

# Did ECB Liquidity Injections Help The Real Economy?

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## **Abstract**

In an effort to boost the Eurozone economy, the European Central Bank (ECB) launched a plethora of monetary interventions. While the series of Longer-Term Refinancing Operations (LTROs) was among the most significant of these, their efficacy, measured by the impact on corporate policies in the Eurozone, is an important but unanswered issue. Analyzing a large panel of individual corporations across countries, we find that non-financial corporations issued more long-term debt and hoarded more cash following the ECB liquidity injections. However, this increase in corporate liquidity was not employed in a productive manner, as corporations did not subsequently increase their investments or employment.

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Since the summer of 2009, the European Central Bank (ECB) has been engaged in a series of both conventional and, latterly, unconventional monetary policy actions, such as injecting liquidity into the banking system via the Longer-Term Refinancing Operations (LTROs), of significant size and scope. However, the key question is whether these ECB liquidity injections have helped the real economy, as intended. Despite the overwhelming press coverage on this topic, the existing literature has mainly focused on the impact of the ECB's unconventional monetary policy on the Eurozone banking sector, and the financial ramifications. However, there is still a lack of evidence on the changes that occurred in corporate financial and operating policies in the Eurozone around the time of the ECB liquidity injections, which have implications for the transmission of the real effects of monetary policy. In this paper, we fill this gap in the literature by examining a series of important, exogenous policy shocks in the Eurozone. Specifically, we study unconventional liquidity interventions and their impact on corporate policies, in a unified framework, including cash holdings, financing, investment, and employment. Understanding the real effects of such liquidity injections is important as many central banks around the world are actively and regularly employing this approach in an effort to stimulate their economies.

The Eurozone, and Europe at large, have faced serious fiscal challenges in recent years, at least since Greece requested emergency funds from the European Union (EU), the International Monetary Fund (IMF), and the ECB in April 2010. These fiscal problems caused substantial stress in the financial markets and spread to other periphery countries in the Eurozone, e.g., Ireland, Italy, Portugal, and Spain, and even threatened its very core. As a reaction to heightened sovereign bond yields and the looming European Sovereign Debt Crisis, the EU, the IMF, and the ECB engineered a series of interventions to improve market liquidity, real output, and employment. However, the efficacy of these measures remains hotly debated.

A prominent example of these interventions is the liquidity injected by the ECB into the commercial banks of Eurozone countries via two unconventional programs: LTROs with a three-year maturity in December 2011 and February 2012, respectively. In addition, the ECB announced in June 2014 that it would conduct a series of targeted LTROs (TLTROs), through which the permitted additional borrowing amounts would also be linked to the banks' lending to the non-financial sector, such that the operations became even more directed towards their final goal, i.e., that of overcoming the financing difficulties at the corporate and household levels.<sup>1</sup> Another example of an ECB liquidity intervention in the Euro-area debt markets is the so-called Securities Markets Program (SMP), which was initiated in May 2010. The SMP focused on liquidity provision in the secondary

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<sup>1</sup>[https://www.ecb.europa.eu/press/pr/date/2016/html/pr160310\\_1.en.html](https://www.ecb.europa.eu/press/pr/date/2016/html/pr160310_1.en.html)

sovereign bond markets in particular countries, and had an aim similar to that of the LTRO, i.e., to explicitly safeguard the monetary policy transmission to the corporate sector. More recently, in March 2015, the ECB received legal approval for implementing its Outright Monetary Transactions (OMT) program, after clearing a number of legislative and legal hurdles, following its announcement several months earlier.<sup>2</sup> However, as of May 2016 purchases were not made under the OMT. Instead, the ECB has purchased Eurozone sovereign bonds, asset-backed securities, and caveat bonds under an asset purchase program (APP).

