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Can Central Banks Boost Corporate Investment:

Evidence from the ECB Liquidity Injections

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Abstract
Can monetary stimulus boost corporate investment? We answer this question by studying ECB's 2011-2012 Longer-Term Refinancing Operations (LTROs), which provided cheap funding to Eurozone banks. We find that, relative to their non-Eurozone counterparts, Eurozone firms invested more after the LTROs. However, riskier banks took more funds from the LTROs, and their uptake is negatively associated with their clients' investment. In other words, firms reduced investment when their banks took cheap LTRO funds from the ECB. Overall, our results highlight the difficulty of boosting investment by injecting liquidity into the banking system, especially with impaired bank balance sheets.

Resume
Kan virksomheders investeringer fremmes ved hjælp af monetære stimuli? Vi adresserer dette spørgsmål ved at undersøge ECB's Longer-Term Refinancing Operations (LTRO'erne) fra 2011/2012, der indebar billig finansiering for banker i eurozonen. Vi finder at virksomheder i eurozonen i forhold til deres modparter udenfor eurozonen investerede mere efter LTRO'erne. LTRO-finansieringen blev dog i høj grad brugt af risikobetonede banker, og deres optag af LTRO-midler er negativt associeret med deres kunders' investeringer. Det vil sige, at virksomheder reducerede deres investeringer såfremt deres bank benyttede den billige LTRO-finansiering fra ECB. Vores resultater tydeliggør vanskelighederne ved at fremme investeringer gennem tilførsel af likviditet til banksystemet, især med svækkede bank balancer.

Key words
Unconventional Monetary Policy, ECB Interventions; Corporate Policies; Real Economy.

JEL classification
G32; G38

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Abstract

Can monetary stimulus boost corporate investment? We answer this question by studying ECB's 2011-2012 Longer-Term Refinancing Operations (LTROs), which provided cheap funding to Eurozone banks. We find that, relative to their non-Eurozone counterparts, Eurozone firms invested more after the LTROs. However, riskier banks took more funds from the LTROs, and their uptake is negatively associated with their clients' investment. In other words, firms reduced investment when their banks took cheap LTRO funds from the ECB. Overall, our results highlight the difficulty of boosting investment by injecting liquidity into the banking system, especially with impaired bank balance sheets.

1. Introduction

Central banks all over the world have undertaken a series of both conventional and, more recently, unconventional monetary policy actions, such as injecting liquidity into the banking system since the 2008 credit crisis. These liquidity injections were of significant size and scope. Despite the overwhelming press coverage on central bank liquidity injections, the nascent literature on the topic has primarily focused on the impact of central banks' unconventional monetary policy on the banking sector and its related financial ramifications. However, the important question of whether these liquidity injections have indeed helped the real economy, as intended, remains unanswered. In this paper, we fill this gap in the literature by examining the impact of unconventional liquidity interventions on corporate policies, particularly those relating to investment and employment. Our research is of considerable importance even as many central banks around the world are actively intervening in markets in order to stimulate economic growth.

The Eurozone provides an ideal laboratory to study the impact of unconventional monetary policies due to its unique structure of a monetary union catering to diverse economies from the member states of the Eurosystem. Since 2010, several Eurozone countries experienced severe fiscal difficulties and financial problems. As a reaction to heightened sovereign default risk, the EU, the IMF, and the ECB engineered a series of interventions to improve market liquidity, real output, and employment. The largest of these interventions was the liquidity injected by the ECB into the commercial banks of Eurozone countries through two unconventional Longer-Term Refinancing Operations (LTROs) with a three-year maturity, implemented in December 2011 and February 2012, respectively.[1] However, the efficacy of these measures as prominent examples of unconventional monetary interventions remains hotly debated.

Theoretically, macro-liquidity injections do not always translate into *corporate* liquidity and investment (see, e.g., Christiano (1994)). First, bank lending to corporations may respond weakly to the unconventional liquidity interventions. This may be due to banks' precautionary motive to deleverage, particularly when banks hold large amounts of risky sovereign debt (Bocola (2016)), or their incentive to use lender-of-last-resort (LOLR) funding from central banks to take on even more sovereign risk rather than lending it to corporations. In addition, not only the size, but also the persistence of the intervention, i.e., banks' repayment policies with respect to these additional funds, are important factors for the impact on banks' lending policies. To that extent, the liquidity transmission mechanism

[1] Figure 1 provides a detailed timeline of the ECB's recent unconventional monetary policies, while the details of related ECB interventions are discussed in Appendix Note 1.

clearly depends upon bank risk characteristics. Second, unconventional liquidity interventions can also affect the real economy through corporations' own liquidity, financing, and investment policies. Unconventional monetary policies that aim at boosting bank liquidity may make corporations less concerned about future financing and, thereby, stimulating investment. However, corporations may also read the LTRO uptake of their banks as a signal of their quality, with more risk attributed to banks with a higher uptake. Since the corporations' future financing may be in jeopardy, they may borrow as much as possible and reduce their investments due to their concern about the possible lack of continuing financing from their respective banks. Thus, the extent to which macro-liquidity injections are converted into economic output also depends on corporate characteristics, such as reliance on debt financing from the banking sector, as well as economic conditions and fiscal policies, more generally. Overall, it is, thus, unclear whether we would necessarily observe a positive effect of liquidity injections on the real economy.[2]

We explicitly address this lacuna in the literature and investigate whether particular ECB liquidity injections indeed helped the real economy. Specifically, we examine the impact of macro-liquidity injections on corporate investment and employment policies in the context of the ECB's LTROs I and II as exogenous liquidity shocks in the Eurozone countries. Although prior studies show that *negative* credit supply shocks result in a reduction in corporate investment (e.g., Chava and Purnanandam (2011)), whether or not a *positive* credit supply shock can boost investment is a under-studied open question. Corporations do not base their investment decisions exclusively on their cost of funding; new investments tend to be driven by long-term plans.

We investigate investment and employment policies in a larger sample of Eurozone corporations around the LTRO implementation. We build a comprehensive dataset that combines monetary policy data from the ECB Statistical Data Warehouse, loan information on Eurozone lenders from the Thomson Reuters Loan Pricing Corporation (LPC) DealScan database, corporate fundamental data from Compustat Global and S&P Capital IQ, credit ratings on non-financial corporations from CreditPro® by S&P Capital IQ, credit default swaps (CDS) data from Markit, and relevant data from other sources. A unique feature of our research is that we capture the LTRO impact on corporate-specific policies, using both country- and bank-level LTRO uptake information.

Making use of these comprehensive data, we find that corporations in countries with a higher LTRO uptake experienced larger investment cuts, while there is no significant change

[2]There is a substantial degree of disagreement among business economists about the real effects of such liquidity injections. For example, the Spanish bank BBVA expresses a more optimistic view and argues that ECB liquidity injections could have boosted Eurozone GDP by between 0.3% and 0.5%.

in their wage payments (payments to employees). Furthermore, corporations associated with banks that had a higher LTRO uptake reduced their investment more than those associated with banks that had a lower LTRO uptake. However, a negative association between the LTRO uptake of banks and corporate investment does not necessarily imply a *causal* relationship. In order to directly address causality, we analyze the determinants of a bank's LTRO uptake and find evidence that LTRO uptake positively relates to bank risk, which is consistent with Drechsler, Drechsel, Marques-Ibanez, and Schnabl (2016). Consequently, we do find that the causal relationship between the LTRO uptake and corporate investment is weak when we account for relevant country, bank, and corporate characteristics, suggesting no causal relationship between the LTRO uptake and the decrease in corporate investment. In fact, we find in counterfactual analyses that the two three-year LTROs halted the deterioration in corporate investment; moreover, as evidenced by the fact that non-Eurozone corporations in Europe experienced even larger investment cuts, post-LTRO.

To better understand the counterintuitive result of lower investment associated with greater liquidity injection, we further explore whether the decrease in corporations' investments following LTRO liquidity injections relates to corporate, bank and/or country characteristics. First, we explore the exposure and response of corporations to the positive bank liquidity shocks, conditional on the riskiness of their respective bank lenders and home country. In this investigation, we find that corporations with a greater dependence on bank debt, and those with risky bank lenders, experienced greater decreases in their investment when their bank lenders had greater LTRO uptakes. These findings are consistent with the LTRO's role in the "revelation of bank quality" and underscore corporations' uncertainty about the real impact of these monetary policy measures. Second, we study the role of the persistence of LTRO interventions for their ultimate transmission to the corporate sector. A noteworthy feature of LTROs is that they allowed banks to repay the ECB's LTRO loans early, i.e., after just one year and, thus, well before the end of the three-year maturity. We find that the banks' holding period for the LTRO funds played a significant role in terms of the transmission of the liquidity to the corporate sector as the average corporation in countries where the banks retained the LTRO funds for a longer period did not decrease its investment. Meanwhile, we find the investment reduction associated with LTROs to be mainly driven by corporations in countries with intermediate levels of LTRO repayments. These findings reveal the interesting distributional effects of unconventional monetary policies, and cast doubt on the real beneficiaries of the liquidity injection, as the countries that were most affected by the Eurozone crisis did not experience an improvement in their respective investments.

Recent discussions of the impact of macroeconomic interventions in the face of anemic

economic growth, even after many years of monetary easing, have shifted the debate to the role of fiscal policies. Hence, we also investigate the role of fiscal policies for the effectiveness of the LTROs to investigate the effect of Eurozone-wide monetary policies, conditional on national policies. In a monetary union such as the Eurozone, individual governments can (and often do) undertake different fiscal actions, which are sometimes unrelated to ECB policies. Related to this discussion, we show that when individual national governments cut their corporate taxes or increased their public investments, the LTRO uptake of banks domiciled in those countries is associated with an increase in corporate investment therein. These findings demonstrate the importance of coordinated monetary and fiscal policies for corporate investment, as there are limits to the efficacy of monetary policies taken in isolation.

Existing studies of unconventional monetary policies are mostly in the U.S. setting (e.g., Berger and Roman (2016)). One related contemporaneous work examining the European setting is Acharya, Eisert, Eufinger, and Hirsch (2017). They find evidence of zombie lending by banks, following the announcement of Outright Monetary Transactions (OMT) in the summer of 2012. Our study is distinguished from theirs in that we focus on corporate policies, following the largest real liquidity injection, i.e., three-year LTRO liquidity injections, in which banks from Greece, Ireland, Italy, Portugal, and Spain (the GIIPS countries) and non-GIIPS countries voluntarily participated. We also explore the role of banks' early repayment decisions of their LTRO borrowing on the corporations' decisions, and find that ECB liquidity injections have been ineffective in boosting corporate investment. However, we do *not* argue for a causal relationship between the LTRO uptake of banks and the corporate investment of their clients. Instead, we find that the LTRO uptake amount significantly proxies for bank risk, particularly for non-GIIPS banks. We show in addition, based on a counterfactual analysis, that these liquidity injections may have halted economic deterioration in the Eurozone. Furthermore, we suggest that it is important to consider monetary policies in tandem with fiscal policies. Hence, our results are consistent with the signaling role of banks' LTRO uptake and their subsequent early repayment: Corporations may read their bank lenders' LTRO uptake and early repayment as a signal of their quality and adjust their investment policies accordingly, particularly in non-GIIPS countries. Our results also imply that unless a bank's balance sheet becomes healthy, the monetary policy transmission mechanism can be ineffective.

The rest of the paper proceeds as follows. We discuss the related literature in Section 2. Section 3 provides descriptive statistics for our data and specifies the empirical setting for our analysis. In section 4, we investigate the impact of macro-liquidity injections on corporate investment. In section 5, we examine the asymmetries in the LTRO impact across corporations and countries. Section 6 concludes.

2. Related Literature

A substantial body of literature has shown that negative credit supply shocks reduce corporate investment. Chava and Purnanandam (2011) show that U.S. corporate investments declined after the banks were negatively affected by the 1998 Russian default. Amiti and Weinstein (2017) show that supply-side financial shocks had a large impact on corporate investment. Chodorow-Reich (2014) shows that credit market disruptions in 2008/2009 caused a significant decrease in employment. Similarly, Cingano, Manaresi, and Sette (2016) show that the liquidity drought in the interbank market during the 2007 crisis caused a large investment decrease for Italian corporations, while Bottero, Lenzu, and Mezzanotti (2015) show that the investment and employment of small corporations in Italy were negatively affected by the credit crunch that followed the Greek crisis. De Marco (2017) shows that during the European Sovereign Debt Crisis, banks cut their credit supply to borrowers because of their own funding problems, and corporations subsequently decreased their investments. The effect of bank credit tightening during the Sovereign Debt Crisis on corporate investment is confirmed by Buca and Vermeulen (2017). However, there has been little prior research on whether a *positive* credit supply shock can boost corporate investment.[3]

Central banks play an active and prominent role in the financial markets, and their actions can profoundly affect corporate policies. Therefore, it is fundamentally important to understand the impact of monetary policy. Although there is substantial research on the conventional monetary policies of the U.S. Federal Reserve System (e.g., Gorton and Metrick (2013), and Romer and Romer (2013)), there is little research on unconventional monetary policies, particularly outside the U.S., and their impact on the real economy. After the global financial crisis and the great recession that ensued, fiscal and monetary interventions were first initiated by the U.S. government and the Federal Reserve System, leading to several studies examining U.S. data. In general, these studies find some evidence of increased risk-shifting by banks, relaxed corporate financing constraints, but an ineffective impact on households following the interventions. For example, Duchin and Sosyura (2015) and Berger and Roman (2016) focus on the Troubled Asset Relief Program (TARP) and find evidence of regulatory arbitrage by banks and a positive impact on "Main Street" after the program. Agarwal, Chomsisengphet, Mahoney, and Stroebel (2015) find that government interventions aimed at lowering banks' funding costs are ineffective in terms of stimulating household

[3]One exception is Kasahara, Sawada, and Suzuki (2016), who show that bank capital injections made by the Japanese government in March 1998/1999 had a negligible impact on the average investment rate of their borrowers. Bergman, Iyer, and Thakor (2017) find a positive effect of cash injection during the Farm Debt Crisis of the 1980s. Foley-Fisher, Ramcharan, and Yu (2016) find that non-financial corporations with a high reliance on longer-term debt increased their investments during the Maturity Extension Program (MEP).

borrowing and spending. Furthermore, the impact of the interventions on the real economy, e.g., corporate financing constraints and investment, may depend on the characteristics of the intervention. For example, Chakraborty, Goldstein, and MacKinlay (2017) find that the mortgage-backed security purchases (but not Treasury bond purchases) made by the Federal Reserve may crowd out banks' commercial lending and decrease corporate investment.

The ECB's introduction of unconventional monetary policies in Europe led to similar studies based on European data. Studies on European policies are particularly important, as Europe has a very different economic governance structure than the U.S., particularly with regard to economic affairs; this implies that the U.S. analysis may not apply in a straightforward way to Europe. The crucial difference lies with regard to the common monetary policy in the Eurozone, even when member countries follow independent fiscal policies. A number of the European studies focus on the sovereign bond market and banks' risk-taking after either the announcement or the actual implementation of unconventional monetary policies. Eser and Schwaab (2016) find that the SMP helped lower the yield spreads and yield volatilities of European sovereign bonds. Although Acharya, Imbierowicz, Steffen, and Teichmann (2017) do find some announcement effects, they note that it was the actual purchases and not the signaling of the policy that drove the bond yields lower. De Pooter, Martin, and Pruitt (2018) find consistent results demonstrating that the Securities Market Program (SMP) helped lower the sovereign bond liquidity premium. Garcia-de Andoain, Heider, Hoerova, and Manganelli (2016) find that ECB liquidity injections helped stabilize the overnight unsecured interbank market. Drechsler, Drechsel, Marques-Ibanez, and Schnabl (2016) find that banks with weaker capitalization borrowed from the ECB and posted riskier collateral to access ECB funding. Also, Acharya and Steffen (2015) document banks' "carry trade" behavior from 2007 to 2013 and attribute it to risk shifting and regulatory arbitrage motives. Acharya, Pierret, and Steffen (2017) find differing impacts of the LTROs and OMT on banks' risk-taking; whereas banks' holding of risky sovereign debt was increased by the LTROs, the OMT reduced sovereign risk and increased banks' debt holdings.

De Pooter, DeSimone, Martin, and Pruitt (2015) find SMP announcement effects but no actual purchase effect on bond yield spreads.[4] Pelizzon, Subrahmanyam, Tomio, and Uno (2016) find that a change in sovereign credit risk leads to a change in sovereign bond market liquidity, and that the ECB intervention weakened this adverse dynamic relationship and improved market liquidity. Krishnamurthy, Nagel, and Vissing-Jorgensen (2018) find that the SMP and the OMT on average, decreased yields across Italy, Spain and Portugal, while

[4]Trebesch and Zettelmeyer (2018) investigate the effects of ECB interventions on the Greek government bond market in mid-2010, and find that the bonds purchased by the ECB experienced a much steeper drop in their yields than did other bonds.

stock prices increased in both distressed and core countries, suggesting that these policies also had beneficial macro-spillovers.

In addition to the sovereign bond market and banks' risk-taking, an increasing number of papers focus on the impact of unconventional monetary policies on the actual users of capital, i.e., corporations, which are the focus of this study. Acharya, Eisert, Eufinger, and Hirsch (2017) show that banks increased their lending to corporations following the "whatever-it-takes" statement of ECB President, Mario Draghi, and the announcement of the OMT. Acharya, Eisert, Eufinger, and Hirsch (2018) show that the contraction in the loan supply from Eurozone periphery banks that arose during the financial crisis from 2006 to 2012 depressed investment, job creation, and sales among related European borrowers, concluding that borrowers saved more cash out of their free cash flows. Similarly, Chodorow-Reich (2014) documents the negative impact of bank lending frictions on employment outcomes. Acharya, Imbierowicz, Steffen, and Teichmann (2017) find that bank risk impairs the transmission of central bank liquidity to loan spreads, which negatively affects high-risk bank borrowers. In contrast, we emphasize the role of bank risk in determining banks' LTRO uptake and corporate investment. In addition, a few recent country-specific papers have shown that unconventional monetary policies by the ECB can indeed have a positive, moderately sized effect on the supply of bank credit to corporations (see, e.g., Carpinelli and Crosignani (2017), Garcia-Posada and Marchetti (2016), and Andrade, Cahn, Fraisse, and Mésonnier (2018)).

