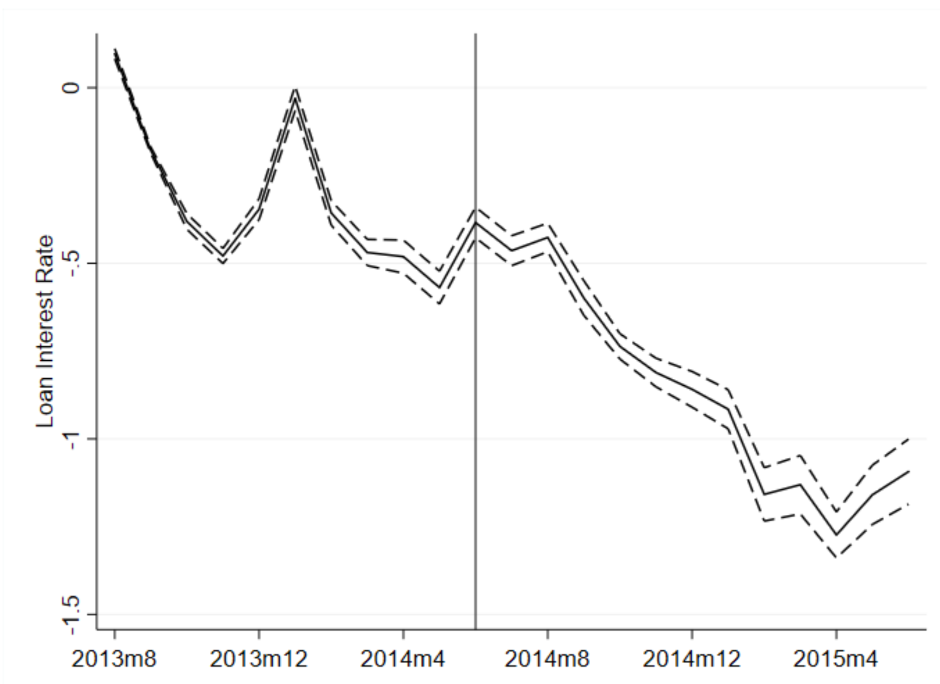

Figure 5: TLTRO Subsidy by Country

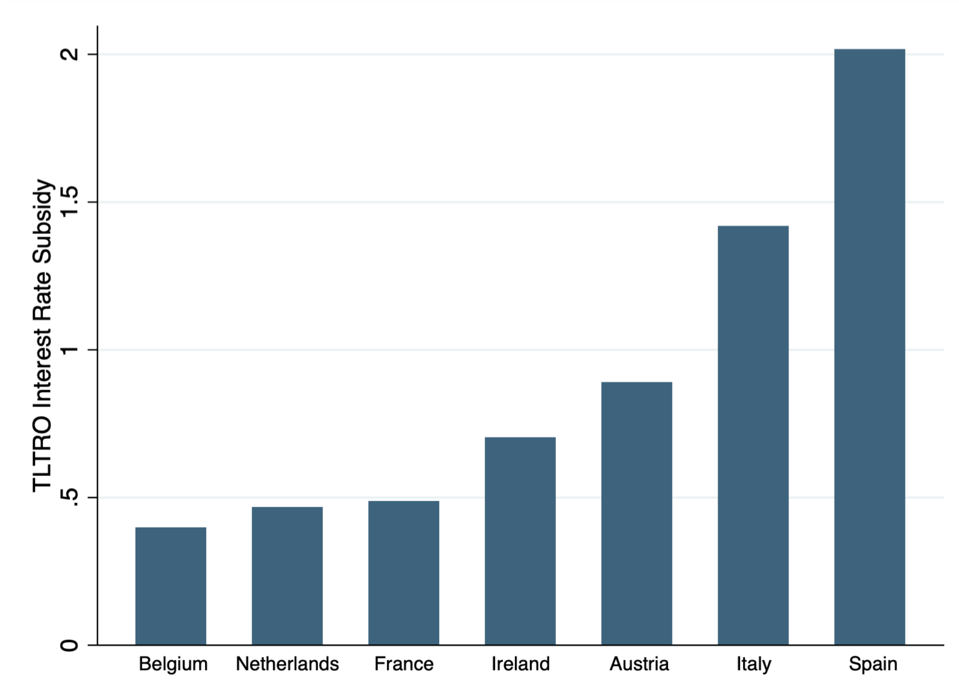

Table 1: Summary Statistics: TLTRO Recipient Banks

Table 1 presents the summary statistics for banks split by capitalization. Panel A and Panel B contains statistics for High Tier 1 and Low Tier 1 Banks, respectively. Low Tier 1 equals 1 if a bank's 2014Q1 Tier 1 is in the bottom quartile. TLTRO-I Uptake is measured at the end of December 2015. TLTRO Rate subsidy is estimated used the opportunity cost of issuing covered bonds. TLTRO windfall is the TLTRO Uptake times Rate Subsidy divided by total equity. All other balance sheet variables are taken from SNL Financial and measured at 2014Q1, prior to TLTRO announcement.

Panel A: High Tier 1 Capitalized Banks

	Mean	Min	P25	P50	P75	Max	SD	N
TLTRO-I Uptake / Total Assets	3.62	0.00	1.04	3.80	5.27	9.98	2.92	21
LTRO Uptake / Total Assets	7.94	0.00	0.00	6.18	13.68	29.11	8.28	22
TLTRO Rate Subsidy	0.93	0.38	0.45	0.65	0.93	2.94	0.76	20
TLTRO Windfall / Total Equity	0.70	0.00	0.09	0.26	0.68	3.59	1.00	18
Ln(Total Assets)	19.19	16.92	17.87	19.06	20.28	21.42	1.38	24
2014 Tier 1 Ratio	12.90	11.02	11.49	12.16	13.89	19.97	2.07	24
2016 Tier 1 Ratio	14.45	8.17	12.52	14.56	16.43	19.90	2.71	24
Total Equity / Total Assets	5.82	3.11	4.30	5.95	7.17	9.00	1.82	24
Securities / Total Assets	28.12	1.88	17.43	28.52	36.33	56.70	14.37	24
Liquid Assets / Total Assets	32.82	13.63	19.74	25.78	46.90	69.87	16.05	21