The extant discussion on the effect of market liquidity interventions, both in policy-making circles and in the academic literature, has focused mainly on the overall market reactions (e.g., bond yields or market liquidity) or how the interventions affected financial institutions. Correspondingly, the final goal of boosting *corporate* liquidity and the real economy has not been analyzed in any depth. As noted in the previous literature, macro-liquidity injections do not necessarily translate into corporate liquidity and investment.<sup>3</sup> Furthermore, unconventional liquidity interventions can affect the real economy not only through bank lending to corporations, but also through the corporations' own liquidity, financing, and investment policies. Unconventional monetary policies may boost bank liquidity, making it less necessary for corporations to hold more precautionary cash. However, banks may use the lender-of-last-resort (LOLR) funding to take on more sovereign risk, rather than lend to corporations. Risk taking by banks through their lending may further increase corporate precautionary motives for holding cash. As a result, corporations may save more cash from their operating cash flows, or even borrow more and save the proceeds as cash holdings. Firms may even decrease their risky investments and switch to *safer* cash-equivalent holdings, such as sovereign bonds. In addition, while macro-liquidity injections can relax corporate financing constraints in a particular region, corporate investment may decrease due to a sharp decline in demand from other regions. Consequently, and especially since the LTROs were implemented at a time of low demand, it is less likely that we will observe a positive effect of liquidity injections on the real economy.<sup>4</sup>

In this paper, we explicitly address this lacuna in the literature and investigate whether particular ECB liquidity injections helped the real economy. Specifically, we examine the impact of the macro-liquidity injections on corporate policies in the context of the ECB's

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<sup>2</sup>Figure I provides a detailed time-line of the recent unconventional monetary policies launched by the ECB.

<sup>3</sup>Theoretical discussions can be found in Christiano (1994). He shows that a liquidity injection cannot be effective in standard real business cycle models and has ambiguous effects in a sluggish capital model.

<sup>4</sup>There is a substantial amount of disagreement among business economists on the real effects of those liquidity injections. For example, the Spanish bank BBVA expresses a more optimistic view and argues that ECB liquidity injections could boost Eurozone GDP by between 0.3% and 0.5%.

LTRO I and II, as exogenous liquidity shocks in Eurozone countries. ECB liquidity injections provide an ideal setting for conducting a cross-country study of corporations' response to macro-liquidity interventions, and for making comparisons of the real effects of various policies, in view of the heterogeneity of economic conditions across the Eurozone. We comprehensively examine corporate cash holdings, their debt financing, and investment and employment policies, which are all integrated components of corporate liquidity management policies.

We use a comprehensive data sample that combines monetary policy data from the ECB Statistical Warehouse, loan information on Euro-area lenders from SDC Dealscan, corporate fundamental data from Compustat and S&P Capital IQ, credit rating data on non-financial corporations from CreditPro<sup>®</sup> by S&P Capital IQ, credit default swap data from Markit, and relevant data from other sources.<sup>5</sup> We find that corporations increased their cash holdings following the ECB liquidity injections, both at the time of their announcement and during the programs' implementation. The increase in cash holdings is statistically significant for Eurozone corporations.<sup>6</sup> Our evidence suggests that corporations seem to raise debt from Eurozone banks (and probably also the public bond market) and hoard the resultant cash receipts. The cash holdings analysis in the sample of Eurozone corporations demonstrates the liquidity injection effects, since we use the actual LTRO uptake in each country. Our results show that the cash increase is related to the actual uptake of the banks under the LTRO program in the same country. However, we further find that such an increase in corporate liquidity was not necessarily employed in a productive manner. Corporations subsequently decreased their investments, while there was no significant change in the corporate payments to employees.

Corporations' response to the liquidity injections may depend on the uncertainty they face regarding credit supply ("credit supply shock") and the demand for, and cost of, their products and services (economic uncertainty). A negative credit supply shock or greater uncertainty about future credit supply may increase the corporate precautionary demand for cash holdings. Corporations with greater uncertainty regarding future demand for their products may increase their cash holdings, decrease their investment, and even decrease employee payments by reducing either the number of employees or their wages. Hence, the impact of liquidity injections on the real economy really depends on the resolution of these economic uncertainties and the corporations' perceptions of the policy response. If

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<sup>5</sup>The advantage of using data from Compustat is that we have quarterly rather than annual data, which, for instance, is obtained when using data from Amadeus and very often used in related European corporate studies.