Another related strand of the literature tackles the general determinants of corporate investment, including corporate taxation and other factors. Graham, Leary, and Roberts (2014) study U.S. data and find that government fiscal activities can affect corporate financial and investment policies. Kydland and Zarazaga (2016) show that concerns about higher taxes caused by fiscal challenges depressed investments and slowed the recovery in the U.S. In this paper, we provide additional insights regarding corporations' adjustment of their investments in response to macro-liquidity injections in terms of both the announcement and the excess inflow of liquidity to their lenders through an increase in (cheaper) external funding from central banks. In the following sections, we empirically examine the impact of macro-liquidity injections on corporate policies in the context of the ECB's LTRO interventions.

3. Data and Methodology

3.1 Data

We collect data from several databases that contain European data ranging from the 2002 adoption of the euro to 2014, thereby allowing us to look at differences in corporate policies

during both normal and distressed periods, along with periods characterized by ECB interventions.[5] We use data on corporate fundamentals from the Compustat Global database.[6] From this source, we identify a sample of European corporations and collect all yearly and quarterly corporate financial and stock price data for the period from 2002 to 2014. Since financial and utility corporations often have capital structures that are quite different from the average corporation, we follow the literature and exclude financial corporations (SIC codes 6000 to 6999), utility corporations (SIC codes 4900 to 4999) and corporations for which no SIC code is available. Furthermore, because we are interested in only active corporations, we follow Bates, Kahle, and Stulz (2009) and require corporations to have *both* a non-negative asset value and non-negative sales to be included in a given year (quarter). We supplement the data from Compustat with corporate data from the Capital IQ database. Capital IQ compiles, inter alia, detailed information on corporate debt structure using financial footnotes contained in corporations' financial reports. Finally, we use CreditPro® (S&P Capital IQ) rating data as a proxy for corporate credit risk so that we can estimate the impact of the ECB's extraordinary liquidity injection, after controlling for such risk.[7] In addition to the corporate data, we also collect country- and industry-specific data from several other sources, including five-year sovereign CDS spreads from Markit, and measures of a country's overall exposure to other countries' economic conditions from the World Bank.

To analyze the impact of the liquidity interventions made by the ECB, we restrict our main sample to corporations located in the Eurozone. This sample includes all corporations located in countries that belong to the Eurosystem (i.e., the Eurozone), and which thereby were directly affected by the ECB's liquidity interventions. To exclude any potential biases or country-specific reasons for the later adoption of the euro by some countries, we include only corporations from those countries that adopted the euro as a common currency in 1999, and joined the European Monetary System at the time of its inception in January 2001. However, we collect similar data for both Eurozone and non-Eurozone corporations, and use the latter as a control group for some of our subsequent analyses.[8]

To address the impact of liquidity intervention on corporate policies, we use the ECB's implementation of its unconventional three-year LTROs. These operations were announced

[5] We restrict ourselves to the period after 2002 to ensure alignment with the establishment of the Eurozone.

[6] The advantage of using data from Compustat rather than, for instance, Amadeus, is that we have quarterly rather than only annual data, which allows for greater granularity in our analysis.

[7] To mitigate the effect of outliers, we winsorize the observations for our variables at the 1^{st} and 99^{th} percentiles. Furthermore, we follow the approach in related empirical research and assume that a corporation has no R&D expenditure (or M&A activities), if it is reported as "missing" by Compustat.

[8] Eurozone countries that are excluded from the analysis are Slovenia (joined in 2007), Cyprus and Malta (joined in 2008), Slovakia (joined in 2009), Estonia (joined in 2011), Latvia and Lithuania (joined in 2015), Poland and the Czech Republic (current applicants), and Luxembourg (missing data). The Non-Eurozone sample includes EU corporations located outside the Eurozone. For details, see Appendix Table A1.

in early December 2011, and were implemented on December 21, 2011 (LTRO I) and February 29, 2012 (LTRO II).[9] In general, as indicated by the steep increase in the amount of outstanding LTRO as presented in Appendix Figure A1, the interventions overall turned out to be of significant size. Since we are particularly interested in whether and how much of the ECB's liquidity injections flowed to individual banks, we make use of both country-specific aggregate information on the Eurozone banks' uptake of LTRO I and LTRO II, and bank-level uptake information that is hand-collected from Bloomberg.[10]

Table 1 outlines these LTRO uptake numbers within the Eurozone, sorted by country.[11] As shown in the table, banks from the periphery countries were highly active because of their actual capital needs, as the LTRO was their only option for accessing medium-term funding. However, for many banks, participation in the unconventional LTROs also provided them with an opportunity to replace their shorter-term borrowing with low-cost three-year borrowing (FitchRatings (2012)). Therefore, banks in even highly rated and safe Eurozone countries such as Germany and France participated in the three-year LTRO. In addition, as Table 1 indicates, the participation in, and the uptake from, the two LTROs were quite similar (both at the aggregate and country levels). The aggregate uptake was approximately 918 billion Euro, with Italian and Spanish banks being, by far, the most active in their participation in terms of both the number of participating banks and the amounts borrowed. Together, banks in these two countries had an uptake of approximately 68% of the aggregate uptake. In terms of the significance of the ECB liquidity intervention, we can see from the ratio of the total LTRO uptake to central government debt in the country that the liquidity injection was greatest for countries in the Eurozone periphery, i.e., GIIPS countries. Furthermore, we also see that banks in the GIIPS countries had the highest LTRO borrowings (scaled by the banks' total assets), and that the bank-specific uptake was very similar across the periphery countries. We supplement these intervention-specific data with other Eurozone-wide data that are obtained from National Central Bank (NCB) reports from members of the Eurosystem and the ECB Statistical Data Warehouse, where all published reports and historical data are stored on a monthly or weekly basis, depending on the source.[12]

[9] For details of various unconventional programs of ECB, please see Appendix Note 1.

[10] We thank Matteo Crosignani for kindly sharing the bank-level LTRO data that he obtained from Bloomberg.

[11] Appendix Figure A2 provides a graphical presentation of these numbers. It should be noted that although the ECB liquidity injection was available only to Eurozone banks, approximately 5% of the total uptake involved non-Eurozone banks that participated through their subsidiaries situated in the Eurozone.

[12] Source: `https://sdw.ecb.europa.eu/home.do` and `http://www.ecb.europa.eu/stats/monetary/res/html/index.en.html`. Note that the ECB does not provide data regarding its intervention programs.

3.2 Empirical Design

With regard to our investigation of the impact of unconventional LTROs on the real economy, we focus on corporate investment and wage policies. As a proxy for corporations' investments, *Investments*, we follow the literature and use the ratio of capital expenditure to total assets. As shown in Table 2, Panel A, the average corporation in our main sample uses 3.12% of its total assets on investment in each quarter. As a proxy for employment compensation, we use *Wages*, which represents the corporations' total salaries and wages, expressed in logarithms. We relate corporate investment and wages to a set of explanatory variables and other controls, including both firm- and time-fixed effects. Our main controls in the investment and employment compensation model specifications are *Cash Flow*, *Market to Book*, *Firm Size*, *Leverage* and *Rated*. *Cash Flow* is the ratio of cash flow to total assets, where cash flow is defined as the earnings after interest and related expenses, income taxes, and dividends. *Market to Book* is the book value of assets minus the book value of equity plus the market value of equity, divided by the book value of assets. *Firm Size* is the logarithm of total assets. *Leverage* is measured as the book value of the long-term debt plus debt in current liabilities, divided by total assets. Finally, *Rated* is a dummy variable that is equal to one if the corporation is rated, and zero otherwise. Since investment and employment may also be determined by the lagged ratios of alternative investment measures, e.g., R&D and acquisitions, along with profitability and the degree of competition in the respective industry, we also use these controls in extended specifications.

To capture the liquidity injection impact of the three-year LTROs, we use the measures *Country LTRO Uptake* and *Lender LTRO Uptake*. *Country LTRO Uptake* measures the differences between countries in terms of participation in the three-year LTROs by reflecting the country-specific uptake of liquidity. In particular, *Country LTRO Uptake* is equal to zero until the first unconventional LTRO, Q4-2011, and equals the amount of each country's total uptake through LTRO I and II, i.e., the sum of banks' LTRO uptake in the respective country, scaled by each country's central government debt holdings in the year 2011. Thus,

$$\text{Country LTRO Uptake}_{\,t,\,c} = \frac{\text{Total Country LTRO Uptake}_{\,t,\,c}}{\text{Central Government Debt}_{\,2011,\,c}} \tag{1}$$

where t indicates the year-quarter and c refers to the country. Hence, this variable measures the country-specific significance of how the unconventional monetary policy implemented by the ECB differentiates between countries that had a high or low uptake. Accordingly, we expect corporations located in countries that received relatively high liquidity injections to have been more heavily affected and to show a stronger reaction in their investment policies.[13]

[13] In robustness tests, we use the ratio of the country-specific LTRO uptake to the country's GDP as a

To provide a deeper investigation of the corporate-level impact of the LTRO uptake by Eurozone banks, we also investigate the lending relationships to banks that participated in the LTROs, *LTRO-bank*, of our corporations in the main sample. To obtain information on each corporation's LTRO-bank relation, we collect syndicated loan information from the LPC Dealscan database and create a subsample of corporations from our main sample with lender and loan information. In particular, we match the information on LTRO-banks with the lender-share and loan-facility data in LPC DealScan.[14] By using the loan-facility data, we specifically also match the LTRO-banks (as lenders) with a subsample of the Eurozone corporations (as borrowers) and, thus, identify whether those corporations have a relationship with a LTRO-bank. Using this procedure, we match 953 corporations, 476 of which have an LTRO-bank relationship. Table 2, Panel B, shows the summary statistics and confirms that there is no major sample bias induced by our procedure for identifying loan relationships.[15]

To explicitly study the impact of corporations' access to LTRO funds, we define a corporate-specific LTRO exposure measure, *Lender LTRO Uptake*, based upon the hand-collected bank-level uptake from Bloomberg. Similar to the *Country LTRO Uptake* measure, *Lender LTRO Uptake* is equal to zero, until the first round of the unconventional LTROs, Q4-2011. However, thereafter, it equals the average LTRO borrowing amount of related banks (LTRO I and LTRO II), scaled by the size of each related bank, i.e., total assets, as of 2011. The measure is determined as

$$\text{Lender LTRO Uptake}_{\,t,\,i} = \sum_{j=1}^{N_i} \left(\frac{\text{Bank LTRO Borrowing}_{\,t,\,j}}{\text{Bank Size}_{\,2011,\,j}} \right) / N_i \tag{2}$$

where t indicates the year-quarter, i refers to the corporation, j refers to a related bank and N_i refers to the total number of LTRO-bank relationships the corporation has. A high value of *Lender LTRO Uptake* implies that the LTRO borrowing of banks with which the corporation has an existing lending relationship, compared to the size of the related banks on average, was significant which, all else being equal, makes it more likely that the corporation had access to (and obtained) additional funds stemming from the LTRO liquidity injections. Thus, compared to *Country LTRO Uptake*, *Lender LTRO Uptake* proxies for the corporate-level access to the unconventional LTRO funds, but is only available for the subsample of corporations for which we also have loan-level information.

Since this paper is based upon Eurozone corporations and provides a cross-country study, we also include the natural logarithm of sovereign CDS spreads, *Sovereign Risk*, and the

proxy for the size of each country's economy. Our main results are robust to this alternative specification.

[14] Based upon our sample of LTRO-banks, we identify 89 banks as lenders with syndicated loans covered in LPC Dealscan. We match Dealscan borrowers with Compustat corporations by using the link provided by Chava and Roberts (2008), and by hand-matching corporations by name and country of origin.

[15] There is a minor sample bias in terms of corporate size because LPC Dealscan provides loan pricing information on syndicated loans, which are typically made to larger corporations.

countries' ratios of exports to GDP, *Sovereign Export*, in our model specifications, to control for sovereign credit risk and the diversification of the economy across markets. As outlined in Table 2, Panel C, the median CDS spread over the sample period within the Eurozone is approximately 17.62 bps. The sovereign CDS spread variable shows a large degree of cross-country and time-series variation, which implies that this is an suitable proxy for our study of unconventional monetary policies within the Eurozone. Likewise, we find a large variation in the countries' dependence on exports.[16]

In section 4, we analyze the impact of the *Country LTRO Uptake* and *Lender LTRO Uptake* measure on corporate investment and employment compensation. As the transmission of the LTRO liquidity injection by the ECB occurred through the banking sector, and banks' incentives for participating in the LTRO programs are important to understand the transmission efficiency, we also analyze the determinants of banks' usage of LTRO funds. To this end, we also collect bank-level data from Bankscope and Markit and investigate the role of bank, country and borrower characteristics *prior* to the LTRO implementation for banks' borrowings through LTRO I and LTRO II. In section 5, we further investigate the impact of the granularity of the LTROs on corporations' investments. We start from the corporations' reliance on bank debt, and investigate the role of this reliance in determining the impact of the country, as well as lender-specific LTRO uptake measures. Next, we investigate the effect of lender and country characteristics, such as the average risk and size of the corporations' lenders, as well as the role of the banks' overall policies on the repayments of the LTRO and (local) fiscal policies.[17]

4. Central Bank Liquidity Injections and Corporate Policies

In this section, we investigate the impact of the unconventional liquidity intervention on the real economy. We focus on the effect of the three-year LTROs implemented by the ECB on corporate investment and employment compensation. We first use the non-Eurozone corporations as the counterfactual, and compare corporate policies of Eurozone and non-Eurozon firms following the liquidity injections. We then restrict our analysis in the sample of firms within Eurozone and among LTRO qualified banks/firms. We further investigate the determinants of bank LTRO uptakes and discuss their implications for the real economy.

[16]Appendix Table A3 provides summary statistics for the non-Eurozone sample, and shows no general differences between Eurozone and non-Eurozone corporations, except for lower sovereign CDS spreads.

[17]Descriptions of all variables presented in this section can be found in Appendix Table A2.

4.1 Counterfactual Analysis: Eurozone versus Non-Eurozone Countries

We use non-Eurozone corporations as the benchmark to compare corporate investment and employment with and without the influence of the LTRO liquidity injections. Although using non-Eurozone corporations as the benchmark may be challenged based on other fundamental differences between Eurozone and non-Eurozone economies in Europe, the comparison can be considered as a rough "counterfactual analysis" investigating the impact of the ECB's three-year LTROs.

In Figure 2, we first plot the change in corporate investment around the LTRO interventions for Eurozone and non-Eurozone corporations. Before the LTRO implementation, Eurozone and non-Eurozone corporations generally showed similar trends in their investments, with a slightly greater decrease in investment for Eurozone corporations. However, after the LTRO implementation, Eurozone corporations sustain their investments better than non-Eurozone corporations, particularly during the first year after the LTRO liquidity injections. This finding provides some preliminary evidence that the three-year LTROs may have halted the deterioration in Eurozone corporations' investments.

We then investigate corporate investment and employment policies after the LTRO intervention occurred in a sample of corporations located in the EU, with non-Eurozone corporations used as the control group for the LTRO effects. Whereas banks in the Eurozone countries may have had access to LTRO liquidity injections during the two rounds of unconventional LTROs, non-Eurozone countries did not have such access.[18] To account for major differences in economic conditions across countries and the corresponding deferred impact, we also match the EU sample countries based upon their sovereign risk when investigating the impact of the LTROs. In particular, we measure country risk using the countries' CDS spreads two years before the LTRO intervention. *Risky* (*Safe*) *Sovereign* is defined as a CDS spread above (below) the median in the pre-intervention and crisis periods (2009 and 2010).

The results are presented in Table 3. In Model (1) of Panels A and B, we use the full sample of corporations. The variable *Post-LTRO* is a time dummy variable equal to one, for year-quarter observations occurring after the ECB had implemented the first three-year LTRO intervention (Q4-2011), and indicates the timing of the LTRO intervention. The variable *Non-Eurozone* is a dummy equal to one, for corporations located in countries that do not belong to the Eurozone. The variable of interest in this counterfactual analysis is *Post-LTRO* $\times$ *Non-Eurozone*, which is the interaction term between the LTRO intervention and

[18] This is valid with the exception of non-Eurozone banks with bank subsidiaries located in the Eurozone. Additionally, we do not account for other stimulus measures that may have been implemented in the non-Eurozone countries during the same period, which would be biased against our finding a positive impact of the LTROs in the Eurozone countries relative to the non-Eurozone countries.

non-Eurozone dummies. The variable equals one, for non-Eurozone corporations in year-quarters following the first LTRO intervention, which captures the effect of the liquidity intervention on corporate policies in non-LTRO countries (the "counterfactual" effect). We find a negative and significant coefficient of the term *Post-LTRO* × *Non-Eurozone* for both the investment and wage analyses. This finding suggests that non-Eurozone corporations may not only have had less access to a substantial financing source, but may also have experienced an even greater decrease in investment than corporations in the Eurozone.

In Models (2) and (3) of Table 3, we further separate our sample of corporations in the EU into high and low sovereign-risk subsamples, based on the risk of the country in which a corporation is located. We then compare corporate policies during the post-LTRO intervention period for the high and low sovereign-risk groups. We find that non-Eurozone corporations in both the high- and low-risk groups experienced a greater decrease in their investments and wages following the unconventional LTROs than did Eurozone corporations. If one takes non-Eurozone corporations (or sovereign risk-matched non-Eurozone corporations) as the "counterfactual" of Eurozone corporations exposed to LTRO liquidity injections, the results in this section suggest that the LTROs helped Eurozone corporations sustain their investments better than corporations elsewhere in Europe at the onset of the European Sovereign Debt Crisis.