NPL / Loans	8.13	2.35	4.36	7.06	11.72	18.11	4.70	14
Loan Loss Reserves / Loans	5.43	1.19	1.90	3.97	7.03	20.63	4.68	19
Writedowns / Total Assets	0.73	-0.07	0.26	0.66	1.14	1.87	0.54	24
ROA	1.20	0.59	0.99	1.12	1.40	2.32	0.36	24
Deposits /Assets	51.46	27.93	39.78	53.60	59.30	78.32	14.07	24
Loans / Asssets	54.68	20.02	48.09	55.68	68.62	76.66	15.55	24

Panel B: Low Tier 1 Capitalized Banks

	Mean	Min	P25	P50	P75	Max	SD	N
TLTRO-I Uptake / Total Assets	4.30	0.16	1.35	3.38	7.44	9.94	3.57	8
LTRO Uptake / Total Assets	5.57	0.00	1.75	6.20	8.77	11.10	4.15	8
TLTRO Rate Subsidy	1.92	0.91	1.06	1.42	2.49	4.55	1.29	7
TLTRO Windfall / Total Equity	1.26	0.02	0.20	0.51	3.31	3.69	1.54	7
Ln(Total Assets)	19.03	17.94	18.05	18.73	19.96	20.83	1.13	8
2014 Tier 1 Ratio	9.97	7.80	10.07	10.18	10.43	10.84	0.94	9
2016 Tier 1 Ratio	12.48	9.04	11.96	12.40	13.48	15.08	1.75	8
Total Equity / Total Assets	6.72	4.02	5.18	6.97	7.82	9.85	1.93	8
Securities / Total Assets	25.03	14.75	17.92	21.89	33.02	39.86	9.21	8
Liquid Assets / Total Assets	26.77	14.65	17.49	30.81	32.82	37.27	8.79	8
NPL / Loans	12.62	4.39	8.04	11.92	17.88	20.92	6.09	8
Loan Loss Reserves / Loans	6.23	2.67	4.70	6.21	8.25	8.82	2.23	8
Writedowns / Total Assets	1.21	0.62	0.81	1.02	1.41	2.59	0.63	8
ROA	1.61	0.90	1.18	1.36	2.11	2.68	0.62	8
Deposits /Assets	47.47	26.37	40.46	49.98	54.55	63.41	11.50	8
Loans / Asssets	59.92	46.63	55.52	58.87	64.32	75.32	8.78	8