<sup>6</sup>For non-Eurozone corporations in other EU countries, we do not find such an effect, which is consistent with our prediction, since Eurozone countries were more directly affected by the ECB liquidity injections than non-Eurozone countries (see, e.g., Appendix Table B4).

the liquidity injections indeed helped resolve these uncertainties, we would expect to see corporations responding by decreasing their cash hoardings, increasing their investments, and increasing their payments to employees via either increased hiring or wages.

Considering the recent crisis in Europe, the demand uncertainty is generally higher for Eurozone corporations with greater industry competition, and when corporations rely more heavily on domestic demand, which faces higher economic uncertainty, in general. We find that firms reduce investment regardless of their industry structure and taxation environment. However, the reduction in investment is more pronounced for firms in countries with lower exportation, lower corruption, and more modest government debt. Overall, our findings do not suggest that the ECB's unconventional monetary policies helped the real economy in the Eurozone through a change in investment or employment around the time of the liquidity injections.

Understanding the determinants of corporate policies is important for evaluating the effectiveness of the ECB's unconventional monetary policies and, in particular, its liquidity interventions. So far, however, the literature on the drivers of corporate cash holdings in the U.S. has focused mostly on micro-variables such as corporate characteristics, while the macro-variables, including government and regulatory interventions, are seldom examined in any depth. We add new insight into corporations' adjustment of their cash holdings and employment compensation, their use of investment assets, and the issuing of public debt in response to such macro-liquidity injections. We do so in terms of the announcement and the actual excess inflow of liquidity to their lenders, and the potential increase in (cheaper) external funding from the ECB. This paper also provides some new evidence about bank lending frictions and their impact on corporate liquidity. Overall, our study sheds new light on the impact of unconventional liquidity interventions.

Most existing studies on unconventional monetary policies are based on the U.S. experience (e.g., Berger and Roman (2016)). Among the few European studies is Acharya, Eisert, Eufinger, and Hirsch (2015a). On the one hand, our findings are consistent with theirs as both studies find that European corporations hold more cash after an exogenous liquidity shock. On the other hand, we focus on *corporations'* decisions and financing methods. Their research finds that corporations mostly save cash out of their free cash flows, while, in contrast, for our sample corporations, the sources of increased cash holdings are mainly bank loans. We also argue that the ECB liquidity injection has been ineffective, due to heightened economic uncertainty and a strong precautionary motive for corporations to hold cash. Overall, an increase in cash holdings can arise in response to both negative and positive exogenous liquidity shocks.

The rest of the paper proceeds as follows. We discuss the background and related literature in the next section. 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 major corporate policies. In section 5, we conduct additional analyses to provide an understanding of how corporate policies, especially related to investment, react to these liquidity injections. Section 6 concludes.

## I. Institutional Background and Related Literature

Central banks play active and prominent roles in financial markets and their actions may profoundly affect corporate policies. Understanding the impact of monetary policy is a fundamentally important issue. While there is substantial research on the conventional monetary policies of the U.S. Federal Reserve System (see, e.g., Gorton and Metrick (2013), and Romer and Romer (2013) ), there is little research on either non-U.S. policies or unconventional monetary policies, and on their impact on the real economy. Studies on European policies are especially important as Europe has a very different governance structure to the U.S., particularly with regard to economic affairs, and the U.S. analysis may not apply in a straightforward way.

After the global financial crisis and the great recession that ensued, monetary interventions were first initiated by the U.S. government and the Federal Reserve System, and hence several studies in the literature examine U.S. data. The first set of studies focuses on banks' response to the government programs. For example, Duchin and Sosyura (2015) analyze the Troubled Asset Relief Program (TARP) and find that banks that applied for TARP assistance made riskier loans, but maintained the same regulatory capital ratios as before. In other words, banks took advantage of the cheap government funding and engaged in risk shifting and regulatory arbitrage. However, Berger and Roman (2016) argue that TARP helped "main street" in terms of mortgage financing and avoiding default. Foley-Fisher, Ramcharan, and Yu (2014) examine the impact of the U.S. Federal Reserve Maturity Extension Program (MEP) on the corporate financing constraint. They show that corporations that were more reliant on long-term debt experienced more positive stock price increases upon the announcement of the MEP, which aimed to lower the cost of long-term debt. These corporations also increased their long-term debt and investments. Overall, the evidence suggests that the MEP helped corporations to relax their financing constraints. There is a burgeoning literature on the impact on households. For example, Agarwal, Chomsisengphet, Mahoney, and Stroebel (2015) provide evidence that government interventions aimed at lowering banks' funding costs are ineffective in terms of stimulating household borrowing and spending.<sup>7</sup> Chakraborty, Goldstein, and MacKinlay