4.2 Investment and Employment Compensation of Eurozone Firms

Corporate access to debt markets has an impact on corporations' investments (Harford and Uysal (2014)), and financing frictions do affect investment decisions (Almeida and Campello (2007)). Thus, the availability of debt financing after the LTRO intervention, and the resulting credit supply shock, may have affected corporations' investment policies, such as capital expenditures. Likewise, we expect that the increased availability of debt financing may have increased employment compensation. Both a positive effect on investment and increased employment compensation would suggest that the LTRO intervention had an ameliorating impact on the real economy. However, corporations may have had a precautionary demand for liquidity because of their own concern about future access to financing. They may have borrowed as much as possible and many even decrease their investments due to concerns about the lack of continued future funding from their banks. If LTRO uptakes were viewed as a signal of bank risk/future liquidity risk, corporations may have even decreased their investments, even when their current access to financing was good.

4.2.1 Country LTRO Uptake and Corporate Investment

To investigate whether the LTRO intervention had an impact on corporate investment and employment decisions, we next present the results of our investigation of proxies for corporate investment and employment compensation. The analysis is conducted based on the sample of all corporations in the Eurozone, and the results are presented in Table 4. We first discuss the results in the models when using *Country LTRO Uptake* as the variable of interest. In Model (1), we use the ratio of capital expenditure to total assets as our proxy for corporate investment. We add only controls that affect the corporate capital expenditure decision. Since investments and employment may also be determined by the lagged ratios of alternative investment measures, e.g., R&D and acquisitions, along with profitability and the degree of competition in the considered industry (see, e.g., Almeida and Campello (2007) and Duchin, Ozbas, and Sensoy (2010)), we use these controls for robustness checks and present the results in Appendix Table A4. As both tables show, after controlling for corporate fundamentals, we find a negative and significant coefficient of the country-specific LTRO uptake measure, which indicates that corporations located in countries with a high uptake of additional liquidity in the banking sector reduced investments following the LTRO intervention; on average, they decreased their investments by 0.32% following the LTRO intervention.[19]

In Model (3) of Table 4, we provide the same analysis for corporate employment compensation. Recall that, as a proxy for employment compensation, we use corporations' total expenses related to wages (on a logarithmic scale). In this case, we do not find a significant effect for the LTRO uptake measure. Therefore, similar to the case of corporate investment, corporate spending on employees was not positively (or negatively) affected by the introduction of the unconventional LTROs. Our tentative conclusion is that although corporations may have had access to more debt financing, they did not use the proceeds from the additional borrowing to invest in their businesses.

4.2.2 Lender LTRO Uptake and Corporate Investment

To further understand the transmission channel, we utilize detailed bank-firm relationship data (from LPC Dealscan) and bank-level LTRO uptake data (from the ECB) to measure the liquidity injection effects at the corporate level. The effectiveness of the liquidity transmission to the corporate sector largely depends on the response of, and the changes in, the lending behavior of banks that participated in the three-year LTROs. Corporations with a

[19]The country-specific LTRO uptake typically differs by 25%, implying that for such a difference, the investment difference is 25%*1.276%=0.32%.

relationship to a LTRO-bank should, all else being equal, be more affected by the ECB's LTRO intervention, if it indeed had a significant impact. On the one hand, a corporation's relationship to an LTRO bank establishes a direct link to the injected macro-liquidity. On the other hand, these corporations would also be more exposed to additional risk-taking by the LTRO banks and, thus, more concerned about their future financing.

In Table 4, Models (2) and (4), we provide an analysis of the impact of LTRO liquidity injections on corporate investment and employment compensation in the sample of corporations for which we have lender information from Dealscan. *Lender LTRO Uptake* provides a corporate-specific measure of their bank lenders' LTRO uptake. If LTROs are sufficiently effective, we expect that corporations that had an existing borrowing relationship with banks that obtained a significant amount of the LTRO funds are, in general, more likely to be positively affected by the LTRO credit supply shock. However, as shown in Table 4, rather than a positive impact, we find a *negative* and statistically significant coefficient of *Lender LTRO Uptake* for investment, whereas the coefficient of *Lender LTRO Uptake* is positive but statistically insignificant for wages. The results also suggest that the average corporation did not increase its investment, although, in relative terms it may have had direct access to the additional credit supply provided by the ECB.

4.2.3 Robustness with a Shorter Window

Our baseline analyses are conducted in the sample period from 2002, the date of adoption of the Euro, to 2014. However, there are a number of interventions during the pre-LTRO period. In this section, we use a shorter pre-LTRO window and a more balanced sample period from 2009 to 2014 to conduct the same analysis. The results are presented in Appendix Table A5. Models (1) and (2) show the results for corporate investment using the *Country LTRO Uptake* and *Lender LTRO Uptake* measures, respectively. Similar to the findings in the baseline sample, we find a significant negative coefficient of our LTRO measures. The results confirm that corporations decreased their investments after the LTRO liquidity injections, although the magnitudes of the coefficients are lower than the baseline results. In Models (3) and (4), we further conduct the analysis for wage payments. While we find some evidence of higher corporate wage payments after the LTROs, when using *Country LTRO Uptake*, the results are not significant when using *Lender LTRO Uptake* to capture the liquidity injection impact. Overall, the evidence in the restricted sample is consistent with the baseline case.

4.3 Determinants of LTRO Uptake

In this section, we analyze the determinants of banks' LTRO uptake to understand the negative investment results. The analysis is conducted on a sample of banks with borrowers located in the Eurozone. Specifically, we make use of loan data from SDC Dealscan and investigate all banks with lending relationships to the Eurozone corporations in our sample. Then, based upon hand-collected information on banks' participation in the LTRO interventions, we capture bank borrowing from the ECB's three-year LTROs using two measures: (1) an indicator variable that is equal to one if the bank participated in one of the LTROs, and (2) the natural logarithm of one plus the bank's total borrowing in billion Euros from LTRO I (Dec-2011) and II (Feb-2012).

Drechsler et al. (2016) find that weakly capitalized banks took out more lender-of-last-resort loans. Thus, we add measures for bank risk as determinants of the LTRO uptake. The variable *High Risk Bank* is equal to one, if at the end of 2010, a bank had a CDS spread above the median CDS spread and zero otherwise. In addition, we add *Bank Size*, which is the bank's total assets at the end of 2010, to capture the potential difference in accessing the liquidity injection because of the size effect. Larger banks may have had sufficient collateral to access the LTRO funds. Also, they may had have better access to liquidity injections because they were "too big to fail." Besides bank characteristics, we also add proxies for borrower risk and country risk, which may affect banks' access to, and usage of, LTRO funds. *Borrower Size* refers to the average size (measured by total assets as a natural logarithm) of the banks' borrowers at the end of 2010. Likewise, *Borrower Leverage*, *Borrower Short-term Debt*, and *Borrower Cash Flow* are the average leverage, short-term debt and cash flow of the banks' borrowers at the end of 2010. *Sovereign Risk* is the countries' CDS spread at end-2010, expressed as a natural logarithm.[20]

We implement our test in a regression framework and the results are presented in Table 5. Panel A focuses on the probability of a bank participating in LTRO liquidity interventions. Panel B reports the determinants of the amounts of the LTRO uptakes. The results indicate that risky banks (*High Risk Bank*) are more likely to borrow, and borrow a greater amount from the LTRO liquidity injections, relative to low risk banks. We also find that large banks access the LTRO injections that much more, which is consistent with our prediction. In addition, banks in riskier countries borrowed more from the LTROs. Compared to bank and country risk measures, the characteristics of the borrowing corporations are less significant

[20]We collect the bank-level measures from Bankscope as well as Markit, while the borrower-related data are based upon the information in our main sample (for details, see Section 3). After combining all the bank-specific data, we end up with 185 banks with all available information to provide us with a balanced dataset.

in determining the banks' LTRO borrowing probability and the uptake amount. In Table 5, when we further separate banks into GIIPS and non-GIIPS banks, the implications are generally similar. Interestingly, we find that for non-GIIPS banks, bank risk significantly increases the probability of participating in LTRO liquidity injections as well as the amount of LTRO uptake. Overall, we find evidence that banks' participation in LTRO and their LTRO uptake amounts positively relate to bank risk and country risk. This is consistent with the explanation for the decrease in investment following an LTRO, i.e., that corporations took the LTRO uptake as a signal of risk and, consequently, decreased their investments. We further explore the role of bank and country risk in explaining the decrease in corporate investment in Section 5.

4.4 LTRO Residual Effect on Investment

A negative relationship between a banks' LTRO uptake and the corporate investment of its corporate borrowers does not necessarily imply a causal relationship. There might be observed and unobserved omitted variables that affect both a bank's LTRO uptake decision and its corporate investment. For example, from previous analyses, we do find evidence that bank risk and country risk positively relate to bank LTRO uptake. In this subsection, we conduct additional analyses to better understand this causal relationship between a bank's LTRO uptake and the corporate investment of its borrowers.

In an ideal setting, to establish a causal relationship, we would need to identify a shock or an instrument that affects a bank's LTRO uptake decision, but not its corporate borrowers' investment or employment policies. While this is challenging, we alternatively utilize the determinants of the LTRO uptake results, and use the *Lender LTRO Residual* to capture the LTRO impact and isolate the effects due to of bank, country, and corporate characteristics. Specifically, *Lender LTRO Residual* is zero until Q4-2011, and equal to the average bank-specific LTRO residual value obtained from the determinants of the LTRO uptake model of the corporation's related banks, Model (3) of Panel B in Table 5, thereafter. Then, we investigate the impact of *Lender LTRO Residual* on the investment and wage payment decisions. These results are presented in Table 6. We find some evidence that *Lender LTRO Residual* decreased investment, but this is which is only marginally significant at the 10% level, while the impact on wage payments is not significant. Therefore, the results suggest that the causal relationship between the LTRO liquidity injections and corporate investment is weak. Instead, other factors such as bank risk and country risk may explain both the LTRO uptake decision and the decrease in corporate investment, which we explore further in Section 5.

5. The Granularity of the LTRO Impact on Investment

Our previous evidence suggests that the unconventional ECB liquidity injections were not sufficient to boost corporate investment, but, as a lower bound, these injections may have halted the decline in investment. In this section, we further understand the decrease in investment and investigate the asymmetries in the impact of the LTRO, particularly the setting in which the two LTROs may have stimulated corporate investment. Corporations may have different reactions to the liquidity injection because of corporation-specific, bank-specific, or local country characteristics. In particular, we explore corporations' exposure to the LTRO liquidity shocks to understand the potential of the LTROs for boosting corporate investment. Then, conditional on corporations' access to the LTRO funding, we study the role of bank risk and country risk, which are significant determinants of the bank LTRO uptake as discussed earlier, in shaping corporate investment following the LTROs. Finally, to understand the role of the persistence and strength of liquidity interventions, we also investigate whether the effect of the LTRO intervention varies across banks' LTRO repayment choices and local fiscal policies.[21]

5.1 The Impact of Bank Debt Reliance

The LTRO liquidity injections are conducted through the banking sector, since the expected transmission channel to the real economy is through bank lending. Corporations with greater dependence on bank debt financing are exposed more to, and may benefit more from, these liquidity injections, which may further stimulate corporate investment. However, corporations may view their lenders' LTRO uptake as a signal of bank risk and future financing uncertainty. Corporations may, therefore, borrow as much as possible and even decrease investment because of their own precautionary demand for liquidity, particularly for those with a greater dependence on bank debt.[22]

To test this prediction, we construct a proxy for bank debt dependence based on Capital IQ data. Specifically, we separate corporations into the subsamples *High Bank Debt* and *Low Bank Debt*, based upon their bank debt obligations (*Bank Debt*), one year before the first three-year LTRO intervention, i.e., Q4-2010. Next, we run the same subsample analysis for corporate investment. The results are presented in Table 7. In Models (1) and (2), we use the country-specific LTRO uptake measure, *Country LTRO Uptake*. We find negative

[21] In this section, we mainly focus on corporate investment. In general, similar to the baseline results, there is no significant change in wage payments following LTROs, conditional on various characteristics.

[22] In Appendix Table A6 and A7, we find evidence that Eurozone corporations, on average, increased leverage and cash holdings after the LTRO liquidity injections. In Appendix Note 2 we provide a detailed discussion of these related results and document that the macro-liquidity injections translate into corporate liquidity.

and significant coefficients for the LTRO uptake measure in both specifications, and the coefficients are quite similar in magnitude for high and low bank-reliant corporations suggesting that the country-based uptake did not have a differential impact for high versus low bank-reliant corporations. In Models (3) and (4), we use the corporate-specific LTRO uptake measure, *Lender LTRO Uptake*. We find a negative coefficient of *Lender LTRO Uptake* for the subsample of corporations with *High Bank Debt*, whereas the coefficient for corporations in the *Low Bank Debt* sample is insignificant. Thus, we find some evidence that corporations with a relatively high reliance on bank debt invest less if their lenders had a high LTRO uptake. This is in line with our previous analysis and conclusions.

Overall, the investment results, conditional on bank debt dependence, presented in this section provide additional evidence that the LTRO intervention did not boost the investment for the average corporate borrower. Instead, corporations with a greater dependence on bank debt and, thus, more exposed to the positive bank liquidity shock, exhibited greater decreases in their investment when their bank lenders had higher LTRO uptakes. In the next section, we explore the roles of bank risk and country risk in explaining the decrease in investment, following the LTRO liquidity injections and, given the corporations' access to the LTRO interventions.

5.2 Bank Risk, Country Risk, and LTRO Impact

The analysis of the determinants of a bank's LTRO uptake in section 4.2 suggests that bank and country risks are significantly and positively related to banks' usage of the ECB's liquidity injections. If bank and country risks are also negatively related to corporate investment, this may explain the decrease in corporate investment after the LTRO liquidity injections. Therefore, we may expect the decrease in investment to be more significant for corporations with risky lenders, and also those in risky countries. In addition, corporations may take the LTRO uptakes as signals of lenders' risks and future financing constraints and may, accordingly, respond by decreasing investment. The signaling role of LTRO uptakes may be more important for corporations with hitherto safe lenders and those in safe countries.

To investigate the roles of bank risk and country risk, we separate corporations into subsamples of *Risky Lender* and *Safe Lender*, based upon the average CDS Spread of their lenders, *Bank Risk*, one year before the first three-year LTRO intervention, i.e., Q4-2010. Then we conduct analyses of corporate investment in both subsamples. These results are presented in Models (1) and (2) of Table 8. In Panel A, we employ the country-specific *Country LTRO Uptake* measure, while Panel B focuses on the corporate-specific *Lender LTRO Uptake*. As outlined in the table, we find significant decreases in investment after the LTRO uptakes for both the *Risky Lender* and *Safe Lender* subsamples, with a greater

decrease for corporations with risky lenders.

To further explore the interaction of bank risk, country risk, and the LTRO impact, we first separate corporations into subsamples based on country risk, i.e., GIIPS and non-GIIPS. GIIPS countries are most affected by the Sovereign Debt Crisis and have a higher country risk, ex ante. The corporations in each subsample are further separated into groups based on their bank lenders' risk. The results are presented in Models (3) to (6) of Table 8. For corporations in GIIPS countries, we find evidence that corporations with risky lenders experienced a greater decrease in investment after the LTRO uptakes, while the change in investment is not significant for those with safe lenders. However, for corporations in non-GIIPS countries, we find a significant decrease in investment after LTRO for both the *Risky Lender* and *Safe Lender* subsamples. We also find that the decrease is greater for corporations with risky bank lenders, which outlines bank risk as the important measure explaining the decrease in investment after the LTRO uptake. Moreover, the LTRO uptake is not only related to previously known bank risk, but may also signal an incremental risk of those that were regarded hitherto as safe lenders. The significant decrease in investment for safe lenders in safe countries is consistent with the signaling role of the LTRO uptake, particularly, for non-GIIPS countries. Overall, the findings in this section confirm the role of bank risk in explaining the decrease in investment following the LTRO uptake, especially given corporations' access to the LTRO funding through their lending relationships.[23]

5.3 The Effect of Early Repayment of LTRO Funds

In terms of the transmission of LTRO liquidity to the corporate sector, the impact may vary across countries due to differences in the persistence of the LTRO liquidity shocks. While the LTROs provided a three-year funding opportunity for Eurozone banks, participating banks were given the option to repay, either in part or in full, the amount of their borrowings after one year, without any penalty in order to increase the attractiveness of the unconventional LTROs. Since banks are closely monitored by financial market participants, it is likely that LTRO-participating banks would have chosen to repay the three-year LTRO funds at the early opportunity, either to signal improvements in their individual funding conditions or because of their decreased funding needs during the process of balance sheet adjustment.[24]

To investigate the role of early repayment, we rely on the end-of-year country-level LTRO data reported by the NCBs to proxy for country-specific LTRO early repayments by banks. Specifically, we use the percentage changes in the country-level LTRO holdings between

[23] In Appendix Table A8, we investigate the role of lender size. We find evidence of a decrease in investment following the bank lenders' LTRO uptake for corporations with small lenders.

[24] See ECB Monthly Bulletin, February 2013.

2012 and 2013 as a proxy for early repayments of the three-year LTROs across countries (for details, see Appendix Table A9).[25] One interesting observation from this measure is that the bank repayments differ for non-GIIPS (core) and GIIPS (periphery) countries. In general, non-GIIPS countries had high LTRO repayment rates. At one extreme, German banks exhibited a 80% decrease in their reliance on LTRO funds from 2012 to 2013. Other non-GIIPS countries in our sample (i.e., Austria, the Netherlands, Belgium, and France) also showed a sharp decrease of approximately 64% in their balances of LTRO funding during this period. Among GIIPS countries, there are mixed patterns in the LTRO early repayment, with more modest amounts for banks in Portugal (13%), Italy (20%), and Greece (29%), and larger repayments of approximately 45% in Spain and Ireland. Based on our proxy for early LTRO repayments, we separate our sample of corporations into three groups: *Low Early LTRO Repayment* (Portugal and Italy)[26], *Medium Early LTRO Repayment* (Spain, Ireland, Austria, the Netherlands, Belgium, and France), and *High Early LTRO Repayment* (Germany). Next, we examine the impact of the LTRO intervention on corporate investment for the three different groups.

The results are presented in Table 9. As seen from the table, the impact of the LTRO intervention on corporate policies differs significantly across the early LTRO repayment groups. The decrease in investment is concentrated in corporations in countries with medium early repayment (Spain, Ireland, Austria, the Netherlands, Belgium, France in Panel B). For those in the low early repayment group (Portugal and Italy in Panel A), the change in investment is not significant. However, the German corporations in the high early repayment group (Panel C) *increased* their investments after their banks' LTRO uptake.