Table 2: Bank Sample by Tier 1 Capital and GIIPS

Table 4 decomposes the High Tier 1 and Low Tier 1 bank samples by country. Low Tier 1 equals 1 if a bank's 2014Q1 Tier 1 is in the bottom quartile. All Low Tier 1 Banks either from Italy, Spain, or Austria.

	High Tier 1	Low Tier 1	Total
All Countries	24	9	33
GIIPS	13	8	21
Italy	3	5	8
Spain	8	3	11
Austria	1	1	2

Table 3: Summary Statistics: Dealscan Loan Panel

Table 2 presents the summary statistics for the Dealscan Loan Panel. The unit of observation is a lender-borrower pair with any loans in the pre-TLTRO period. Only TLTRO recipient banks are included. Pre Loan Amt. is the outstanding loan amount (in millions of dollars) in the six quarters prior to the TLTRO announcement. Post Loan Amt. is the outstanding loan amount (in millions of dollars) in the six quarters after the TLTRO announcement. Δ ln(Loan) is the log difference of the previous two quantities. Firm Risk equals 1 if both the borrower's 2010-2014 ROA volatility is above sample median and 2012-2014 median interest coverage is below the sample median.

	Mean	Min	P25	P50	P75	Max	SD	N
Pre Loan Amt. (in mil.)	122.17	0.07	22.91	67.32	142.93	2725.12	187.52	4028
Post Loan Amt. (in mil.)	135.76	0.00	21.60	72.06	168.25	2868.12	203.95	4028
Δ ln(Loan)	0.04	-3.89	0.01	0.03	0.36	1.48	0.85	4028
Firm Risk	0.22	0.00	0.00	0.00	0.00	1.00	0.41	4028
GIIPS Borrower	0.34	0.00	0.00	0.00	1.00	1.00	0.47	4028
No. Lenders	5.47	1.00	3.00	5.00	7.00	15.00	3.14	4028

Table 4: Summary Statistics: SME LLD

Table 3 presents the summary statistics for the ECB LLD SME Loan Panel. The unit of observation is a lender-borrower pair originated either in the six quarters prior or six quarters after the TLTRO announcement. Delinquent equals 1 if the loan is in payment or principle arrears. Defaulted equals if a loan defaulted as per the Basel definition. Internal LGD Estimate is the bank's loss given default estimate. Current rate is the loan's current interest rate. Realized Default Loss is the realized losses as a fraction of original loan balance. Original Loan balance is the loan amount in Euros. Maturity is the number of years until maturity from the origination date. Days Delinquent is the number of days a loan has been in payment or principle arrears.

	Mean	Min	P25	P50	P75	Max	SD	N
pr(Delinquent)	0.05	0.00	0.00	0.00	0.00	1.00	0.21	520831
pr(Default)	0.02	0.00	0.00	0.00	0.00	1.00	0.15	520831
Internal LGD Estimate	33.99	0.00	18.28	39.07	45.30	100.00	20.13	498919
Current Rate	4.38	-0.32	2.59	4.00	5.56	21.00	2.46	520831
Realized Default Loss	43.16	0.00	20.88	42.13	64.48	105.82	26.09	2804
Original Loan Balance	116833	0	15000	30000	76230	205000000	931897	520831
Days Delinquent	172	1	9	45	243	1872	251	24309

Table 5: Impact of TLTRO on Bank Funding Costs

Table 5 presents the differences in TLTRO gains for banks. The unit of observation is a bank. Tier 1 Capital is a bank's 2014Q1 (immediately before TLTRO-I announcement) Tier 1 Ratio. Rate Subsidy is the estimated interest rate subsidy on TLTRO loans relative to the opportunity cost of issuing covered bonds. High Rate Subsidy equals 1 if the banks rate subsidy is above sample median. Uptake is the TLTRO loans borrowed as a fraction of total assets. Equity Windfall is the Rate Subsidy times TLTRO loans divided by bank total equity. Δ ROA is the change in return on assets from pre- (2013) to post- (2015) TLTRO. 1-day and 10-day CAR are the cumulative abnormal returns of a bank's common stock one and ten days (respectively) around the announcement of TLTRO-I on June 5, 2014. CARs are estimated using the market model over (-200,-90) using the S&P Europe 350 market index. All standard errors are clustered at the bank level.