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<sup>7</sup>We focus here mainly on studies of the impact of unconventional monetary policies on corporations, rather than households.

(2016) find that the mortgage-backed securities (MBS) purchases made by the Federal Reserve may crowd out banks' commercial lending and decrease corporate investment. However, they do not find the same effects for Treasury purchases.

The introduction of unconventional monetary policies in Europe by the ECB led to similar studies based on European data. Eser and Schwaab (2016) study the ECB's SMP, through which the ECB purchased bonds in the market. They find that the SMP helped lower the yield spreads and yield volatilities of European sovereign bonds. Moreover, they point out that it was the *actual* purchases, and not the signaling of the policy, that drove the lower bond yields.<sup>8</sup> De Pooter, Martin, and Pruitt (2015) find consistent results demonstrating that the SMP helped lower the sovereign bond liquidity premium. De Andoain, Heider, Hoerova, and Manganeli (2016) find that ECB liquidity injections helped stabilize the overnight unsecured interbank market. Drechsler, Drechsel, Marques-Ibanez, and Schnabl (2014) find that banks with weaker capitalization borrow from the ECB and post riskier collateral to access the ECB funding. Acharya, Pierret, and Steffen (2016) find different effects from the LTRO and OMT on bank risk. While the LTRO increased banks' holding of risky sovereign debt, the OMT reduced sovereign risk and increased banks' debt holdings. However, De Pooter, DeSimone, Martin, and Pruitt (2015) find SMP announcement effects, but no actual purchase effect on bond yield spreads. Pelizzon, Subrahmanyam, Tomio, and Uno (2015) investigate the dynamic relationship between sovereign credit risk and sovereign bond market liquidity. They find that the change in sovereign credit risk leads the change in market liquidity. However, ECB intervention weakened the adverse relationship and improved market liquidity. Trebesch and Zettelmeyer (2014) investigate the determinants and effects of ECB interventions on the Greek government bond market in mid-2010. They find a much steeper drop in bond yields for those bought by the ECB.

Most studies focus on the impact of unconventional monetary policies on banks rather than the actual users of capital, i.e., corporations, which are our focus in this study.<sup>9</sup> In this regard, Acharya, Eisert, Eufinger, and Hirsch (2015b) show that banks increase their lending to corporations, upon the implementation of the OMT. However, these corporations use the funds to build up their cash reserves, rather than to increase their investment or employment. Acharya, Eisert, Eufinger, and Hirsch (2015a) show that the contraction in the loan supply from Eurozone periphery banks that arose during the financial crisis in 2006-2012 depressed investment, job creation, and sales among related European

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<sup>8</sup>These findings are in contrast to those of Acharya, Imbierowicz, Steffen, and Teichmann (2015), who do find some announcement effects.

<sup>9</sup>Another related area of the literature tackles the determinants of corporate investment, including corporate tax and other factors. For instance, Graham, Leary, and Roberts (2014) study U.S. data and find that government fiscal activities can affect corporate financial and investment policies.

borrowers, and conclude that the 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 (2015) investigate the transmission of the liquidity interventions of central banks to the bank deposit and loan spreads of European corporations. They find differing transmissions of central bank liquidity for low compared to high-risk banks, and an impaired transmission to corporate borrowers from high-risk banks. Carpinelli and Crosignani (2015) also examine the LTRO, but only use data from Italian banks. They highlight the important role of collateral for the transmission of unconventional monetary policies. Garcia-Posada and Marchettin (2015) analyze the real effect of the LTRO on Spanish corporations, find that it had a positive, moderately-sized effect on the supply of bank credit to corporations, and provide evidence of a bank lending channel in the context of unconventional monetary policy. Andrade, Cahn, Fraisse, and Mésonnier (2015) analyze the impact in France and find that LTROs enhanced the loan supply for French corporations. In contrast to much of the prior literature, we provide a comprehensive examination of corporations in the EU as a whole, with a focus on the Eurozone, and examine the effects on corporate liquidity in a more detailed manner.