In columns (2) and (3) of Table 9, we further investigate whether the impact of the bank-level LTRO uptake and early repayments differ for large and small corporations, i.e., corporations that are relatively less versus more financially constrained. In general, small corporations rely more on bank debt financing, and have fewer capital market alternatives when their bank lenders are financially constrained. On the one hand, when the LTRO uptake improves the funding condition of banks and relaxes corporate financing constraints, small corporations may respond more positively to the LTRO intervention. On the other hand, when the LTRO uptake signals bank risk, small corporations may respond more negatively to their lenders' LTRO uptake. As seen from the table, we again find more negative results for investment for corporations in countries with medium early repayment. For the low early

[25]The NCBs' country-level LTRO data may contain LTROs with other maturities, i.e., three-month and one-year. However, most of the LTROs were of three-year maturity. As discussed in the 2013 annual report of the Bank of Spain, "Most of the decrease in this balance took place in January when institutions availed themselves of the early redemption option offered by three-year refinancing operations."

[26]Greece had low early repayment, but is not covered by the analysis due to missing bank LTRO data.

repayment group in Panel A, while large corporations decreased investment with the *Lender LTRO Uptake*, we observe a significant increase in investment for small corporations following the lenders' LTRO uptake. For the high early repayment group in Panel C, the increase in investment after the lenders' LTRO uptake mainly comes from small corporations.

To obtain a complete picture of the corporate policies following LTRO uptake and early repayment, we report the corresponding results for cash, leverage and wage payment policies in Appendix Table A10. For corporations in countries with relatively low early repayments (i.e., Portugal and Italy (Panel A)), we find that corporations increase their leverage and cash holdings with their lenders' LTRO uptake, which is consistent with the transmission of the LTRO funding to the corporate level, as well as precautionary demand for cash. However, there is no increase in leverage and cash for corporations in countries with medium and high early repayment (Panels B and C). These findings are also intuitive, since we expect a lower transmission of funds for high early repayers of LTRO funds. Overall, the results in this section suggests the role of transmission of LTRO funds to the corporate level for low early repayment banks. Apart from Germany, where corporations increased investment despite having experienced no significant increase in leverage, small corporations in Portugal and Italy did benefit from LTRO funding.

5.4 The Role of Fiscal Policy

Fiscal and monetary policies interact closely in reality, and these interactions can lead to very different outcomes than those predicted by the analysis of each policy in isolation (Dixit and Lambertini (2003)). Whereas the ECB has launched a plethora of expansionary monetary interventions since the onset of the European Sovereign Debt Crisis, many Eurozone member states implemented austerity plans to cut government spending, intending to reduce their fiscal deficits and sovereign debt. One feature of the Eurozone economies is that although the ECB determines the common monetary policy for all member countries, each member state's government decides its own fiscal policy. This feature limits the flexibility of economic policymaking and introduces greater complexity to overall economic policies, with attendant spillover effects on product supply and consumer demand in the Eurozone. In particular, fiscal policies that do not support the Eurosystem-wide monetary policy may offset the positive liquidity shock created by the ECB, because they may weaken the signaling effect by the banks, and potentially hurt the corporations even more. Therefore, we expect the decrease in investment to be more pronounced when there is a lack of coordination between monetary and fiscal policies, i.e., expansionary monetary policy through the LTROs, accompanied by a contractionary fiscal policy in a particular country. However, when there is closer coordination between monetary and fiscal policies, we expect to observe increased

corporate investment following the implementation of the ECB's unconventional monetary policy.

To investigate the role of fiscal policy, we analyze the impact of the country-level changes in corporate tax rates and government investment expenditures, as proxies for the country-specific fiscal policies. Accordingly, contractionary fiscal policies involve increasing corporate taxation, decreasing government spending (investment expenditures), or both. Specifically, we measure the changes in tax policy as the country-specific change in the corporate tax rate from one year before to one year after the first LTRO intervention, i.e., the change from Q4-2010 to Q4-2012. Next, we classify corporations into subsamples based on whether their local national government increased, maintained or decreased its corporate tax rate, and conduct our investment analysis within the subsamples of corporations located in *Increased Corporate Tax*, *Unchanged Corporate Tax* and *Decreased Corporate Tax* countries, respectively.[27]

To account for governments' spending policies, we again use the country-specific change in the government investment expenditures from one year before, to one year, after the first LTRO intervention, i.e., the change from Q4-2010 to Q4-2012. Specifically, we use the median of the ratio of the quarterly government investment expenditures to GDP for each year to classify corporations into subsamples based on whether their national government increased or decreased the amount of investment expenditures between Q4-2010 to Q4-2012. Next, we conduct our investment analysis within the subsamples of corporations located in *Increased Government Investment*, and *Decreased Government Investment* countries, respectively.

The results of our analysis of fiscal policies are presented in Table 10. In Panel A, the analysis is conducted in the baseline Eurozone sample, with *Country LTRO Uptake* as a proxy for monetary policy. As we can see from Models (1) and (5), we find significant negative coefficients for *Country LTRO Uptake* for corporations in countries that increased their corporate taxes or decreased government investments. These results indicate that in countries with relatively contractionary fiscal policies, corporations decreased their investments following the LTRO liquidity injection. Furthermore, for Models (3) and (4), we find some evidence that when governments adopted accommodative fiscal policies in the face of substantial monetary stimulus, corporations actually *increased* their investment along with their local banks' uptake of the LTRO liquidity injections.

In Panel B, we further investigate the interaction of monetary and fiscal policy in the bank-firm-linked sample, with *Lender LTRO Uptake* as a proxy for monetary policy. We again find some evidence that corporations in countries with accommodative fiscal policies

[27]During the period Q4-2010 to Q4-2012, France and Portugal increased, and Finland, the Netherlands and Greece decreased their nominal corporate tax rates. The remaining countries did not change their corporate tax rates.

increased or had a smaller decrease in investment following the LTRO liquidity injections. However, the results are not as robust as those for the full sample with the *Country LTRO Uptake* used as a proxy for monetary policy, which may indicate the differential impact of the signaling versus the transmission channels of monetary policy: ECB monetary policy can be transmitted as a positive signal to the corporate level *only* if the local government sends an accommodative signal at the same time. In contrast, the actual transmission effect may still be present, but to a much smaller degree, despite accommodative fiscal policies, so long as it is ensured that the corporations actually have access to the additional funds stemming from the ECB operations. Overall, the results in this section provide additional evidence of the potential for increased corporate investment in countries with coordinated monetary and fiscal policies.

6. Conclusions

In this paper we investigate whether, and how, corporate investment is affected by unconventional monetary interventions by analyzing the largest liquidity injections in history. Focusing on the ECB's three-year LTROs, we find that non-Eurozone firms which are not directly affected by LTROs reduced investments more than Eurozone firms. Such a counterfactual analysis suggests that LTROs helped Eurozone corporations to decelerate their investment decline. However, non-financial corporations in the Eurozone did not increase their investments after these massive liquidity injections. The investment of these corporations are negatively associated with the amount of funds their banks obtained from the ECB. Banks' LTRO uptake amounts are positively related to their own credit risk.

We further investigate the role of bank risk in explaining the decrease in corporate investment following the LTROs. We find that corporations with a greater exposure to bank debt and those with risky lenders exhibit greater decrease in investment following their lenders' LTRO uptakes. The results suggest that bank risk and the signaling role of the banks' LTRO uptake might have impeded the transformation of liquidity injection into real economic outputs. In addition, we find that the negative investment effect of the unconventional LTROs varies across LTRO repayment choices that relate to the persistence of the LTRO interventions. Smaller corporations whose lenders' held the LTRO funds for a longer period did increase investment following their lenders' LTRO uptake. Furthermore, we find that when governments adopted more accommodative fiscal policies at the same time, corporate investment increased in response to their lenders' LTRO uptakes.

While our results suggest that liquidity injections can decelerate economic decline, our study outlines the significance of bank and country characteristics that impede the effective-

ness of unconventional monetary policies in improving real economic output. When bank balance sheets are stressed, it would be difficult to stimulate corporate investment by just injecting liquidity into poorly capitalized banks. Fiscal policies and other unconventional monetary policies, including the more aggressive Targeted LTRO, may have resulted in different outcomes, but they too should be carefully discussed and analyzed. We leave these issues for future study once additional data become available.

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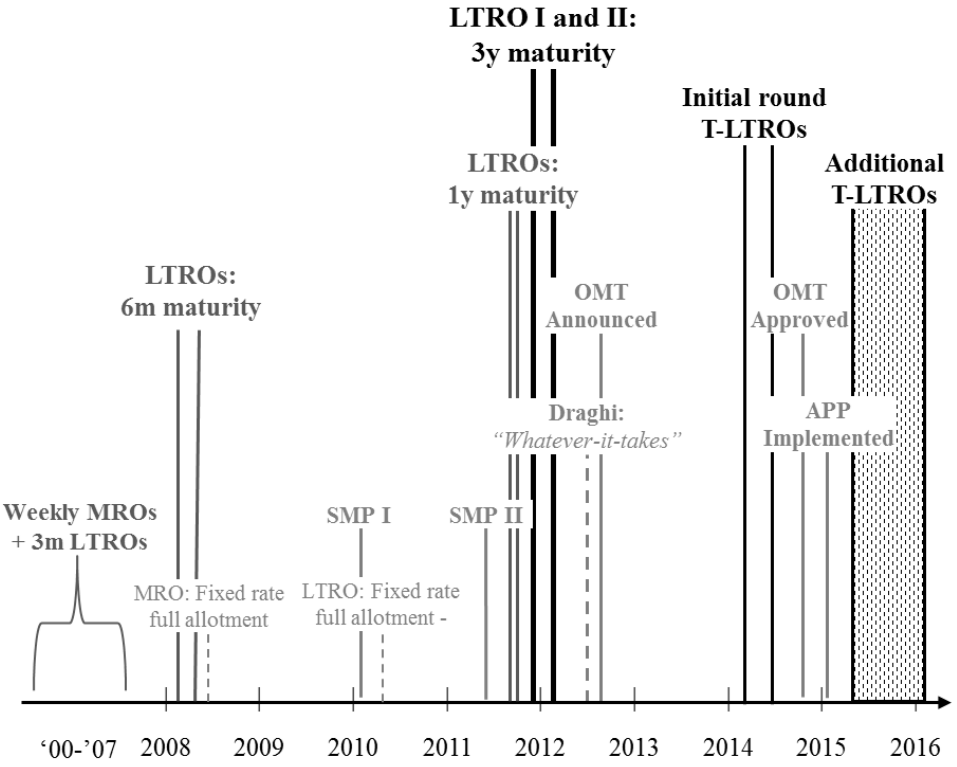

Figure 1
ECB's unconventional monetary policies

This figure outlines the timeline of recent unconventional monetary policies implemented by the European Central Bank (ECB). *MRO* labels the standard Marginal Refinancing Operations that are conducted on a weekly basis. *LTROs* refers to Longer-Term Refinancing Operations, while *TLTROs* refers to the recently introduced Targeted Longer-Term Refinancing Operations. *SMP*, the Securities Markets Program, was more recently replaced by the Outright Monetary Transactions (OMT) program. *APP* represents the most recently introduced Asset Purchase Program, that is still under way. The "*whatever-it-takes*" event refers to a speech made by Mario Draghi, the President of the ECB, at the Global Investment Conference, London, 26 July 2012.

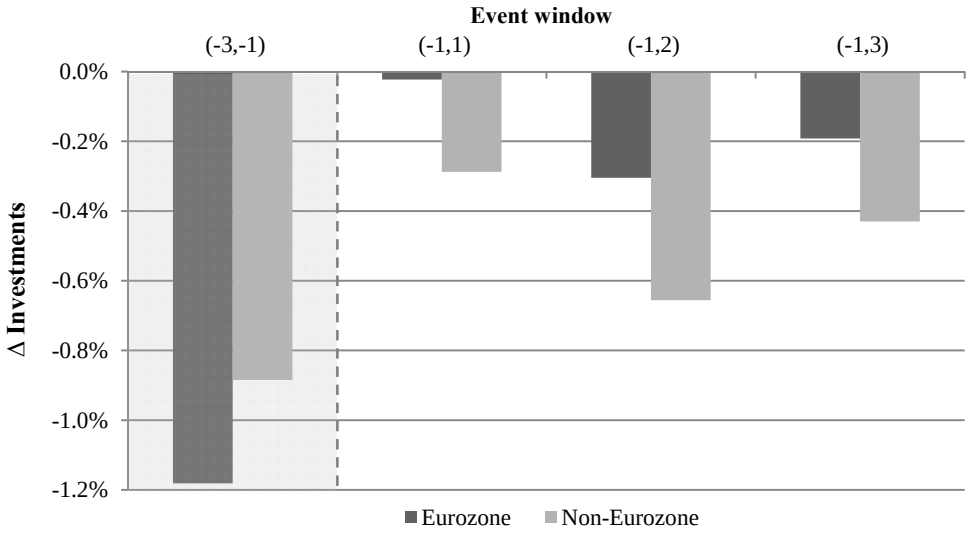

Figure 2
Time series of corporate investment before and after the LTRO intervention in Europe

This figure plots the changes in the investment ratios for Eurozone and non-Eurozone corporations, from before the financial crisis (Q2-2008) before the three-year LTRO interventions (Q2-2011), respectively from before (Q2-2011) to one (Q4-2012), two (Q4-2013) and three (Q4-2014) years after the three-year LTRO interventions. Specifically, the figure outlines the average of corporations' investment ratios. Our measure for corporate investment is *Investments*, which is the corporate capital expenditure, scaled by total assets. The overall sample of corporations is taken from Compustat Global and is restricted to EU countries. For details, please see Appendix Table A1.

Table 1
Liquidity injection from the ECB's three-year Longer-Term Refinancing Operations

	LTRO I: Dec-2011	LTRO II: Feb-2012	Total LTRO Borrowing	Country LTRO Uptake	Bank LTRO Uptake
	EUR bn	EUR bn	EUR bn	% of Gov. Debt	% of Bank Size
Country	(1)	(2)	(3)	(4)	(5)
Austria	3.66	7.83	11.49	4.82	7.10
Belgium	45.28	43.71	88.99	25.02	12.30
France	5.59	6.52	12.12	0.61	3.40
Germany	12.25	13.13	25.38	1.67	6.70
Greece	60.94 §	n.a.	60.94	25.54	n.a.
Ireland	21.91	17.62	39.52	22.33	11.50
Italy	172.08	128.11	300.20	15.92	13.40
Netherlands	8.86	1.96	10.81	2.58	9.80
Portugal	24.54	24.76	49.30	29.37	11.80
Spain	153.21	165.53	318.74	51.44	15.70
Total	508.32	409.17	917.49		

This table presents data on the liquidity injections that Eurozone countries obtained from the three-year Longer-Term Refinancing Operations (LTROs) initiated by the European Central Bank (ECB) on December 21, 2011 (LTRO I) and February 29, 2012 (LTRO II), respectively. *Totel LTRO Borrowing* refers to the total amount that banks in the respective country obtained through LTRO I and II, with the numbers given in billion EUR. In column 4, we scale the *Total LTRO Borrowing* for each country by the country's central government debt obligations, as of December 2011. In column 5, we report the average LTRO borrowing by banks, scaled by the banks' total assets in 2010, in the respective country. The information about the bank and country-specific LTRO uptake is based upon hand-collected data from Bloomberg, as well as central bank announcements and public commentaries. The data on banks' total assets are obtained from Bankscope and available public financial reports, while the information for government debt by country is obtained from the World Bank Database.
§In the case of Greece, we only have information about the total LTRO amount which, besides the three-year LTROs, also includes the standard one-month and three-month LTROs. As we cannot separate the latter, the number is not directly comparable to the uptake numbers for the other countries.