	(1) Rate Subsidy	(2) Equity Windfall	(3) Uptake	(4) Δ ROA	(5) 1-day CAR	(6) 10-day CAR
Tier 1 Capital	-0.201**	-0.175**	-0.514***	-0.041**	-0.010***	-0.030***
	(-2.54)	(-2.27)	(-2.90)	(-2.23)	(-3.74)	(-3.29)
Constant	3.664***	3.014**	10.048***	0.383*	0.137***	0.373***
	(3.38)	(2.69)	(4.05)	(1.74)	(4.49)	(3.35)
R^2	0.20	0.12	0.14	0.10	0.33	0.12
Observations	27	25	29	32	26	26

t statistics in parentheses. Standard errors clustered at the bank level.

* $p < .10$, ** $p < .05$, *** $p < .01$

Table 6: Main Results

Table 6 presents the main results capturing the effect of TLTROs on Low Tier 1 capitalized banks. The dependent variable is the log difference in outstanding loan volume that firm i receives from lender j from pre- (2014Q2) to post- (2015Q2) TLTRO-I announcement. Column (4) estimates an extensive margin specification where the dependent variable is whether a borrower received any loan from a lender. Column (5) estimates an intensive margin where the specification is conditional on receiving loans from a lender in post-TLTRO period. Column (6) considers the placebo test that falsely assumes the policy was announced in 2013Q2, one year before the actual announcement. Only TLTRO recipient banks are included in the estimation. Column (7) considers the announcement of TLTRO-2 in March 2016. Only TLTRO recipient banks are included in the estimation. Low Tier 1 equals 1 if a bank's 2014Q1 Tier 1 is in the bottom quartile. Firm Risk equals 1 if both the borrower's 2010-2014 ROA volatility is above sample median and 2012-2014 median interest coverage is below the sample median. All specifications are conditional on receiving loans from a lender in the pre-TLTRO period.

	TLTRO-I Main Specification			Extensive	Intensive	Placebo Test	TLTRO-II
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	Δ ln(Loan)	Δ ln(Loan)	Δ ln(Loan)	pr(Loan)	Δ ln(Loan)	Δ ln(Loan)	Δ ln(Loan)
Low Tier 1 $\times$ Firm Risk	-0.199**	-0.270***	-0.121***	-0.046***	-0.054**	-0.020	-0.017
	(-2.62)	(-6.31)	(-2.98)	(-2.96)	(-2.07)	(-0.39)	(-0.31)
Industry $\times$ Country FE	No	Yes	No	No	No	No	No
Firm FE	No	No	Yes	Yes	Yes	Yes	Yes
Bank FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R^2	0.02	0.23	0.71	0.76	0.70	0.69	0.75
Observations	4028	3995	3776	3776	3249	3743	4163

t statistics in parentheses. Standard errors clustered at the bank level.

* $p < .10$, ** $p < .05$, *** $p < .01$

Table 7: Effect of Rate Subsidy on Lending

Table 7 estimates the effect of the rate subsidy from TLTRO on bank lending behavior. The dependent variable is the log difference in outstanding loan volume that firm i receives from lender j from pre- (2014Q2) to post- (2015Q2) TLTRO-I announcement (2014Q2). Rate Subsidy is the estimated cost advantage offered by TLTRO-I relative to the cost of covered bond issuance. Low Tier 1 equals 1 if a bank's 2014Q1 Tier 1 is in the bottom quartile. Firm Risk equals 1 if both the borrower's 2011-2014 ROA volatility is above sample median and 2012-2013 median interest coverage is below the sample median. Columns (3) & (4) estimate an extensive margin specification where the dependent variable is whether a borrower received any loan from a lender. Columns (5) & (6) estimate an intensive margin where the specification is conditional on receiving loans from a lender in post-TLTRO period. All specifications are conditional on receiving loans from a lender in the pre-TLTRO period.