There is a large literature on corporate cash holdings that is too broad to be surveyed here. We will restrict ourselves to a few prominent examples. In an early paper, Bates, Kahle, and Stulz (2009) show that corporations in the U.S. increased their cash holdings significantly between 1980 and 2006. Such increases in cash holdings have been shown to be a global phenomenon. Pinkowitz, Stulz, and Williamson (2016) find that differences in cash holdings between U.S. and comparable international corporations are not related to country characteristics. Azar, Kagy, and Schmalz (2016) argue that the lower cost of carrying cash can potentially explain the higher cash holdings in recent times. Our study extends this literature by examining the impact of unconventional monetary interventions, during which the cost of holding cash is low, at least for certain corporations with access to cheaper bank credit.

Our paper relates to the above literature and adds new and more granular results to the literature on corporate liquidity management, in line with more recent studies in this area. As outlined by Bolton, Chen, and Wang (2014), corporations that face external financial frictions need to use liquidity reserves to service outstanding debt. Thus, corporations that face only costly lending opportunities will be forced to use their cash reserves. In times of generally illiquid lending markets, the expectation is that corporate cash holding dries up. In another paper, Bolton, Chen, and Wang (2013) argue that, when market conditions are good and/or corporations face significant uncertainties in their future financing conditions, they may raise external funds. In other words, corporations may issue new equity and/or

debt and hoard the proceeds as cash, even if there is no immediate use for the funds. This implies that corporations that face low liquidity conditions or expect a decrease in the liquidity of their credit facilities may have more conservative liquidity policies, and hence maintain high cash-holding ratios. Similarly, Bocola (2016) emphasizes the role of precautionary motive in crisis. Subrahmanyam, Tang, and Wang (2015) examine the relationship between credit default swaps (CDS), debt financing and corporate liquidity management, and find that the inception of CDS trading increases corporate cash holdings, and that this is partly financed by increases in debt financing. The increase in debt financing is then motivated by the less vigilant monitoring of the creditors, which is tantamount to less stringent borrowing conditions for the borrower. All these papers outline the importance of cash holdings for corporate liquidity management, and show that corporations do adjust their internal liquidity with respect to the availability of external funding. Through the investigation contained in this paper, we are able to add insights into the corporations' adjustment of their cash holdings in response to macro-liquidity injections, in terms of the announcement and the actual excess inflow of liquidity to their lenders, and in terms of the potential increase in (cheaper) external funding from the central banks.

Distinct from the previous literature, this paper investigates whether unconventional monetary policies helped the real economy in Europe, by focusing on corporations' response to ECB liquidity injections. Unconventional monetary policies can affect the real economy, not only through bank lending, but also through corporate liquidity management, financing, and investment policies. Macro-liquidity injections do not necessarily translate into corporate liquidity. The unconventional liquidity interventions by the ECB may have boosted bank liquidity, making it less necessary for corporations to hold more precautionary cash. The three-year LTROs were implemented in order to ensure that monetary policy continued to be effectively transmitted to the real economy, thereby supporting the ability of banks to maintain and expand lending to Eurozone households and non-financial corporations. Thus, not only should the LTROs have improved banks' liquidity, but they should also, in particular, have led to a boost in banks' lending to the corporate sector and hence provided a liquidity channel for credit. As such, the announcement by the ECB of its intent to implement medium-term lending facilities should, first of all, have been seen as a signal of direct liquidity provision by the ECB. As outlined by Acharya, Eisert, Eufinger, and Hirsch (2015b), ECB announcements like the whatever-it-takes speech made in July 2012 by the ECB president, Mario Draghi, can themselves have a positive effect, in terms of providing market confidence, even if there is no significant, immediate impact on the real economy.