Table 2
Summary statistics

Panel A: Main sample

Country	DEU	FRA	ITA	GRC	NLD	FIN	ESP	BEL	AUT	IRL	PRT	Total
Investments	3.31	3.05	2.47	2.48	3.11	3.39	3.29	3.85	5.41	2.56	3.16	3.12
Wages	1.85	1.86	2.30	1.19	2.88	2.16	3.30	2.10	3.15	1.30	2.77	2.07
Cash	10.07	10.23	6.96	4.15	6.82	8.06	7.08	8.01	8.85	11.37	4.00	8.29
Leverage	16.40	19.06	27.63	33.97	22.80	23.86	28.33	22.42	22.35	21.28	40.2	22.07
Net Debt	55.58	59.01	64.26	60.54	58.65	57.39	63.95	56.70	55.96	55.04	73.59	59.01
Short-term Debt	0.05	0.06	0.11	0.16	0.05	0.07	0.08	0.05	0.08	0.03	0.14	0.07
Bank Debt	11.36	9.97	20.99	21.78	13.38	15.49	22.47	11.43	14.23	12.56	22.58	14.54
Firm Size	4.53	4.59	5.70	4.84	6.32	4.99	6.42	5.15	5.44	5.69	5.92	5.02
Market to Book	120.0	121.6	114.4	95.2	128.9	125.9	123.4	114.7	114.7	128.9	106.9	117.9
Cash Flow	4.84	3.57	3.07	1.62	5.80	7.21	5.89	4.81	5.36	2.90	2.96	4.10
Industry Sigma	7.61	5.69	3.20	3.07	5.53	4.43	2.59	4.48	3.30	4.55	2.97	4.85
Net Working Capital	6.17	1.90	0.85	5.11	2.13	3.75	-2.08	-0.58	3.38	0.55	-7.76	2.75
R&D/Sales	0.00	0.00	0.00	0.00	0.00	0.47	0.00	0.00	0.00	0.00	0.00	0.00
Acquisition Activity	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
# N	31333	30712	10825	9810	6594	6000	5443	4939	3376	2519	2392	113943
# Firms	837	837	285	233	190	143	136	124	92	75	57	3009

Panel B: Sample with existing loan information from LPC Dealscan

Country	DEU	FRA	ITA	GRC	NLD	FIN	ESP	BEL	AUT	IRL	PRT	Total
Investments	3.92	3.34	2.97	3.45	3.25	3.76	3.26	4.06	5.82	2.98	5.61	3.55
Wages	3.10	3.62	3.34	2.35	3.83	3.93	3.96	2.90	3.76	2.01	4.12	3.43
Cash	8.49	8.97	7.36	4.44	6.84	5.41	6.71	6.73	8.20	9.49	4.17	7.65
Leverage	22.0	24.3	30.3	42.6	25.1	27.8	32.6	26.8	26.4	30.2	39.0	26.5
Net Debt	60.7	63.4	69.2	66.4	62.0	60.1	66.9	61.4	55.4	62.5	72.5	62.9
Short-term Debt	0.05	0.05	0.10	0.15	0.04	0.08	0.08	0.05	0.08	0.03	0.08	0.06
Bank Debt	10.3	9.62	21.0	23.0	12.7	13.0	25.3	11.6	17.3	13.6	11.8	13.4
Firm Size	6.32	6.82	6.60	5.90	7.21	6.83	7.09	6.52	6.53	7.18	7.82	6.72
Market to Book	119	120	115	98.5	130	121	118	115	122	143	121	119
Cash Flow	4.93	4.07	3.71	2.12	5.74	6.77	6.08	5.17	5.71	3.12	5.94	4.72
Industry Sigma	6.43	5.04	3.01	2.75	4.50	4.07	2.53	4.76	3.30	2.80	2.78	4.44
Net Working Capital	5.93	-2.3	-0.4	0.43	1.72	3.64	-1.6	-2.6	8.06	0.36	-8.4	1.11
R&D/Sales	0.02	0.00	0.00	0.00	0.00	0.52	0.00	0.00	0.43	0.00	0.00	0.00
Acquisition Activity	0.00	0.00	0.00	0.00	0.21	0.03	0.00	0.00	0.00	0.00	0.00	0.00
# N	1076	1000	3700	2015	3816	2473	2993	2039	1084	1232	475	4059
# Firms	245	238	93	43	101	54	70	43	24	32	10	953
# LTRO-Bank Rel.	122	111	57	9	52	18	48	25	11	16	7	476

Panel C: Country-specific measures

Country	DEU	FRA	ITA	GRC	NLD	FIN	ESP	BEL	AUT	IRL	PRT	Total
Sovereign Risk	10.55	11.71	52.00	56.40	29.95	13.09	50.74	24.96	10.35	27.89	36.86	17.62
Sovereign Export	42.25	27.12	26.21	22.10	69.27	39.08	25.51	76.44	51.00	90.48	29.91	31.12
Corporate Tax	30.17	35.42	31.40	29.00	25.50	26.00	30.00	33.99	25.00	12.50	29.00	34.43
Gov. Investments	8.68	15.81	11.69	19.42	15.69	15.13	16.45	8.65	11.73	13.72	14.80	14.26
Gov. Debt	67.06	67.01	105.9	126.6	50.27	41.69	50.08	101.8	73.17	32.54	69.23	69.88

This table provides sample averages (medians) of corporate characteristics for each country in our samples of Eurozone corporations. Panel A outlines the summary statistics for the main data sample, while Panel B shows the summary statistics for the sample Eurozone corporations, for which we also have loan information from LPC Dealscan. In Panel C, we show summary statistics for country-specific measures used in our analysis. The sample period for each country is 2002-2014, and the variables are based on quarterly observations. For the specific definition of each variable we refer to Appendix Table A3. The corporate fundamental data are obtained from Compustat Global, while country-specific data are obtained from Markit, the World Bank, as well as the ECB Statistical Data Warehouse. For any data unavailable for a specific quarter, we replace the missing values with yearly observations. Ratios are given in percentages.

Table 3
Counterfactual analysis of the LTRO effect: Eurozone versus Non-Eurozone

Panel A: Investments

	Investments	Investments	
	Full sample	Risky Sovereign	Safe Sovereign
	(1)	(2)	(3)
Post-LTRO	-0.491***	-0.345*	-0.634***
	(0.09)	(0.19)	(0.10)
Post-LTRO × Non-Eurozone	-0.606***	-0.870***	-0.422***
	(0.05)	(0.13)	(0.06)
Cash Flow	0.002	0.012***	-0.002**
	(0.00)	(0.00)	(0.00)
Market to Book	0.004***	0.006***	0.003***
	(0.00)	(0.00)	(0.00)
Firm Size	0.086***	0.149***	0.065**
	(0.02)	(0.05)	(0.02)
Leverage	-0.013***	-0.019***	-0.008***
	(0.00)	(0.00)	(0.00)
Rated	0.070	0.203	0.042
	(0.11)	(0.26)	(0.12)
Country Controls	Y	Y	Y
Time FE	Y	Y	Y
Firm FE	Y	Y	Y
R-square	0.586	0.525	0.617
N	149798	37088	107834

Panel B: Employment

	Wages	Wages	
	Full sample	Risky Sovereign	Safe Sovereign
	(1)	(2)	(3)
Post-LTRO	-0.096**	-0.083	-0.063
	(0.04)	(0.05)	(0.06)
Post-LTRO × Non-Eurozone	-0.070***	-0.099***	-0.116***
	(0.02)	(0.03)	(0.03)
Cash Flow	-0.006***	-0.010***	-0.005***
	(0.00)	(0.00)	(0.00)
Market to Book	0.000***	0.000**	0.000***
	(0.00)	(0.00)	(0.00)
Firm Size	0.703***	0.736***	0.684***
	(0.01)	(0.02)	(0.01)
Leverage	-0.001**	-0.002**	-0.000
	(0.00)	(0.00)	(0.00)
Rated	0.157**	0.312***	0.100
	(0.06)	(0.07)	(0.07)
Country Controls	Y	Y	Y
Time FE	Y	Y	Y
Firm FE	Y	Y	Y
R-square	0.772	0.832	0.769
N	91049	19222	69184

This table presents estimates of the "counterfactual" effect of the liquidity uptake from the ECB's three-year Longer-Term Refinancing Operations (LTROs), on corporate policies, in a sample of corporations located in the European Union (EU), both either inside or outside the Eurozone. Our measure for investment is *Investments*, which is the corporation's capital expenditure, scaled by total assets. The variable *Post-LTRO* is a dummy variable equal to one, for year-quarter observations after the ECB had implemented the first three-year LTRO intervention (Q4-2011). The variable *Post-LTRO* × *Non-Eurozone* is the interaction variable between the non-Eurozone dummies and LTRO intervention and captures the effect of the liquidity intervention on corporate policies in non-LTRO countries ("counterfactual" effect) accordingly, which equals one for non-Eurozone corporations after the first LTRO intervention (for details see Appendix A1). In Model (1), we use the full sample of corporations. In Models (2) and (3), corporations are separated into high and low-risk sovereigns, based on their location and the respective country's CDS spreads. *Risky* (*Safe*) *Sovereign* is defined as a CDS spread above (below) the median in the pre-intervention and crisis period (2009 and 2010). In Panel A and Panel B, we present the estimates from our analysis of corporate investment and wages, respectively. The sample period is 2002-2014, based on quarterly observations. (*** denotes significance at the 1% level, ** significance at the 5% level, and * significance at the 10% level. The numbers in parentheses are standard errors.)

Table 4
LTRO uptake effect on investment and employment: Eurozone firms

	Investments		Wages	
	(1)	(2)	(3)	(4)
Country LTRO Uptake	-1.276***		-0.140	
	(0.24)		(0.08)	
Lender LTRO Uptake		-0.514***		0.019
		(0.11)		(0.05)
Cash Flow	0.009***	0.018***	-0.004***	-0.003*
	(0.00)	(0.00)	(0.00)	(0.00)
Market to Book	0.004***	0.003***	0.000***	0.001***
	(0.00)	(0.00)	(0.00)	(0.00)
Firm Size	0.124***	-0.037	0.677***	0.717***
	(0.03)	(0.04)	(0.01)	(0.03)
Leverage	-0.016***	-0.022***	-0.001***	-0.003***
	(0.00)	(0.00)	(0.00)	(0.00)
Rated	0.313***	0.507***	0.101*	-0.175**
	(0.12)	(0.12)	(0.06)	(0.08)
Sovereign Risk	-0.301***	-0.298***	0.011	0.066**
	(0.03)	(0.03)	(0.01)	(0.03)
Sovereign Export	-0.014***	-0.028***	0.003	-0.001
	(0.00)	(0.00)	(0.00)	(0.00)
Time FE	Y	Y	Y	Y
Firm FE	Y	Y	Y	Y
R-square	0.568	0.602	0.787	0.713
N	86392	32725	51997	19667

This table presents estimates of the effect of the liquidity uptake from the ECB's three-year Longer-Term Refinancing Operations (LTROs) on corporate investment and employment compensation in a sample of corporations located in the Eurozone. Our measure for investment is *Investments*, which is the corporations' capital expenditure, scaled by total assets. Our measure for employment compensation is *Wages*, which is the corporations' total salaries and wages, given in logarithms. The variable *Country LTRO Uptake* is equal to zero until Q4-2011, and is equal to the countries' total LTRO uptake amount, scaled by the countries' central government debt, afterwards. The variable *Lender LTRO Uptake* is equal to zero until Q4-2011, and equal to the LTRO uptake amount of the corporate-related banks, scaled by the size of each bank, thereafter. We classify Eurozone banks as related if the corporation in the five years prior to the first LTRO intervention had a loan relation to the bank. The information about the bank-specific LTRO uptake is based upon hand-collected data from Bloomberg, as well as central bank announcements and public commentaries. The loan information data is obtained from LPC Dealscan. In all models, we include base corporate-level financial variables in addition to macro-economic variables. The sample period is 2002-2014, based on quarterly observations. (*** denotes significance at the 1% level, ** significance at the 5% level, and * significance at the 10% level. The numbers in parentheses are standard errors.)

Table 5
Determinants of banks' LTRO borrowing

Panel A: Bank-specific LTRO borrowing indicator

	LTRO Borrowing Indicator$_{j,11/12}$			LTRO Borrowing Indicator$_{j,11/12}$	
	All Banks	All Banks	All Banks	GIIPS Banks	Non-GIIPS Banks
	(1)	(2)	(3)	(4)	(5)
High Risk Bank$_{j,10}$	1.237***	1.584***	1.414***	1.053	3.032***
	(0.358)	(0.424)	(0.446)	(0.833)	(1.076)
Bank Size$_{j,10}$	0.174**	0.388***	0.538***	1.266***	0.551**
	(0.080)	(0.111)	(0.134)	(0.345)	(0.264)
Borrower Size$_{j,10}$		-0.11	-0.18	-0.62	-0.21
		(0.264)	(0.281)	(0.511)	(0.704)
Borrower Leverage$_{j,10}$		0.034	0.016	0.038	-0.01
		(0.023)	(0.026)	(0.050)	(0.066)
Borrower Short-term Debt$_{j,10}$		-7.66	-9.08*	-15.3*	-49.3*
		(4.689)	(5.284)	(9.235)	(26.50)
Borrower Cash Flow$_{j,10}$		-0.26**	-0.21*	-0.52**	0.060
		(0.117)	(0.114)	(0.231)	(0.200)
Sovereign Risk$_{10}$			1.269***	1.986	0.174
			(0.405)	(2.787)	(0.898)
Pseudo R-square	0.085	0.222	0.280	0.501	0.417
N	185	155	155	80	75

Panel B: Bank-specific LTRO borrowing amount

	Log(1 + Total Bank LTRO Borrowing)			Log(1 + Total Bank LTRO Borrowing)	
	All Banks	All Banks	All Banks	GIIPS Banks	Non-GIIPS Banks
	(1)	(2)	(3)	(4)	(5)
High Risk Bank$_{j,10}$	0.782***	0.789***	0.621***	0.450*	0.502**
	(0.18)	(0.19)	(0.19)	(0.26)	(0.21)
Bank Size$_{j,10}$	0.061***	0.174***	0.248***	0.484***	0.099**
	(0.00)	(0.03)	(0.04)	(0.06)	(0.03)
Borrower Size$_{j,10}$		-0.138**	0.033	-0.028	-0.107
		(0.05)	(0.06)	(0.13)	(0.07)
Borrower Leverage$_{j,10}$		0.012	0.005	0.002	0.006
		(0.00)	(0.00)	(0.01)	(0.00)
Borrower Short-term Debt$_{j,10}$		-2.969**	-1.818	-2.797	-3.485*
		(1.42)	(1.38)	(1.98)	(1.99)
Borrower Cash Flow$_{j,10}$		-0.045	-0.028	-0.067**	0.005
		(0.03)	(0.02)	(0.03)	(0.04)
Sovereign Risk$_{10}$			0.486***	0.728**	-0.023
			(0.12)	(0.28)	(0.11)
R-square	0.418	0.447	0.500	0.750	0.293
N	185	155	155	80	75

This table presents estimates of the effect of bank, country and borrower measures on banks' borrowings from the ECB's three-year Longer-Term Refinancing Operations (LTROs) in a sample of banks with borrowers located in the Eurozone. In Panel A, our measure for banks' LTRO borrowings is *LTRO Borrowing Indicator*, which is an indicator that is equal to one, if the bank participated in one of the LTROs. In Panel B, our measure for banks' LTRO borrowings is *Log(1 + Total Bank LTRO Borrowing)*, which is the natural logarithm of 1 plus the banks' total borrowing from LTRO I (Dec-2011) and II (Feb-2012). We regress the bank LTRO borrowing measures on a set of control variables. *High Risk Bank* is a dummy variable equal to one, if the bank at the end of 2010 had a CDS spread above the median CDS spread, and zero otherwise. *Bank Size* is the banks' total assets at the end of 2010, given in natural logarithm. *Borrower Size* refers to the average size (measured by total assets given in natural logarithm) of the banks' borrowers at the end of 2010. Likewise, *Borrower Leverage*, *Borrower Cash Flow* and *Borrower Short-term Debt* is the average leverage, cash flow and short-term debt of the banks' borrowers at the end of 2010. *Sovereign Risk* is the countries' CDS spread at the end of 2010, given in natural logarithm. (*** denotes significance at the 1% level, ** significance at the 5% level, and * significance at the 10% level. The numbers in parentheses are standard errors.)

Table 6
Lender LTRO residual effect on investment and employment

	Investments	Wages
	(1)	(2)
Lender LTRO Residual	-0.146*	0.021
	(0.07)	(0.04)
Cash Flow	0.027***	-0.004
	(0.00)	(0.00)
Market to Book	0.004***	0.001***
	(0.00)	(0.00)
Firm Size	-0.148**	0.647***
	(0.06)	(0.04)
Leverage	-0.022***	-0.006***
	(0.00)	(0.00)
Rated	0.456***	-0.155*
	(0.12)	(0.09)
Sovereign Risk	-0.299***	0.095**
	(0.05)	(0.04)
Sovereign Export	-0.050***	-0.009*
	(0.00)	(0.00)
Time FE	Y	Y
Firm FE	Y	Y
R-square	0.621	0.680
N	20097	12247

This table presents estimates of the residual effect of lenders' liquidity uptake from the ECB's three-year Longer-Term Refinancing Operations (LTROs) on corporate investment and employment compensation in a sample of corporations located in the Eurozone. Our measure for investment is *Investments*, which is the corporations' capital expenditure, scaled by total assets. Our measure for employment compensation is *Wages*, which is the corporations' total salaries and wages, given in logarithms. The variable *Lender LTRO Residual* is zero until Q4-2011, and equal to the bank specific LTRO residual value obtained from the regression analysis from Table 5, Panel B, Model (3), of the corporate-related banks, thereafter. We classify Eurozone banks as related if the corporation in the five years prior to the first LTRO intervention had a loan relation to the bank. The loan information data are obtained from LPC Dealscan. We also include base corporate-level financial variables in addition to macro-economic variables. The sample period is 2002-2014, based on quarterly observations. (*** denotes significance at the 1% level, ** significance at the 5% level, and * significance at the 10% level. The numbers in parentheses are standard errors.)

Table 7
LTRO effect on Investment: The role of corporations' bank debt reliance

	Investments		Investments	
	High Bank Debt	Low Bank Debt	High Bank Debt	Low Bank Debt
	(1)	(2)	(3)	(4)
Country LTRO Uptake	-0.812**	-0.832**		
	(0.37)	(0.33)		
Lender LTRO Uptake			-0.891***	0.279
			(0.16)	(0.17)
Cash Flow	0.014***	0.007***	0.026***	0.015***
	(0.00)	(0.00)	(0.00)	(0.00)
Market to Book	0.006***	0.003***	0.004***	0.002***
	(0.00)	(0.00)	(0.00)	(0.00)
Firm Size	0.175***	0.086**	-0.011	-0.037
	(0.06)	(0.04)	(0.07)	(0.06)
Leverage	-0.018***	-0.012***	-0.018***	-0.020***
	(0.00)	(0.00)	(0.00)	(0.00)
Rated	0.618**	0.136	0.710**	0.316**
	(0.30)	(0.12)	(0.27)	(0.12)
Sovereign Risk	-0.353***	-0.227***	-0.467***	-0.145***
	(0.05)	(0.03)	(0.06)	(0.05)
Sovereign Export	-0.012	-0.019***	-0.029**	-0.024***
	(0.01)	(0.00)	(0.01)	(0.00)
Time FE	Y	Y	Y	Y
Firm FE	Y	Y	Y	Y
R-square	0.525	0.563	0.601	0.594
N	31262	45556	12710	17797

This table presents estimates of the effect of the corporate reliance on bank debt and the liquidity uptake from the ECB's three-year Longer-Term Refinancing Operations (LTROs), on corporate investment, in a sample of corporations located in the Eurozone. Our measure for investment is *Investments*, which is the corporation's capital expenditure, scaled by total assets. *Bank Debt* is the debt from bank loans, divided by total assets. In Models (1) and (2), and Models (3) and (4), corporations are separated into those with *High* and *Low Bank Debt* ratios, based upon their bank debt ratios one year before the first three-year LTRO intervention (Q4-2010). The variable *Country LTRO Uptake* is equal to zero, until Q4-2011, and equal to the country-specific total LTRO uptake amount, scaled by the central government debt of the country, thereafter. The variable *Lender LTRO Uptake* is equal to zero until Q4-2011, and equal to the LTRO uptake amount of the corporate's related banks, scaled by the size of each bank, thereafter. We classify Eurozone banks as related if the corporation in the five years prior to the first LTRO intervention had a loan relation to the bank. The sample period is 2002-2014, based on quarterly observations. (*** denotes significance at the 1% level, ** significance at the 5% level, and * significance at the 10% level. The numbers in parentheses are standard errors.)