	Main Specification	Extensive	Intensive
	(1)	(2)	(3)
	Δ ln(Loan)	pr(Loan)	Δ ln(Loan)
Rate Subsidy $\times$ Firm Risk	-0.008	-0.006	0.010
	(-0.20)	(-0.52)	(0.58)
Low Tier 1 $\times$ Firm Risk	0.181	0.041	0.162**
	(1.46)	(0.75)	(2.34)
Rate Subsidy $\times$ Low Tier 1 $\times$ Firm Risk	-0.168***	-0.049*	-0.126***
	(-2.81)	(-1.75)	(-4.23)
Firm FE	Yes	Yes	Yes
Bank FE	Yes	Yes	Yes
R^2	0.71	0.77	0.72
Observations	3487	3487	2991

t statistics in parentheses. Standard errors clustered at the bank level.

* $p < .10$, ** $p < .05$, *** $p < .01$

Table 8: Bank Capital v. Liquidity

Table 8 estimates the baseline model controlling for other fixed bank characteristics. Models (1) & (2) control for liquid assets ratio, models (3) & (4) control for a bank's deposit ratio, and models (5) & (6) control for the fraction of non-performing loans. The dependent variable is the log difference in outstanding loan volume (scaled by borrower total assets) that firm i receives from lender j from pre- (2014Q1) to post- (2015Q1) TLTRO-I announcement (2014Q2). Only TLTRO recipient banks are included in the estimation. Firm Risk equals 1 if both the borrower's 2010-2014 ROA volatility is above sample median and 2012-2014 median interest coverage is below the sample median. All specifications are conditional on receiving loans from a lender in the pre-TLTRO period.

	Liquidity		Deposits	
	(1)	(2)	(3)	(4)
ln(Tier 1) × Firm Risk		0.609***		0.477***
		(2.98)		(2.80)
ln(Assets) × Firm Risk	-0.076**	-0.059*	-0.089***	-0.077**
	(-2.24)	(-1.72)	(-2.94)	(-2.28)
ln(Liq. Assets) × Firm Risk	0.042	-0.017		
	(0.51)	(-0.21)		
ln(Deposits) × Firm Risk			-0.235**	-0.178
			(-2.34)	(-1.56)
Firm FE	Yes	Yes	Yes	Yes
Bank FE	Yes	Yes	Yes	Yes
R^2	0.71	0.71	0.72	0.72
Observations	3755	3755	3684	3684

t statistics in parentheses. Standard errors clustered at the bank level.

* $p < .10$, ** $p < .05$, *** $p < .01$

Table 9: SME Ex-Post Performance

Table 9 presents the effect of TLTRO-I on SME lending by measures of ex-post performance. Each observation is a bank loan. Delinquent is equal to one if the loan is in payment arrears. ln(Days Delinquent) is the log of the number of days the loan has been in payment arrears. Default is equal to 1 if the loan defaulted. Interest Rate is the current interest rate on the loan. Post is equal to 1 after TLTRO-I announcement in June 2014. Low Tier 1 equals 1 if a bank's 2014Q1 Tier 1 is in the bottom quartile. The model is estimated over 2013M7 to 2015M6. Time FE correspond to the loan origination dates. Only TLTRO-I recipient banks are included in the estimation.

	(1) pr(Delinquent)	(2) ln(Days Delinquent)	(3) Deliquent Amt.	(4) pr(Default)	(5) Interest Rate
Low Tier 1 × Post	-0.023***	-0.091***	-0.018***	-0.016***	-0.292**
	(-4.73)	(-3.69)	(-3.18)	(-4.19)	(-2.37)
ln(Loan Amt.)	-0.004***	-0.016***	-0.004	-0.001*	-0.538***
	(-3.57)	(-3.86)	(-1.49)	(-1.85)	(-5.47)
Bank FE	Yes	Yes	Yes	Yes	Yes
Industry × Time FE	Yes	Yes	Yes	Yes	Yes
Country × Time FE	Yes	Yes	Yes	Yes	Yes
Bank Controls	Yes	Yes	Yes	Yes	Yes
R^2	0.04	0.03	0.19	0.02	0.44
Observations	520831	520778	24894	520831	520831

t statistics in parentheses. Standard errors clustered at the bank level.