However, banks' holding of government bonds may crowd out corporate lending. The

decreased credit supply may increase corporations' precautionary cash holdings. Moreover, banks' increased holding of risky government bonds increases the risk to bank lenders, which further increases corporate precautionary cash holdings. Although an important motivation for providing LOLR funding is to stop bank panics, it may increase banks' risk-taking incentives (Drechsler, Drechsel, Marques-Ibanez, and Schnabl (2014)). Acharya and Steffen (2015) also document banks' "carry trade" behaviour during 2007-2013, for risk-shifting and regulatory arbitrage motives. Acharya, Pierret, and Steffen (2016) find that the LTRO facilitated a reallocation of the sovereign debt in bank portfolios (with a home bias). Therefore, the liquidity injection by the ECB may have further encouraged banks' risk taking, and strengthened the sovereign-bank linkage, which will have further increased corporate precautionary cash holdings. As a result, corporations may have been encouraged to save more cash from their existing cash flows, borrow more, and save the proceeds as cash holdings. Corporations may even have decreased their risky investments and switched to "safer" cash equivalent holdings, such as sovereign bonds. In addition, even when macro-liquidity injections can relax the corporate financing constraints in a particular region, corporate investment may decrease due to a sharp decline in customer demand from other regions. All of this makes it less likely for us to observe a positive effect of liquidity injections on the real economy. In the following sections, we will examine the impact of the macro-liquidity injections on corporate policies in the context of the ECB's LTRO liquidity injections.

## II. Data and Methodology

### A. Data

We collect data from several databases that contain European data, so as to analyze the impact of the liquidity interventions made by the ECB. These data are for the period ranging from the adoption of the Euro in 2002 to 2014, and thereby allow us to look at differences in corporate financial, investment, and employment policies during normal and distressed periods, as well as periods characterized by ECB interventions.<sup>10</sup>

We use data on corporate fundamentals from the Compustat Global database. From this source, we identify a sample of European corporations and collect all yearly, as well as quarterly, corporate financial and stock price data for the period 2002-2014. As 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

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<sup>10</sup>We restrict our sample to the period after 2002 in order to allow for an alignment with the establishment of the Eurozone. We set the end of our sample to the year 2014, as the same corporate fundamental data for the year 2015 were unavailable at the time of data collection for this research.

6000 to 6999) and utility corporations (SIC codes 4900 to 4999), as well as corporations for which no SIC code is available. Further, as we are only interested in active corporations, we also require corporations to have a non-negative asset value, and non-negative sales, to be included in a given year (quarter) (as in Bates, Kahle, and Stulz (2009)). We supplement the data from Compustat with corporate data from the Capital IQ database. In contrast to Compustat, Capital IQ compiles, among other things, detailed information on corporate debt structure, using financial footnotes contained in the corporations’ financial reports. From this source, we obtain, in particular, data on the drawn and undrawn portions of their credit lines that we use in extended analyses. Finally, we use CreditPro<sup>®</sup> (S&P Capital IQ) rating data as a proxy for corporate credit risk, so that we are able to estimate the impact of the extraordinary liquidity injection made by the ECB, after controlling for such risk.

To mitigate the effect of outliers, we follow the related literature (see, e.g., Chen, Dou, Rhee, Truong, and Veeraraghavan (2015)) and winsorize the observations for our variables at the 1st and 99th percentile. Further, we follow the conventional approach in related empirical research (as in Bates, Kahle, and Stulz (2009)) and assume that the corporation has no R&D expenditure if it is reported as “missing” by Compustat, setting the missing values equal to zero. We use the same argument for observations of corporations’ merger and acquisition (M&A) activities.