Table 8
LTRO effect on investment: The role of lender characteristics

Panel A: Country LTRO uptake and lenders' credit risk

	Investments		Investments			
			GIIPS		Non-GIIPS	
	Risky Lender	Safe Lender	Risky Lender	Safe Lender	Risky Lender	Safe Lender
	(1)	(2)	(3)	(4)	(5)	(6)
Country LTRO Uptake	-2.699***	-2.313**	-1.721**	0.993	-9.994***	-4.540***
	(0.47)	(0.93)	(0.77)	(0.77)	(1.67)	(1.37)
Controls	Y	Y	Y	Y	Y	Y
Time FE	Y	Y	Y	Y	Y	Y
Firm FE	Y	Y	Y	Y	Y	Y
R-square	0.617	0.633	0.589	0.619	0.650	0.636
N	9819	10494	3905	965	5914	9529

Panel B: Lender LTRO uptake and lenders' credit risk

	Investments		Investments			
			GIIPS		Non-GIIPS	
	Risky Lender	Safe Lender	Risky Lender	Safe Lender	Risky Lender	Safe Lender
	(1)	(2)	(3)	(4)	(5)	(6)
Lender LTRO Uptake	-0.707***	-0.418***	-0.496*	-0.995	-0.874***	-0.433***
	(0.18)	(0.14)	(0.27)	(0.27)	(0.24)	(0.14)
Controls	Y	Y	Y	Y	Y	Y
Time FE	Y	Y	Y	Y	Y	Y
Firm FE	Y	Y	Y	Y	Y	Y
R-square	0.616	0.633	0.588	0.619	0.649	0.636
N	9819	10494	3905	965	5914	9529

This table presents estimates of the effect of bank characteristics and the liquidity uptake from the ECB's three-year Longer-Term Refinancing Operations (LTROs), on corporate investment, in a sample of corporations located in the Eurozone. Our measure for investment is *Investments*, which is the corporations' capital expenditure, scaled by total assets. We separate corporations into *Risky* and *Safe Lender*. *Risky (Safe) Lender* is a dummy variable equal to one if the corporations' lenders one year before the first three-year LTRO intervention, i.e., Q4-2010, on average had a CDS spread above (below) the median, and zero otherwise. The variable *Country LTRO Uptake* is equal to zero until Q4-2011, and equal to the country-specific total LTRO uptake amount, scaled by the central government debt of the country, thereafter. The variable *Lender LTRO Uptake* is equal to zero until Q4-2011, and equal to the LTRO uptake amount of the corporate-related banks, scaled by the size of each bank, thereafter. The sample period is 2002-2014, based on quarterly observations. (*** denotes significance at the 1% level, ** significance at the 5% level, and * significance at the 10% level. The numbers in parentheses are standard errors.)

Table 9
LTRO effect on investment: The role of banks' early repayment of LTRO

Panel A: Low early LTRO repayment

	Investments	Investments	
	Full Sample	Large Corporations	Small Corporations
	(1)	(2)	(3)
Lender LTRO Uptake	-1.006	-2.852***	11.687***
	(1.05)	(0.93)	(3.98)
Controls	Y	Y	Y
Time FE	Y	Y	Y
Firm FE	Y	Y	Y
R-square	0.556	0.611	0.535
N	4876	2343	2533

Panel B: Medium early LTRO repayment

	Investments	Investments	
	Full Sample	Large Corporations	Small Corporations
	(1)	(2)	(3)
Lender LTRO Uptake	-0.537***	-0.405***	-0.626**
	(0.11)	(0.12)	(0.25)
Controls	Y	Y	Y
Time FE	Y	Y	Y
Firm FE	Y	Y	Y
R-square	0.644	0.687	0.582
N	16900	10006	6894

Panel C: High early LTRO repayment

	Investments	Investments	
	Full Sample	Large Firms	Small Firms
	(1)	(2)	(3)
Lender LTRO Uptake	10.809**	5.338	21.035***
	(4.40)	(5.67)	(7.24)
Controls	Y	Y	Y
Time FE	Y	Y	Y
Firm FE	Y	Y	Y
R-square	0.558	0.582	0.548
N	8812	4251	4561

This table presents estimates of the effect of the liquidity uptake from the ECB's three-year Longer-Term Refinancing Operations (LTROs) by loan-related banks, and LTRO repayment policies on corporate polices, in a subsample of Eurozone corporations with existing loan information in LPC Dealscan. Our measure for corporate investment is *Investments*, which is the corporation's capital expenditure, scaled by total assets. The variable *Lender LTRO Uptake* is equal to zero until Q4-2011, and equal to the LTRO uptake amount of the corporate-related banks, scaled by the size of each bank, thereafter. In Panels A through Panels C corporations are separated based on their location and the respective country's LTRO repayment policy, compared to the initial *Country LTRO Uptake*. *Low* (*Medium*, *High*) *Early LTRO Repayment* is defined as a LTRO repayment ratio from 2012 to 2013, i.e., at the first possible LTRO repayment date, that is below 30% (between 30% and 70%, above 70%). The sample period is 2002-2014, and based on quarterly observations. In all models, we include base corporate-level financial variables in addition to macro-economic variables. (*** denotes significance at the 1% level, ** significance at the 5% level, and * significance at the 10% level. The numbers in parentheses are standard errors.)

Table 10
LTRO effect on investment: The role of fiscal policy

Panel A: Eurozone sample

	Investments			Investments	
	Increased Corp. Tax	Unchanged Corp. Tax	Decreased Corp. Tax	Increased Gov. Investment	Decreased Gov. Investment
	(1)	(2)	(3)	(4)	(5)
Country LTRO Uptake	-9.899***	-1.343***	14.115*	1.404*	-1.797***
	(1.46)	(0.30)	(9.59)	(0.72)	(0.29)
Controls	Y	Y	Y	Y	Y
Time FE	Y	Y	Y	Y	Y
Firm FE	Y	Y	Y	Y	Y
R-square	0.626	0.554	0.531	0.576	0.562
N	25926	44138	16328	39965	46427

Panel B: Eurozone sample with existing loan information

	Investments			Investments	
	Increased Corp. Tax	Unchanged Corp. Tax	Decreased Corp. Tax	Increased Gov. Investment	Decreased Gov. Investment
	(1)	(2)	(3)	(4)	(5)
Lender LTRO Uptake	0.182	-1.034***	7.920*	-0.409***	-0.569**
	(0.16)	(0.16)	(4.43)	(0.14)	(0.24)
Controls	Y	Y	Y	Y	Y
Time FE	Y	Y	Y	Y	Y
Firm FE	Y	Y	Y	Y	Y
R-square	0.665	0.577	0.604	0.607	0.601
N	9041	17602	6082	13942	18783

This table presents estimates of the effect of fiscal policy and the liquidity uptake from the ECB's three-year Longer-Term Refinancing Operations (LTROs) on corporate investment. Our measure for corporate investment is *Investments*, which is the corporate capital expenditure, scaled by total assets. Panel A shows the results based upon a sample of corporations located in the Eurozone and using the country-specific LTRO uptake. The variable *Country LTRO Uptake* is equal to zero until Q4-2011, and equal to the country-specific total LTRO uptake amount, scaled by the central government debt of the country, thereafter. Panel B shows the results based upon a subsample of Eurozone corporations with existing loan information in LPC Dealscan, and using the lender-specific LTRO uptake. The variable *Lender LTRO Uptake* is equal to zero until Q4-2011, and equal to the LTRO uptake amount of the corporate-related banks, scaled by the size of each bank, thereafter. In Models (1) to (3), corporations are separated into those with increased, unchanged and decreased corporate tax rates (*Increased (Unchanged, Decreased) Corporate Tax*), based on the home countries' (absolut) change of the corporate tax rate between Q4-2010 and Q4-2012, i.e., around the first LTRO. The corporate tax rate data are given on a quarterly basis. In Models (4) and (5), corporations are separated into those with increased and decreased government investments (*Increased (Decreased) Government Investment*), based on the home countries' (relative) change in the government investment expenditures to GDP ratio between Q4-2010 and Q4-2012, i.e., around the first LTRO. In all models, we include base corporate-level financial variables in addition to macroeconomic variables. The sample period is 2002-2014, based on quarterly observations. (*** denotes significance at the 1% level, ** significance at the 5% level, and * significance at the 10% level. The numbers in parentheses are standard errors.)

Appendices

Note 1 - Background on ECB's open market operations

The ECB open market operations are aimed "to steer short-term interest rates, to manage the liquidity situation and to signal the monetary policy stance in the euro area" and can be classified into regular open market operations and non-standard monetary policies.[28] Regular open market operations consist of main refinancing operations (MROs) and three-month longer-term refinancing operations (three-month LTROs). MROs are the ECB's primary, regular open market operations and refer to regular one-week liquidity-providing reverse transactions. In October 2008, the ECB switched to a fixed-rate full allotment mode such that Eurozone banks were then able to obtain unlimited short-term liquidity at a fixed rate, provided they pledged sufficient eligible collateral. To provide additional, longer-term refinancing, the ECB also offers three-month LTROs which in 2003 amounted to 45 billion EUR (about 20% of the overall liquidity provided by the ECB). In recent years, the regular open market operations have been complemented by a set of non-standard monetary policies. On 28 March 2008, the ECB announced two six-month LTROs (allotted on 2 April and 9 July 2008), which were both present for the amount of 25 billion EUR. The three- and six-month LTROs were carried out through a variable-rate standard tender procedure. In June 2010, the ECB Governing Council decided to adopt a fixed-rate tender procedure with full allotment in the regular three-month LTROs (allotted on 28 July, 25 August, and 29 September 2010). On 6 October 2011, the ECB further announced two twelve-month LTROs as fixed-rate tender procedures with full allotment. These were conducted in addition to the regular and special term refinancing operations in October and December 2011, respectively.

On 8 December 2011, to increase the ECB's support for the Eurozone banking sector and to improve the real economy, two three-year LTROs were announced. The LTROs were allotted on 21 December 2011 (LTRO I) and 29 February 2012 (LTRO II) and settled with maturities on 29 January 2015 and 26 February 2015, respectively. The interest rate on the two long-term loans was the average MRO rate over the life of the operation and approximately 1%. The three-year LTROs eased credit conditions, not only by allowing banks to borrow unlimited funds for three years (given the provision of eligible collateral) but also by assisting banks with the management of their "gap risk", i.e., increasing banks' ability to match the tenor of their assets and liabilities. Prior to the LTROs, many banks were only able to secure overnight funding. To increase the attractiveness of the unconventional LTROs, participating banks were given the option to repay part or the full amount of their borrowings after one year without any penalty, i.e., as of 25 January (LTRO I) and 22 February (LTRO II) 2013, respectively. While banks used the LTROs loans to rollover previous and to obtain new central bank borrowing, it was stated, that "there is no limit on what the banks can do with the money".[29]

In total, 523 credit institutions participated in LTRO I and were provided with 489.2 billion EUR amounting to a net injection of 210 billion EUR. As outlined by FitchRatings (2012), the participants in LTRO I can roughly be divided into two groups. On the one hand, banks from the periphery countries were highly active due to their actual capital needs, as the LTROs provided them with their only option for accessing medium-term funding. On the other hand, the unconventional LTROs simply provided an opportunity to replace shorter-term funds with 1% three-year borrowing for the banks. Following the ECB, 45.72 billion EUR of the total uptake was used to replace the twelve-month allotment that had taken place in October 2011, and many of the 123 counter-parties were located in highly rated, safe countries such as France and Germany.[30] In particular, the banks

[28]For details about the financial instruments that are used to achieve open market transactions, see https://www.ecb.europa.eu/mopo/implement/html/index.en.html.

[29]Source: http://www.nytimes.com/2011/12/22/business/a-central-bank-doing-what-central-banks-do.html?_r=0.

[30]Source: ECB Monthly Bulletin, January 2012.

that placed the highest bids were those that had 1) the highest upcoming rollover needs and 2) the lowest maturity structures. However, it was also claimed that certain banks avoided the LTROs due to concerns that participating banks would be stigmatized as troubled institutions.[31] Since a considerable portion of the banks' collateral was already pledged at the ECB at the time of the first allotment, the central banks relaxed the collateral requirements to encourage uptake in LTRO II.[32] In the end, LTRO II provided a liquidity injection of 529.5 billion EUR (310 billion EUR in net terms) to 800 credit institutions. Table 1 provides the LTRO amounts by country.

In June 2014, to "further ease private sector credit conditions and stimulate bank lending to the real economy", the ECB announced targeted LTROs (TLTROs) that provide financing to credit institutions with maturity of up to four years. Under the TLTRO, counter-parties are only allowed to borrow an amount that is capped in accordance with their corporate lending. In September and December 2014, the ECB initially introduced two successive TLTROs, in which counterparties were able to borrow in accordance with their initial allowance, at a rate equal to a 10 basis point spread over the MRO rate. In the series of four rounds of TLTRO conducted between March 2015 and June 2016, the ECB eliminated this excess MRO spread. The TLTROs will all mature on 26 September 2018, while the voluntary early repayment depend on the actual settlement dates.

In addition to the refinancing operations, the ECB implemented several outright asset purchase programs (APP) since 2009. Under the expanded APP, the ECB purchases marketable debt instruments from both the public and private sectors to inject liquidity into the banking system, with a monthly purchase target of initially 60, and currently, 80 billion EUR. The active APP consists of the third covered bond (CBPP3), asset-backed securities (ABSPP), and public sector (PSPP) purchase programs that where initiated on 20 October 2014, 21 November 2014, and 9 March 2015, respectively. These programs were intended to be carried out "until the end of March 2017 and in any case until the Governing Council sees a sustained adjustment in the path of inflation that is consistent with its aim of achieving inflation rates below, but close to, 2% over the medium term." Besides the still-active APPs, there have been several terminated APP programs in the past years. CBPP was active from July 2009 to June 2010 and reached a nominal amount of 60 billion Euro. CBPP2 followed from November 2011 to October 2012 with a nominal amount of 16.4 billion Euro. The Securities Market Program (SMP) was started in May 2010 with the aim of "addressing the severe tensions in certain market segments which had been hampering the monetary policy transmission mechanism" and provided liquidity in selected secondary sovereign bond markets. In September 2012, SMP was replaced by outright monetary transactions (OMT), a bailout funding program of the European Stability Mechanism (ESM).[33]

[31] See, for instance, `http://www.zerohedge.com/contributed/ltro-users-manual`.

[32] For instance, the rating threshold was reduced for certain asset-backed securities (ABS), and rated corporate loans were allowed to be used as collateral under given circumstances.

[33] Previous the European Financial Stability Facility and European Financial Stabilization Mechanism.

Note 2 - Discussion of LTRO impact on other corporate policies

For the investigation of the effect of the ECB's LTRO intervention on corporate investment, it is important to consider that macro-liquidity injections, such as the ECB's unconventional LTROs, not always translate (directly) into corporate liquidity. Indeed, unconventional liquidity interventions may boost bank liquidity, improve corporations' debt financing conditions and make it less necessary for corporations to hold precautionary cash. If this were the outcome of the liquidity injection, the injection would have achieved the ECB's goal in undertaking the intervention from a corporate liquidity perspective. However, banks may use Lender-Of-Last-Resort funding to take on additional sovereign risk rather than lending to corporations, which may accentuate corporations' precautionary motives for holding cash. If the latter effect dominates, particularly Eurozone corporations situated in countries with a high LTRO uptake, would have higher cash holdings following the LTRO intervention Furthermore, as the aggregate demand was clearly down at the onset of the European Sovereign Debt Crisis corporations would have been likely to maintain their precautionary motives for holding significant amounts of cash, independent of the supply-side effect.

Table A6 presents the results of an analysis of the LTRO impact for corporate liquidity and debt financing policies in our sample of Eurozone corporations. As a proxy for corporate liquidity we use *Cash*, i.e., cash holdings, scaled by total assets. For corporate debt financing we use *Leverage* (total debt), *Net Debt* (current plus non-current liabilities minus cash holdings), as well as *Short-term Debt* (all current liabilities), all scaled by total assets. As outlined by Model (1), we find a positive and significant coefficient estimate for *Country LTRO Uptake* at the 1% level when investigating corporations' cash holdings.[34] Specifically, this result suggests that corporations located in countries in which the excess inflow of liquidity to lenders was high, on average, increased their cash holdings by approximately 0.55%, compared to that of other corporations. In unreported results we further find that the impact of the LTROs on cash holdings is amplified for corporations that use bank-related loans and credits as their main source of debt financing and for more risky corporations, i.e., those with a greater precautionary cash holdings.[35] We conclude from the results that the LTROs did not mitigate corporate uncertainty about the future (bank) lending supply.

As outlined by Models (2) to (3), we also find positive and significant *Country LTRO Uptake* coefficients when analyzing the LTRO impact on corporations' leverage and net debt ratios. The results suggest that corporations in high LTRO uptake countries were able to increase their leverage ratio by approximately 1.1%. In addition, the results in Model (4) regarding corporations' short-term debt holdings suggests that corporations replaced shorter-term with more long-term liabilities, which is in line with the fact that the LTRO intervention for the first time provided longer-term funding opportunities for Eurozone banks.[36] In line with the findings by Darracq-Paries and Santis (2015) we conclude that corporations at least were able to refinance existing debt contracts following the macro-liquidity injection. This supports the view that the three-year LTROs can be interpreted as a favorable credit supply shock. However, we emphasize that we cannot exclude other sources of funding responsible for that increase/decrease, respectively.

[34]We follow Opler, Pinkowitz, Stulz, and Williamson (1999), and Bates, Kahle, and Stulz (2009).

[35]This is similar to the discussion of precautionary cash holdings of more financially constrained corporations as outlined in Azar, Kagy, and Schmalz (2016) and Bolton, Chen, and Wang (2014)).