* $p < .10$, ** $p < .05$, *** $p < .01$

Table 10: Residential Mortgage Ex-Post Performance

Table 10 presents the effect of TLTRO-I on residential mortgage lending by measures of ex-post performance. Each observation is a bank loan. Delinquent is equal to one if the loan is in payment arrears. Post is equal to 1 after TLTRO-I announcement in June 2014. Low Tier 1 equals 1 if a bank's 2014Q1 Tier 1 is in the bottom quartile. The model is estimated over 2013M7 to 2015M6. Time FE correspond to the loan origination dates. Only TLTRO-I recipient banks are included in the estimation.

	(1) pr(Delinquent)	(2) pr(Delinquent)	(3) pr(Delinquent)	(4) pr(Delinquent)
Low Tier 1 × Post	-0.016***	-0.016***	-0.016***	-0.017***
	(-4.69)	(-4.58)	(-4.13)	(-4.81)
ln(Maturity)	0.003*	0.002	0.002	0.002
	(2.03)	(1.32)	(1.68)	(1.72)
ln(Loan Amt.)	-0.000	-0.002	-0.002	-0.002
	(-0.12)	(-1.21)	(-1.75)	(-1.44)
ln(Debt/Income)		0.002**	0.002***	0.002***
		(2.38)	(3.36)	(3.08)
LTV		0.005***	0.006***	0.006***
		(4.41)	(4.78)	(5.66)
Bank FE	Yes	Yes	Yes	Yes
Country × Time FE	Yes	Yes	Yes	Yes
Bank Controls	Yes	Yes	Yes	Yes
Employment Type FE	No	No	Yes	Yes
Payment Type FE	No	No	Yes	Yes
Postcode FE	No	No	No	Yes
R^2	0.05	0.05	0.06	0.06
Observations	307886	301642	301616	300716

t statistics in parentheses. Standard errors clustered at the bank level.
* $p < .10$, ** $p < .05$, *** $p < .01$

Table 11: Aggregate Effects

Table 11 estimates the shock to aggregate funding to borrowers using the Khwaja-Mian adjustment term derived in Jiménez et al. (2019). In Columns (1) and (2), the dependent variable is the log difference in outstanding loan volume that firm i receives from lender j from pre- (2014Q2) to post- (2015Q2) TLTRO-I announcement. In Column (3), the dependent variable is the log change in outstanding loan volume that firm i receives from all lenders. Avg. ln(Tier 1) is the mean of ln(Tier 1) across a firm's lenders. Column (4) adjusts the estimate aggregate OLS estimate for the demand shock bias estimated from including firm fixed effects following Jiménez et al. (2019). Standard errors for the adjustment term are derived using influence functions (See Erickson and Whited (2002)) and the delta method. Panels A and B is estimated using the High Firm Risk and Low Firm Risk samples, respectively. Firm Risk equals 1 if both the borrower's 2010-2014 ROA volatility is above sample median and 2012-2013 median interest coverage is below the sample median.

Panel A: High Risk Firms

	OLS	FE	Agg. OLS	Adjusted
	(1)	(2)	(3)	(4)
	Δ ln(Loan)	Δ ln(Loan)	Δ Agg. Loan	Δ Agg. Loan
ln(Tier 1)	0.859***	0.408**		
	(3.84)	(2.69)		
Avg. ln(Tier 1)			1.925**	
			(2.14)	
Adjusted Treatment Effect				0.963
				(0.31)
Firm FE	No	Yes	No	No
R^2	0.01	0.81	0.02	0.02
Observations	876	820	245	245

Panel B: Low Risk Firms

	OLS	FE	Agg. OLS	Adjusted
	(1)	(2)	(3)	(4)
	Δ ln(Loan)	Δ ln(Loan)	Δ Agg. Loan	Δ Agg. Loan
ln(Tier 1)	-0.121	-0.151		
	(-0.76)	(-1.19)		
Avg. ln(Tier 1)			0.525	
			(1.07)	
Adjusted Treatment Effect				0.448
				(0.87)
Firm FE	No	Yes	No	No
R^2	0.00	0.67	0.00	0.00
Observations	3152	2956	879	879

t statistics in parentheses. Standard errors clustered at the bank level.