In addition to firm controls for corporate policies, we also use the 5-year sovereign CDS spreads from Markit as a proxy for country credit risk.<sup>11</sup> The 5-year tenor is by far the most liquid one for CDS contracts, and is the benchmark employed in the related literature. We use end-of-quarter observations of the daily 5-year CDS spread to match the quarterly corporate fundamental data. For additional country-specific measures, we use data from the World Bank. As a proxy for a country’s overall exposure to other countries’ economic conditions, we use data on the country’s exportation of goods and services. In order to be able to measure the impact of the ECB liquidity intervention in each country, we also collect annual data on each country’s central government debt obligations. We also use these and other country- and industry-specific data, e.g., export and corporate tax rates, as well as indicators for corruption and competition, to investigate the impact of differences in credit supply, and demand differences, on the sensitivity to the LTRO intervention across corporations.

We restrict our main sample to corporations located in the Eurozone to analyze the impact of liquidity interventions made by the ECB. This sample includes all corporations located in countries that belong to the European monetary union (Eurozone) and thereby

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<sup>11</sup>We restrict the sample of CDS to senior CDS with “complete” or “modified” restructuring as default triggers.

directly affected by the ECB's liquidity interventions.<sup>12</sup> To exclude any potential biases or country-specific reasons for the later adoption of the Euro by some countries, we only include corporations from those countries that adopted the Euro as a common currency in 1999, and the European Monetary System from the time of its inception in January 2001.<sup>13</sup> However, we collect data for both Eurozone and non-Eurozone corporations (see Appendix Table B2) and use the latter as a control group for some of our subsequent analyses.

Our main objective in this research project is to investigate the impact of liquidity intervention on corporate policies. To address this issue, we use the ECB's implementation of its unconventional three-year LTROs, which, in particular, were set in place not only to increase the ECB's support for the Eurozone banking sector, but also to improve the real economy. The two LTROs were unconventional in the sense that the ECB was, for the first time, offering LTROs with a maturity of three years.<sup>14</sup> These operations were announced in early December 2011, and the two LTROs were then implemented on 21 December 2011 (LTRO I) and 29 February 2012 (LTRO II), respectively. The operations themselves were conducted via an auction mechanism. The amount of liquidity that was auctioned was determined by the ECB, and the banks bid against each other to access the available liquidity.<sup>15</sup> In this sense, the uptake of the LTRO may also have been biased in favor of banks that had a particular need for liquidity, and thus participated more aggressively in the auctions.

For detailed information about the LTRO liquidity interventions made by the ECB, and the banks' uptake of the three-year LTRO, we use data from two sources. As we are particularly interested in whether and how much of the liquidity injection made by the ECB flowed to individual banks, we use country-specific aggregate information on the Eurozone banks' uptake of LTRO I and LTRO II, respectively.<sup>16</sup>

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<sup>12</sup>The non-Eurozone sample includes all corporations located in countries that belong to the EU but are outside the Eurozone, e.g., Denmark.

<sup>13</sup>Today, the Eurozone consists of 19 of the 28 EU member states. Slovenia adopted the Euro in 2007 and was followed by Cyprus and Malta in 2008, Slovakia in 2009, and most recently Estonia in 2011. By 2015, Latvia and Lithuania had also adopted the Euro, while Poland and the Czech Republic are current applicants. Further, due to CDS data for Luxembourg being missing, we exclude corporations that are located there (46 companies).

<sup>14</sup>The fundamental difference between the LTRO and other regular refinancing operations, therefore, lies basically in the maturity of the funding made available. This means of financing not only allowed banks to employ more reliable liquidity management, but also eased credit conditions, more generally. Also, the interest rate was set lower than those that would otherwise have been applied, even for credit-worthy banks.

<sup>15</sup>In Appendix A, we provide background information about the LTROs, while the time series of the overall amount of uptake is represented visually in Appendix Figure B1.

<sup>16</sup>The data are hand-collected from Bloomberg and include bank-level uptake information related to LTRO I and II. We thank Matteo Crosignani for kindly sharing these data.

Table I provides these LTRO uptake numbers within the Eurozone, by country.<sup>17</sup> As shown in the table, banks from the periphery countries were highly active due to their actual capital needs, as the LTRO was providing them with their only option for accessing medium-term funding. However, for many banks, participating in the unconventional LTROs also provided an opportunity to replace their shorter-term borrowing with low-cost three-year borrowing.<sup>18</sup> Therefore, even highly rated and safe Eurozone countries like Germany and France participated in the three-year LTRO auctions. In addition, as Table I indicates, the participation in and uptake from the two LTRO auctions were quite similar (both at the aggregate and country levels). The aggregate uptake was about 918 billion Euro, with Italian and Spanish banks being by far the most active in the auctions, in terms of both the number of participating banks and the amounts borrowed.<sup>19</sup> Together, banks in these two countries had an uptake of about 68% of the aggregate uptake.