[36]A related discussion based upon French data is given in Andrade, Cahn, Fraisse, and Mésonnier (2018)

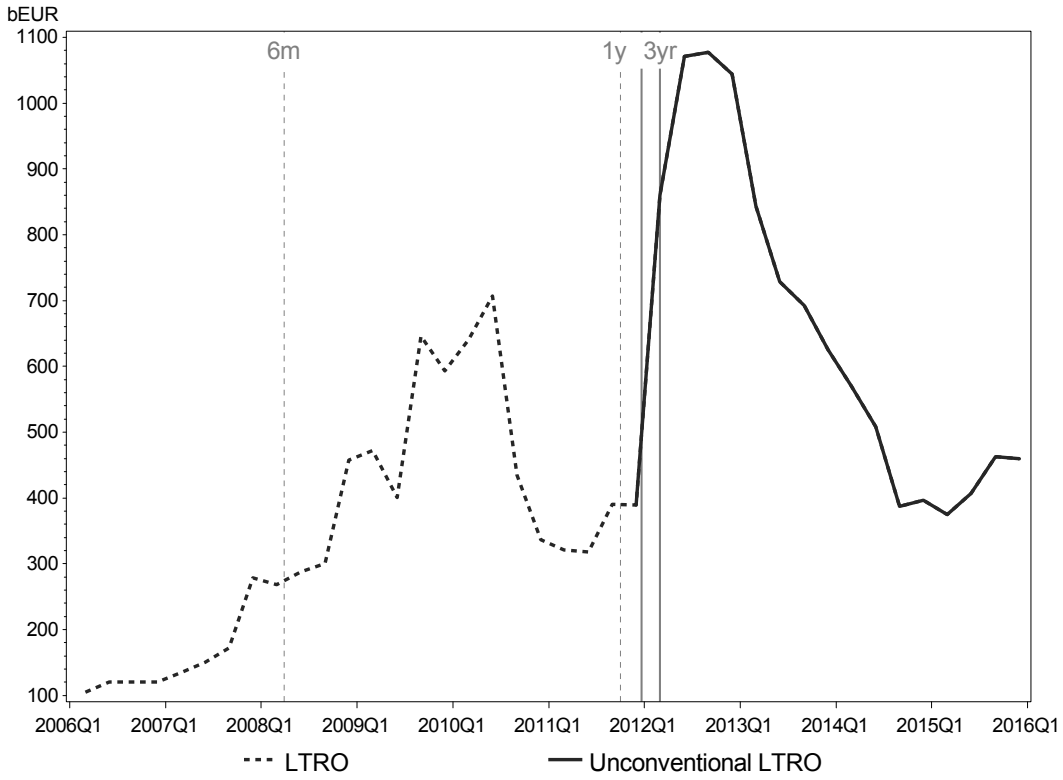

Figure A1
Time series of the ECB's Longer-Term Refinancing Operations

This figure plots the amounts of the ECB's Longer-Term Refinancing Operations (LTROs) for the period 2006 to 2016. The numbers are given in billion EUR. Unconventional LTROs refers to the two three-year LTROs. The data source is the ECB Statistical Data Warehouse, which publishes monthly numbers for the outstanding amounts.

Figure A2
LTRO uptake in the Eurozone

This figure presents the total liquidity injection that countries within the Eurozone obtained from the three-year Longer-Term Refinancing Operations (LTROs), which were initiated by the European Central Bank (ECB) on December 21, 2011 (LTRO I) and February 29, 2012 (LTRO II), respectively. The color shading refers to the respective countries' total LTRO uptake, scaled by the central government debt. The information about the country-specific LTRO uptake is based upon hand-collected data from Bloomberg as well as central bank announcements and public commentaries. The information on central government debt by country is obtained from the World Bank Database. In the case of Greece, we only have information about the total LTRO amount that, besides the three-year LTROs, also includes the standard one-month and three-month LTROs. As we cannot separate the latter, the number is not directly comparable to the uptake numbers for other countries.

Table A1
Sample countries

Panel A: Eurozone

Country	Country Code	EU Membership	Euro Adoption	Region	Credit Rating (2011)
Austria	AUT	1995	1999	Core	AAA
Belgium	BEL	1995	1999	Core	AA
Finland	FIN	1995	1999	Core	AAA
France	FRA	1995	1999	Core	A
Germany	DEU	1995	1999	Core	AAA
Greece	GRC	1995	2001	Periphery	CCC
Ireland	IRL	1995	1999	Periphery	BB
Italy	ITA	1995	1999	Periphery	BB
Netherlands	NLD	1995	1999	Core	AAA
Portugal	PRT	1995	1999	Periphery	B
Spain	ESP	1995	1999	Periphery	BB

Panel B: Non-Eurozone

Country	Country Code	EU Membership	Euro Adoption	Region	Credit Rating (2011)
Bulgaria	BGR	2007		Periphery	A
Czech Republic	CZE	2004		Periphery	AA
Denmark	DNK	1995		Core	AAA
Hungary	HUN	2004		Periphery	B
Lithuania	LTU	2004	2015	Periphery	A
Latvia	LVA	2004	2014	Periphery	A
Poland	POL	2004		Periphery	AA
Romania	ROU	2007		Periphery	BB
Sweden	SWE	1995		Core	AAA
United Kingdom	GBR	1995		Core	AAA

This table presents details of the European countries included in our sample. Panel A covers the countries in our Eurozone sample, Panel B those in our non-Eurozone sample. The *Eurozone* sample only includes countries that agreed to use the euro as a common currency in 1999, and adopted the euro right from its introduction in January 2001, and for which data are available. The sample *Non-Eurozone* includes countries that are outside the Eurozone but are part of the European Union (EU). Accordingly, our sample of EU corporates is the combination of the Eurozone and non-Eurozone samples. *EU Membership* shows the year the country became a member of the EU. Likewise, *euro Adoption* shows the year in which a given country adopted the euro as its local currency. *Credit Rating* is based on information from Markit Data as of end-2011. The overall sample of corporations is taken from Compustat Global and is restricted to EU countries. For details, please see Section 3.

Table A2
Description of main variables

Dependent Variables		*Description*
Investments	Capital Expenditures/ Total Assets	Corporate capital spending. Quarterly corporate measure. Source: Compustat.
Wages	Log(Total Wage payments)	The natural logarithm of total expenses related to salaries and wages. Quarterly corporate measure. Source: Compustat.
Cash	Cash/ Total Assets	Corporate cash holdings including marketable securities. Quarterly corporate measure. Source: Compustat.
Leverage	Debt/ Total Assets	The book value of the sum of current and long-term debt, scaled by total assets. Quarterly corporate measure. Source: Compustat.
Net Debt	(Total liabilities - Cash)/ Total Assets	The sum of current and non-current liabilities minus cash holdings, scaled by total assets. Quarterly corporate measure. Source: Compustat.
Short-term Debt	(Debt due in one year)/ Total Assets	Fraction of long-term debt that is due in one year, scaled by total assets. Quarterly corporate measure. Source: Compustat.
Main Explanatory Variables		*Description*
Country LTRO Uptake	Total Country LTRO Uptake/ Central Government Debt_{2011}	Total Country LTRO Uptake is the sum of the euro amounts of the two three-year LTROs (LTRO I and II) for each country. Accordingly, the variable is equal to zero until time Q4-2011 (first round of three-year LTRO) and afterwards equal to each country's total uptake, scaled by the central government debt holdings in the year 2011. Quarterly country measure. Source: Bloomberg and the World Bank.
Lender LTRO Uptake	Average (Bank LTRO Uptake/ Bank Size_{2011}) of related banks	The firm-level average of a related banks' uptake in the two three-year LTROs (LTRO I and II), scaled by the size of the respective bank. Accordingly, the variable is equal to zero until time Q4-2011 (first round of three-year LTRO) and afterwards equal to the average of related banks' total uptake. Quarterly corporate measure. Source: Bloomberg and annual reports.
LTRO-Bank Relation	Dummy	Dummy variable equal to one for corporations that in the five years prior to Q4-2011 (first round of three-year LTRO) had a loan relation to a Eurozone bank that participated in the three-year LTROs as of December 2011 and February 2012. Corporate measure. Source: LPC Dealscan.
Post-LTRO	Dummy	Dummy variable equal to one for the post-intervention period, i.e., Q1-2012 to Q4-2014 (zero otherwise). Quarterly measure. Source: ECB Statistical Data Warehouse.
Non-Eurozone	Dummy	Dummy variable equal to one for corporations located in a EU-country outside the Eurozone, as of 2014 (zero otherwise). Country measure. Details are provided in Appendix A1.
GIIPS	Dummy	Dummy variable equal to one for corporations located in either Greece, Ireland, Italy, Portugal or Spain. Country measure. Source: Compustat.

Description of main variables (cont.)

Other Corporate Variables		*Description*
Firm Size	Log(Total Assets)	Book value of assets, given in logarithms. Quarterly corporate measure. Source: Compustat.
Market to Book	(Total Liabilities + Market Equity) / Total Assets	Market value of total assets, scaled by book value of total assets. Market equity is the amount of shares outstanding times the share price as of the end of the fiscal quarter/year. Quarterly corporate measure. Source: Compustat.
Cash Flow	EBIT/ Total Assets	Operating income before interest and taxes (after depreciation), scaled by total assets. Quarterly corporate measure. Source: Compustat.
Industry Sigma	Cash-flow risk	Average standard deviation of corporate cash flows within the same two-digit SIC code (minimum 3 observations). Quarterly industry measure. Source: Compustat.
Net Working Capital	(Net working capital - Cash)/ Total Assets	Corporate working capital net of cash holdings, scaled by total assets. Source: Compustat.
R&D/Sales	R&D/ Total Sales	Costs related to research and development, scaled by corporate sales. Quarterly corporate measure. Source: Compustat.
Sales	Log(EBIT)	Operating income before interest and taxes (after depreciation), given in logarithms. Corporate measure. Source: Compustat.
Acquisition Activity	Acquisitions/ Total Assets	The amount used for M&A activities, scaled by total assets. Quarterly corporate measure. Source: Compustat.
Dividends	Dummy	Dummy variable equal to one for corporations with positive dividends in a given quarter/year (zero otherwise). Quarterly corporate measure. Source: Compustat.
Bank Debt	Bank Debt/ Total Assets	Bank debt is the amount of debt from bank loans. Quarterly corporate measure. Source: Capital IQ.
Rated	Dummy	Dummy variable equal to one for corporations with available rating information (zero otherwise). Corporate measure. Source: S&P Capital IQ.

Other Country Variables		*Description*
Sovereign Risk	Log(5-year Sovereign CDS spread)	End-of-quarter observation of five-year sovereign CDS spreads. Quarterly country measure. Source: Markit.
Early LTRO Repayment	(Δ NCB LTRO Holdings$_{2012-2013}$)/ Country LTRO Uptake$_{2011/2012}$	The change in National Central Banks' LTRO Holdings from 2012 to 2013, scaled by the total intital LTRO uptake in the respective country. Country measure. Source: National Central Bank Reports and Bloomberg.
Corporate Tax	Corporate tax rate	National corporate tax rates. Quarterly country measure. Source: ECB Statistical Data Warehouse.
Government Investments	Investment expenditures by governments/ GDP	Local government spending on investments, scaled by GDP. Quarterly country measure. Source: ECB Statistical Data Warehouse.
Government Debt	Government debt/ GDP	Total Government debt, scaled by GDP. Quarterly country measure. Source: ECB Statistical Data Warehouse.

This table provides descriptions of all the variables used in the analyses. All financial variables are winsorized at the 1^{st} and 99^{th} percentiles, and in our empirical specifications we use ratios given in percentages.

Table A3
Summary statistics for non-Eurozone corporations

Country	GBR	SWE	POL	DNK	ROU	BGR	LTU	LVA	HUN	CZE	Total
Investments	2.55	1.90	4.04	3.36	4.37	4.66	4.66	4.07	6.77	4.32	2.74
Wages	0.09	2.65	2.17	3.76	1.68	1.44	1.96	0.46	7.75	5.36	1.12
Cash	9.38	8.94	5.23	6.05	1.64	4.07	2.36	2.72	7.74	3.33	7.94
Leverage	13.83	14.21	14.32	22.48	0.84	26.14	27.2	14.58	14.47	13.49	14.43
Net Debt	49.81	52.68	47.08	53.49	34.28	46.86	51.57	37.67	41.59	41.70	49.56
Short-term Debt	0.04	0.06	0.08	0.06	0.11	0.08	0.1	0.06	0.06	0.06	0.05
Bank Debt	11.86	12.91	12.92	17.38	15.22	19.63	23.4	17.41	23.09	7.89	12.99
Firm Size	3.82	5.57	4.72	6.51	5.23	5.29	5.22	2.04	10.43	8.70	4.47
Market to Book	133.1	146.3	118.3	120.5	85.5	98.9	91.9	70.7	108.7	93.7	129.5
Cash Flow	3.04	2.68	2.54	4.42	6.33	6.07	5.18	4.22	5.13	4.96	3.03
Industry Sigma	11.23	13.66	6.17	5.87	4.18	3.33	6.14	5.56	3.12	4.23	9.19
Net Working Capital	-1.62	2.11	6.91	2.96	6.38	5.82	2.32	19.17	8.86	0.02	0.82
R&D/Sales	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Acquisition Activity	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Sovereign Risk	42.11	13.66	79.50	20.08	213.09	180.56	110.20	125.86	45.50	32.00	34.14
Sovereign Export	0.27	0.46	0.39	0.51	0.33	0.52	0.56	0.43	0.75	0.63	0.30
# N	67801	20122	17319	5980	2576	1018	1317	1370	797	420	118720
# Firms	2213	574	461	159	78	30	30	30	22	14	3611

This table provides sample averages (medians) of corporate characteristics for each country in our sample of non-Eurozone corporations. *Cash* is the ratio of cash and short-term investments to total assets. *Investments* is the ratio of capital expenditure to total assets. *Wages* is the total salaries and wages, given in logarithms. *Leverage* is the book value of the long-term debt plus debt in current liabilities, divided by total assets. *Net Debt* is the ratio of current plus non-current liabilities minus cash holdings to total assets. *Short-term Debt* is the ratio of current liabilities to total assets. *Bank Debt* is the amount of debt from bank loans, divided by total assets. *Firm Size* is the total assets, given in logarithms. *Market to Book* is the book value of assets minus the book value of equity plus the market value of equity, all divided by the book value of assets. *Cash Flow* is the ratio of the cash flow to total assets, where cash flow is the earnings after interest and related expenses, income taxes, and dividends. *Industry Sigma* is industry cash flow risk, measured by the mean cash flow volatility across two-digit SIC codes. *Net Working Capital* (NWC) is the difference between current assets and current liabilities net of cash, divided by total assets. *R&D/Sales* is the ratio of R&D to sales. *Acquisition Activity* is the ratio of acquisitions to total assets. *Sovereign Risk* is the five-year sovereign CDS spread for the country. *Sovereign Export* is the country's export-to-GDP ratio. The sample period for each country is 2002-2014, and the variables are based on quarterly observations. For the specific definition of each variable we refer to Appendix Table A3. The corporate fundamental data are obtained from Compustat Global, while country-specific data are obtained from Markit, the World Bank, as well as the ECB Statistical Data Warehouse. For any data unavailable for a specific quarter, we replace the missing values with yearly observations. Ratios are given in percentages.

Table A4
LTRO effect on investment and employment: Controlling for lagged corporate measures

	Investments		Wages	
	(1)	(2)	(3)	(4)
Country LTRO Uptake	-1.075***		-0.113	
	(0.25)		(0.09)	
Lender LTRO Uptake		-0.260**		0.072
		(0.11)		(0.05)
Cash Flow	0.005**	0.011***	-0.007***	-0.006***
	(0.00)	(0.00)	(0.00)	(0.00)
Market to Book	0.003***	0.003***	0.000**	0.001**
	(0.00)	(0.00)	(0.00)	(0.00)
Firm Size	0.224***	-0.188**	0.364***	0.407***
	(0.04)	(0.07)	(0.02)	(0.04)
Leverage	-0.020***	-0.024***	-0.001	-0.002*
	(0.00)	(0.00)	(0.00)	(0.00)
Rated	0.318**	0.430***	0.136**	-0.139
	(0.14)	(0.14)	(0.06)	(0.08)
Sovereign Risk	-0.322***	-0.420***	0.038**	0.077**
	(0.03)	(0.05)	(0.01)	(0.03)
Sovereign Export	-0.012**	-0.025***	0.003	-0.002
	(0.00)	(0.00)	(0.00)	(0.00)
Lagged Dividends	0.110***	0.067	-0.017	0.029
	(0.04)	(0.05)	(0.01)	(0.03)
Lagged R&D/Sales	0.568***	-0.057	0.031	-0.061
	(0.13)	(0.22)	(0.05)	(0.11)
Lagged Acquisition Activity	-2.413***	-2.602***	-0.480***	-0.476*
	(0.36)	(0.46)	(0.15)	(0.26)
Industry Sigma	-0.010	0.009	-0.002	0.011*
	(0.00)	(0.01)	(0.00)	(0.00)
Net Working Capital	-0.007***	-0.005***	-0.000	0.000
	(0.00)	(0.00)	(0.00)	(0.00)
Log Sales	0.137***	0.499***	0.359***	0.356***
	(0.03)	(0.06)	(0.01)	(0.03)
Competition	0.001	0.006***	-0.005***	-0.005***
	(0.00)	(0.00)	(0.00)	(0.00)
Time FE	Y	Y	Y	Y
Firm FE	Y	Y	Y	Y
R-square	0.598	0.635	0.790	0.719
N	64635	25417	47910	18092

This table presents estimates of the effect of the liquidity uptake from the ECB's three-year Longer-Term Refinancing Operations (LTROs) on corporate investment and employment compensation in a sample of corporations located in the Eurozone. Our measure for corporate investment is *Investments*, which is the corporations' capital expenditure, scaled by total assets. Our measure for employment compensation is *Wages*, which is the corporations' total salaries and wages, given in logarithms. Models (1) and (3) include all the base corporate-level financial variables in addition to macro-economic variables. In Models (2) and (4) we include, in addition to basic investment and employment compensation determinants, lagged values of alternative investment measures and other corporate and industry controls. The variable *Country LTRO Uptake* is equal to zero until Q4-2011, and is equal to the countries' total LTRO uptake amount, scaled by the countries' central government debt, afterwards. The variable *Lender LTRO Uptake* is equal to zero until Q4-2011, and equal to the LTRO uptake amount of the corporate-related banks, scaled by the size of each bank, thereafter. We classify Eurozone banks as related if the corporation in the five years prior to the first LTRO intervention had a loan relation to the bank. The information about the bank-specific LTRO uptake is based upon hand-collected data from Bloomberg, as well as central bank announcements and public commentaries. The loan information data is obtained from LPC Dealscan. In all models, we include base corporate-level financial variables in addition to macro-economic variables. The sample period is 2002-2014, based on quarterly observations. (*** denotes significance at the 1% level, ** significance at the 5% level, and * significance at the 10% level. The numbers in parentheses are standard errors.)