* $p < .10$, ** $p < .05$, *** $p < .01$

Table 12: Country-Wise Reallocation of Risk

Table 12 tests the hypothesis that borrower risk is transferred across countries through low and high capitalized bank's balance sheets. Unlike previous tables, these specifications restrict the sample to low capitalized GIIPS banks and high capitalized non-GIIPS banks. Columns (1) & (2) include borrowers from all Euro Area countries while Columns (3) & (4) are restricted to GIIPS borrowers. The dependent variable is the log difference in outstanding loan volume that firm i receives from lender j from pre- (2014Q2) to post- (2015Q2) TLTRO-I announcement. Only TLTRO recipient banks are included in the estimation. Low Tier 1 equals 1 if a bank's 2014Q1 Tier 1 is in the bottom quartile. Firm Risk equals 1 if both the borrower's 2010-2014 ROA volatility is above sample median and 2012-2014 median interest coverage is below the sample median.

	Low Cap GIIPS to High Cap Non-GIIPS		GIIPS Borrowers	
	(1) High Risk Δ ln(Loan)	(2) Low Risk Δ ln(Loan)	(3) High Risk Δ ln(Loan)	(4) Low Risk Δ ln(Loan)
Low Tier 1	-0.074*	0.002	-0.165**	0.073*
	(-1.95)	(0.04)	(-2.47)	(1.75)
Firm FE	Yes	Yes	Yes	Yes
R^2	0.81	0.67	0.85	0.69
Observations	475	2197	179	364

t statistics in parentheses. Standard errors clustered at the bank level.
* $p < .10$, ** $p < .05$, *** $p < .01$

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Appendices

A Additional Results

Table A1: Non-TLTRO Control Group

Table A1 estimates the baseline specification using different groups of banks. Model (1) includes only TLTRO-I Recipient Banks. Model (2) is estimated using non-euro, non-TLTRO-I recipient banks. Model (3) tests the interaction of these two groups. The dependent variable is the log difference in outstanding loan volume (scaled by borrower total assets) that firm i receives from lender j from pre- (2014Q1) to post- (2015Q1) TLTRO-I announcement (2014Q2). Low Tier 1 equals 1 if a bank's 2014Q1 Tier 1 is in the bottom quartile. Firm Risk equals 1 if both the borrower's 2010-2014 ROA volatility is above sample median and 2012-2014 median interest coverage is below the sample median.All specifications are conditional on receiving loans from a lender in the pre-TLTRO period.

	TLTRO	Euro Non-TLTRO	Non-Euro Non-TLTRO
	(1)	(2)	(3)
ln(Tier 1) × Firm Risk	0.665***	0.048	-0.148
	(3.79)	(0.40)	(-0.42)
Firm FE	Yes	Yes	Yes
Bank FE	Yes	Yes	Yes
R^2	0.71	0.75	0.74
Observations	3776	2743	1192

t statistics in parentheses. Standard errors clustered at the bank level.
* $p < .10$, ** $p < .05$, *** $p < .01$

Table A2: Alternative Specification

Table A2 estimates the effect of TLTRO using an alternative specification. The unit of observation is a lead arranger - loan package and includes loans originated 6 quarters before and 6 quarters after TLTRO-I announcement in June 2014. The dependent variable are (1) the interest rate spread of the loan contract, (2) the natural log of the borrowers ROA volatility since 5 years prior to the loan contract, and (3) the firms leverage at the time of the loan contract, (4) The firm's interest coverage ratio at the time of the loan, and (5) the log of the interaction of borrowers ROA volatility and leverage. Only TLTRO-I recipient banks are included in the estimation. Low Tier 1 equals 1 if a bank's 2014Q1 Tier 1 is in the bottom quartile.