Table A5
LTRO effect on investment and employment: Robustness with shorter window

	Investments		Wages	
	(1)	(2)	(3)	(4)
Country LTRO Uptake	-0.765***		0.200**	
	(0.20)		(0.09)	
Lender LTRO Uptake		-0.244***		-0.034
		(0.08)		(0.05)
Cash Flow	-0.002	0.004	-0.002**	0.004
	(0.00)	(0.00)	(0.00)	(0.00)
Market to Book	0.005***	0.006***	0.001***	0.001
	(0.00)	(0.00)	(0.00)	(0.00)
Firm Size	0.757***	0.176**	0.615***	0.695***
	(0.06)	(0.08)	(0.02)	(0.05)
Leverage	-0.006***	-0.017***	-0.001	-0.001
	(0.00)	(0.00)	(0.00)	(0.00)
Rated	0.338*	0.226	0.057	-0.044
	(0.19)	(0.16)	(0.09)	(0.12)
Sovereign Risk	-0.537***	-0.666***	-0.027	-0.036
	(0.03)	(0.05)	(0.02)	(0.04)
Sovereign Export	-0.045***	-0.056***	-0.010***	0.004
	(0.00)	(0.00)	(0.00)	(0.00)
Time FE	Y	Y	Y	Y
Firm FE	Y	Y	Y	Y
R-square	0.684	0.738	0.827	0.744
N	37934	14552	32950	12458

This table presents estimates of the effect of the liquidity uptake from the ECB's three-year Longer-Term Refinancing Operations (LTROs) on investment polices in a sample of corporations located in the Eurozone. Our measure for corporate investment is *Investments*, which is the corporation's capital expenditure, scaled by total assets. Our measure for employment compensation is *Wages*, which is the corporation's total salaries and wages, given in logarithms. Model (1) and (3) show the estimates of the country-based effect of LTRO in our main sample, while Models (2) and (4) show the effect of loan-related banks' LTRO uptake in a subsample of Eurozone corporations with existing loan information in LPC Dealscan. The variable *Country LTRO Uptake* is equal to zero until Q4-2011, and is equal to the countries' total LTRO uptake amount, scaled by the countries' central government debt, afterwards. The variable *Lender LTRO Uptake* is equal to zero until Q4-2011, and equal to the LTRO uptake amount of the corporate-related banks, scaled by the size of each bank, thereafter. We classify Eurozone banks as related if the corporation in the five years prior to the first LTRO intervention had a loan relation to the bank. The information about the bank-specific LTRO uptake is based upon hand-collected data from Bloomberg, as well as central bank announcements and public commentaries. The loan information data is obtained from LPC Dealscan. In all models, we include base corporate-level financial variables in addition to macro-economic variables. The sample period is 2009-2014, based on quarterly observations. (*** denotes significance at the 1% level, ** significance at the 5% level, and * significance at the 10% level. The numbers in parentheses are standard errors.)

Table A6
LTRO effect on cash and debt financing policies

	Cash	Leverage	Net Debt	Short-term Debt
	(1)	(2)	(3)	(4)
Country LTRO Uptake	1.612***	2.945***	3.118***	-0.016***
	(0.56)	(0.65)	(1.15)	(0.00)
Industry Sigma	0.012	0.099***	0.091***	0.001***
	(0.01)	(0.01)	(0.03)	(0.00)
Cash Flow	0.002	-0.058***	-0.122***	-0.000**
	(0.00)	(0.00)	(0.00)	(0.00)
Market to Book	0.014***	0.009***	0.052***	0.000**
	(0.00)	(0.00)	(0.00)	(0.00)
Firm Size	-0.103	2.642***	-3.250***	0.001
	(0.07)	(0.09)	(0.18)	(0.00)
Net Working Capital	-0.123***	-0.301***	-0.631***	-0.005***
	(0.00)	(0.00)	(0.00)	(0.00)
Capital Expenditure	-0.120***	-0.171***	-0.236***	-0.001***
	(0.00)	(0.01)	(0.01)	(0.00)
Cash	0.000***	-0.229***	-0.549***	-0.002***
	(0.00))	(0.00)	(0.00)	(0.00)
Div. Dummy	0.697***	-1.207***	-1.158***	-0.005***
	(0.08)	(0.09)	(0.18)	(0.00)
R&D/Sales	0.016***	-0.013***	0.014**	-0.000***
	(0.00)	(0.00)	(0.00)	(0.00)
Acquisition Activity	-0.022***	0.065***	0.007	-0.000
	(0.00)	(0.01)	(0.01)	(0.00)
Sovereign Risk	1.537***	0.098	0.734***	0.004***
	(0.29)	(0.34)	(0.15)	(0.00)
Sovereign Export	0.531***	1.162***	-0.038	-0.000
	(0.07)	(0.08)	(0.02)	(0.00)
Rated	-0.051***	-0.109***	-1.161*	-0.001
	(0.01)	(0.01)	(0.65)	(0.00)
Time FY	Y	Y	Y	Y
Firm FE	Y	Y	Y	Y
R-square	0.767	0.795	0.778	0.801
N	82053	82053	64040	57166

This table presents estimates of the effect of the liquidity uptake from the ECB's three-year Longer-Term Refinancing Operations (LTROs) on corporate policies in a sample of corporations located in the Eurozone. *Cash* is defined as cash and cash equivalents, scaled by total assets. *Leverage* is measured as the book value of the long-term debt plus debt in current liabilities, divided by total assets. *Net Debt* is defined as the ratio of current plus non-current liabilities minus cash holdings, to total assets. *Short-term Debt* is defined as the ratio of current liabilities to total assets. The variable *Country LTRO Uptake* is equal to zero until Q4-2011, and is equal to the countries' total LTRO uptake amount, scaled by the countries' central government debt, afterwards. The information about the bank-specific LTRO uptake is based upon hand-collected data from Bloomberg, as well as central bank announcements and public commentaries. In all models, we include base corporate-level financial variables in addition to macro-economic variables. The sample period is 2002-2014, based on quarterly observations. (*** denotes significance at the 1% level, ** significance at the 5% level, and * significance at the 10% level. The numbers in parentheses are standard errors.)

Table A7
Counterfactual analysis of the LTRO effect on cash and debt financing policies

Panel A: Cash holdings

	Cash	Cash	
	Full Sample	Risky Sovereign	Safe Sovereign
	(1)	(2)	(3)
Post-LTRO × Non-Eurozone	-0.733***	0.680***	-1.187***
	(0.12)	(0.24)	(0.15)
Post-LTRO	0.749***	0.397	0.656**
	(0.21)	(0.34)	(0.27)
Controls	Y	Y	Y
Time FE	Y	Y	Y
Firm FE	Y	Y	Y
R-square	0.751	0.678	0.762
N	143731	35385	103686

Panel B: Leverage

	Leverage	Leverage	
	Full Sample	Risky Sovereign	Safe Sovereign
	(1)	(2)	(3)
Post-LTRO × Non-Eurozone	-0.619***	-0.363	-1.146***
	(0.13)	(0.29)	(0.16)
Post-LTRO	1.230***	1.451***	-0.176
	(0.22)	(0.42)	(0.28)
Controls	Y	Y	Y
Time FE	Y	Y	Y
Firm FE	Y	Y	Y
R-square	0.793	0.803	0.790
N	143731	35385	103686

This table presents estimates of the "counterfactual" effect of the liquidity uptake from the ECB's three-year Longer-Term Refinancing Operations (LTROs), on corporate cash and leverage policies, in a sample of corporations located in the European Union (EU), both inside or outside the Eurozone. *Cash* is defined as cash and cash equivalents, scaled by total assets. *Leverage* is measured as the book value of the long-term debt plus debt in current liabilities, divided by total assets. The variable *Post-LTRO* is a dummy variable equal to one, for year-quarter observations after the ECB had implemented the first three-year LTRO intervention (Q4-2011). The variable *Post-LTRO* × *Non-Eurozone* is the interaction variable between the non-Eurozone dummies and LTRO intervention and captures, accordingly, the effect of the liquidity intervention on corporate policies in non-LTRO countries ("counterfactual" effect) accordingly, equal to one, for non-Eurozone corporations after the first LTRO intervention (for details see Appendix A1). In Model (1), we use the full sample of corporations. In Models (2) and (3), corporations are separated into high and low risk sovereigns, based on their location and the respective country's CDS spreads. *Risky* (*Safe*) *Sovereign* is defined as a CDS spread above (below) the median in the pre-intervention and crisis period (2009 and 2010). In Panel A and Panel B we present the estimates from our analysis of corporate investment, and wages, respectively. In all models, we include base corporate-level financial variables in addition to macro-economic variables. The sample period is 2002-2014, based on quarterly observations. In all specifications, we use controls, as well as firm- and time-fixed effects. (*** denotes significance at the 1% level, ** significance at the 5% level, and * significance at the 10% level. The numbers in parentheses are standard errors.)

Table A8
LTRO effect on investment: The role of lender characteristics

Panel A: Country LTRO uptake and lenders' size

	Investments		Investments			
			GIIPS		Non-GIIPS	
	Large Lender	Small Lender	Large Lender	Small Lender	Large Lender	Small Lender
	(1)	(2)	(3)	(4)	(5)	(6)
Country LTRO Uptake	-3.107***	-2.897***	0.715	-2.451***	-7.011***	-7.154***
	(0.94)	(0.39)	(2.31)	(2.31)	(1.41)	(1.62)
Controls	Y	Y	Y	Y	Y	Y
Time FE	Y	Y	Y	Y	Y	Y
Firm FE	Y	Y	Y	Y	Y	Y
R-square	0.631	0.613	0.589	0.599	0.642	0.636
N	10245	10068	1336	3534	8909	6534

Panel B: Lender LTRO uptake and lenders' size

	Investments		Investments			
			GIIPS		Non-GIIPS	
	Large Lender	Small Lender	Large Lender	Small Lender	Large Lender	Small Lender
	(1)	(2)	(3)	(4)	(5)	(6)
Lender LTRO Uptake	-0.439***	-0.584***	-0.322	-2.493***	-0.491***	-0.610***
	(0.15)	(0.17)	(0.31)	(0.31)	(0.17)	(0.16)
Controls	Y	Y	Y	Y	Y	Y
Time FE	Y	Y	Y	Y	Y	Y
Firm FE	Y	Y	Y	Y	Y	Y
R-square	0.631	0.612	0.589	0.599	0.641	0.635
N	10245	10068	1336	3534	8909	6534

This table presents estimates of the effect of bank characteristics and the liquidity uptake from the ECB's three-year Longer-Term Refinancing Operations (LTROs), on corporate investment, in a sample of corporations located in the Eurozone. Our measure for corporate investment is *Investments*, which is the corporations' capital expenditure, scaled by total assets. We separate corporations into *Large (Small) Lender*. *Large (Small) Lender* are corporations' whose lenders in Q4-2010 on average had total assets above (below) the median. Panel A shows the results based upon a sample of corporations located in the Eurozone and using the country-specific LTRO uptake. The variable *Country LTRO Uptake* is equal to zero until Q4-2011, and equal to the country-specific total LTRO uptake amount, scaled by the central government debt of the country, thereafter. Panel B shows the results based upon a subsample of Eurozone corporations with existing loan information in LPC Dealscan, and using the lender-specific LTRO uptake. The variable *Lender LTRO Uptake* is equal to zero until Q4-2011, and equal to the LTRO uptake amount of the corporate-related banks, scaled by the size of each bank, thereafter. We classify Eurozone banks as related if the corporation in the five years prior to the first LTRO intervention had a loan relation to the bank. The information about the bank-specific LTRO uptake is based upon hand-collected data from Bloomberg, as well as central bank announcements and public commentaries. The loan information data is obtained from LPC Dealscan. In all models, we include base corporate-level financial variables in addition to macro-economic variables. The sample period is 2002-2014, based on quarterly observations. (*** denotes significance at the 1% level, ** significance at the 5% level, and * significance at the 10% level. The numbers in parentheses are standard errors.)

Table A9
Total LTRO holdings by National Central Banks

	Total LTRO Holdings				Repayment Ratio
	2010	2011	2012	2013	2012 to 2013
Country	EUR billion (1)	EUR billion (2)	EUR billion (3)	EUR billion (4)	percentage (5)
Austria	3.49	7.18	15.71	5.87	-62.62
Belgium	4.12	17.97	39.92	14.29	-64.22
France	20.22	123.14	172.88	61.53	-64.41
Germany	33.46	47.11	69.65	13.77	-80.23
Greece	78.38	60.94	1.95	1.39	-28.79
Ireland	56.03	76.29	63.09	34.50	-45.31
Italy	31.01	160.61	268.30	213.71	-20.35
Netherlands	0.92	3.19	24.48	8.81	-63.99
Portugal	22.97	39.03	49.26	42.69	-13.33
Spain	39.66	156.68	315.35	178.06	-43.53
Total	290.26	692.13	1020.58	574.62	-43.70

This table presents the holdings and repayment of Longer-Term Refinancing Operations (LTROs) by National Central Banks (NCB) in the Eurozone. *Total LTRO Holdings* include all Longer-Term Refinancing Operations, i.e., the three-month to the three-year Longer-Term Refinancing Operations initiated by the European Central Bank (ECB) on December 21, 2011 (LTRO I) and February 29, 2012 (LTRO II), respectively, and are end-of year values. In column 5, the table outlines the percentage change in the total LTRO holdings by NBCs from 2012 to 2013. The information about the NCB LTRO holdings is based upon hand-collected data from the NCBs' websites.

Table A10
LTRO effect on employment, cash and debt financing: The role of banks' early repayment of LTRO

Panel A: Low Early LTRO Repayment

	Wages	Cash	Leverage	Net Debt	Short-term Debt
	(1)	(2)	(3)	(4)	(5)
Lender LTRO Uptake	-0.075	9.365***	20.073***	17.840***	0.025
	(0.25)	(1.79)	(2.87)	(3.47)	(0.02)
Controls	Y	Y	Y	Y	Y
Time FE	Y	Y	Y	Y	Y
Firm FE	Y	Y	Y	Y	Y
R-square	0.843	0.642	0.756	0.768	0.810
N	2879	4615	4615	3847	3673

Panel B: Medium Early LTRO Repayment

	Wages	Cash	Leverage	Net Debt	Short-term Debt
	(1)	(2)	(3)	(4)	(5)
Lender LTRO Uptake	0.003	-0.882***	-0.456	0.318	-0.012***
	(0.06)	(0.23)	(0.33)	(0.46)	(0.00)
Controls	Y	Y	Y	Y	Y
Time FE	Y	Y	Y	Y	Y
Firm FE	Y	Y	Y	Y	Y
R-square	0.683	0.769	0.777	0.812	0.796
N	10769	16001	16001	12636	11981

Panel C: High Early LTRO Repayment

	Wages	Cash	Leverage	Net Debt	Short-term Debt
	(1)	(2)	(3)	(4)	(5)
Lender LTRO Uptake	1.947	6.991	-25.832**	-31.896*	-0.200**
	(2.25)	(11.2)	(12.9)	(16.4)	(0.08)
Controls	Y	Y	Y	Y	Y
Time FE	Y	Y	Y	Y	Y
Firm FE	Y	Y	Y	Y	Y
R-square	0.771	0.717	0.771	0.784	0.736
N	5143	8343	8343	6973	6268

This table presents estimates of the effect of the liquidity uptake from the ECB's three-year Longer-Term Refinancing Operations (LTROs) by loan-related banks, and LTRO repayment policies on corporate polices, in a subsample of Eurozone corporations with existing loan information in LPC Dealscan. Our measure for employment compensation is *Wages*, which is the corporations' total salaries and wages, given in logarithms. *Cash* is defined as cash and cash equivalents, scaled by total assets. *Leverage* is measured as the book value of the long-term debt plus debt in current liabilities, divided by total assets. *Net Debt* is defined as the ratio of current plus non-current liabilities minus cash holdings, to total assets. *Short-term Debt* is defined as the ratio of current liabilities to total assets. In Panel A through Panel C corporations are separated based on their location and the respective country's LTRO repayment policy, compared to the initial LTRO-country uptake. *Low* (*Medium*, *High*) *Early LTRO Repayment* is defined as a LTRO repayment ratio from 2012 to 2013, i.e., at the first possible LTRO repayment date, that is below 30% (between 30% and 70%, above 70%). The variable *Country LTRO Uptake* is equal to zero until Q4-2011, and is equal to the country-specific total LTRO uptake amount, scaled by the central government debt of the country, thereafter. The variable *Lender LTRO Uptake* is equal to zero until Q4-2011, and equal to the LTRO uptake amount of the corporate-related banks, scaled by the size of each bank, thereafter. We classify Eurozone banks as related if the corporation in the five years prior to the first LTRO intervention had a loan relation to the bank. The information about the bank-specific LTRO uptake is based upon hand-collected data from Bloomberg, as well as central bank announcements and public commentaries. The loan information data is obtained from LPC Dealscan. In all models, we include base corporate-level financial variables in addition to macro-economic variables. The sample period is 2002-2014, and based on quarterly observations. (*** denotes significance at the 1% level, ** significance at the 5% level, and * significance at the 10% level. The numbers in parentheses are standard errors.)

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