	(1) ln(Spread)	(2) ln(σ(ROA))	(3) Leverage	(4) IC	(5) ln(σ(ROA) $\times$ Lev.)
Low Tier 1 $\times$ Post	-0.092**	-0.063***	-0.020*	-0.102	-0.076**
	(-2.54)	(-2.93)	(-1.72)	(-0.32)	(-2.16)
Industry $\times$ Time FE	Yes	Yes	Yes	Yes	Yes
Borrower Country $\times$ Time FE	Yes	Yes	Yes	Yes	Yes
Bank FE	Yes	Yes	Yes	Yes	Yes
Bank Controls $\times$ Post	Yes	Yes	Yes	Yes	Yes
R^2	0.74	0.56	0.60	0.60	0.55
Observations	2447	4517	4576	4421	4459

t statistics in parentheses. Standard errors clustered at the bank level.

* $p < .10$, ** $p < .05$, *** $p < .01$

Table A3: SME Ex-Post Performance

Table A3 presents a placebo test of the effect of TLTRO-I on SME lending. Each observation is a bank loan. Delinquent is equal to one if the loan is in payment arrears. ln(Days Delinquent) is the log of the number of days the loan has been in payment arrears. Default is equal to 1 if the loan defaulted. Interest Rate is the current interest rate on the loan. Post is equal to 1 after June 2013, a year before the actual policy announcement. Low Tier 1 equals 1 if a bank's 2014Q1 Tier 1 is in the bottom quartile. The model is estimated over 2012M7 to 2014M6. Time FE correspond to the loan origination dates. Only TLTRO-I recipient banks are included in the estimation.

	(1) pr(Delinquent)	(2) ln(Days Delinquent)	(3) Deliquent Amt.	(4) pr(Default)
Low Tier 1 $\times$ Post	-0.011	-0.056	0.021	-0.005
	(-1.08)	(-1.49)	(1.54)	(-0.61)
ln(Loan Amt.)	-0.002***	-0.007**	-0.003	-0.001
	(-3.70)	(-2.68)	(-1.05)	(-0.81)
Bank FE	Yes	Yes	Yes	Yes
Industry $\times$ Time FE	Yes	Yes	Yes	Yes
Country $\times$ Time FE	Yes	Yes	Yes	Yes
Bank Controls	Yes	Yes	Yes	Yes
R^2	0.05	0.05	0.22	0.03
Observations	409264.00	409219.00	23997.00	409264.00

t statistics in parentheses. Standard errors clustered at the bank level.

* $p < .10$, ** $p < .05$, *** $p < .01$

B Bank Sample

Table A4: Bank Sample and Tier 1 Ratios

TLTRO-I Recipient	2014Q1 Tier 1 Ratio
ABN AMRO Group	14.99
AIB Group	14.31
ABANCA Corporacin Bancaria, SA	11.30
BNP Paribas SA	12.04
BPER Banca S.p.A.	9.247
Banca Monte dei Paschi di Siena S.p.A.	11.44
Banco Popolare	10.10
Banco Bilbao Vizcaya Argentaria, S.A.	11.54
Banco Popular Espanol, S.A.	11.16
Banco Santander, S.A.	10.84
Banco de Sabadell, S.A.	11.08
Bank of Ireland	13.35
Bankia, S.A.	10.83
Bankinter, S.A.	12.00
Belfius Bank SA	15.36
CaixaBank, S.A.	12.25
Credit Agricole S.A.	11.30
Credit Mutuel Group	14.51
Erste Bank	12.50
HSBC Holdings plc	11.86
ING Bank N.V.	11.65
Ibercaja Banco, S.A.	10.07
Intesa Sanpaolo S.p.A.	12.46
KBC Bank NV	15.76
Kutxabank, S.A.	12.10
Liberbank, S.A.	11.02
Mediobanca Banca di Credito Finanziario S.p.A.	10.26
NIBC Bank N.V.	19.97
Raiffeisen Zentralbank AG	10.43
Societe Generale	13.47
UniCredit S.p.A.	10.18
Unione di Banche Italiane S.p.A.	12.23