In Appendix Figure B2 we graphically present the country-specific total LTRO uptake in the Eurozone. In terms of the significance of the ECB liquidity intervention, it is seen from the ratio of the total LTRO uptake to central government debt that the liquidity injection was greatest for countries in the Eurozone periphery, i.e., Greece, Ireland, Italy, Portugal, and Spain (GIIPS). We supplement these intervention-specific data with other Eurozone-wide data provided by the ECB. The latter are obtained from the ECB Statistical Data Warehouse, where all published reports as well as historical data are stored on a monthly or weekly basis, depending on the source.<sup>20</sup>

### B. Empirical Specification

In terms of methodology, our approach is twofold. In the first part of the paper, we provide an investigation into the impact of the ECB’s unconventional LTROs, i.e., LTRO I and II, on corporate liquidity management. We also test the impact of the LTROs on the real economy, i.e., corporate investment and employment policies. Our main measure of corporate liquidity is the corporations’ cash holdings, *Cash*. Cash is the most liquid

<sup>17</sup>While the ECB liquidity auction was only available for banks located in the Eurozone, a few non-Eurozone banks participated through their subsidiaries situated in Eurozone countries. However, the uptake by non-Eurozone-headquartered banks was only minor (about 5% of the total uptake).

<sup>18</sup>See, e.g., the discussion in the Fitch Ratings Special Report “European Banks’ Use of LTRO” [http://inwestycje.pl/resources/Attachment/2012/02\\_28/file13936.pdf](http://inwestycje.pl/resources/Attachment/2012/02_28/file13936.pdf).

<sup>19</sup>The country-specific LTRO data that we use in this study are quite comprehensive and the total numbers are consistent with the data cited in the media. See, e.g., <http://www.bloomberg.com/news/articles/2011-12-21/ecb-will-lend-banks-more-than-forecast-645-billion-to-keep-credit-flowing>, <http://www.marketwatch.com/story/ecb-allots-713-billion-to-banks-in-ltro-2012-02-29>.

<sup>20</sup>See, e.g., <https://sdw.ecb.europa.eu/home.do>. For data on ECB liquidity provision, see e.g. <http://www.ecb.europa.eu/stats/monetary/res/html/index.en.html>. Note that the ECB itself does not provide country-specific data on banks’ participation in its intervention programs.

asset a corporation can hold and a change in cash holdings would clearly reflect a change in corporate liquidity. Following Bates, Kahle, and Stulz (2009) and Subrahmanyam, Tang, and Wang (2015), we measure corporate cash holdings by the ratio of cash and cash equivalents to total assets. As outlined in Table II, the cross-country average of the corporate cash holdings is 8.29% for Eurozone companies. In line with Chen, Dou, Rhee, Truong, and Veeraraghavan (2015), we find wide variation in the cash holdings ratio across countries. Corporations in some countries, e.g. Portugal, have cash holdings that are less than half (4.0%) those of the Eurozone in general, while those in other countries, such as Germany, France, and Ireland, have cash holding ratios of above 10%.

We relate corporate cash holdings to a set of explanatory variables and other controls, including firm and time fixed effects. With respect to the determinants of corporate cash holdings, we follow the models of Chen, Dou, Rhee, Truong, and Veeraraghavan (2015), Bates, Kahle, and Stulz (2009) and Subrahmanyam, Tang, and Wang (2015). Our choice of determinants of cash holdings included in our empirical specifications of the cash holdings models is motivated by the transaction and precautionary explanations for cash holdings. *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. The *Size* variable 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. The variable *Cash Flow/Assets* 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. The variable *Industry Sigma* is the industry cash flow risk, measured by the mean cash flow volatility across two-digit SIC codes. *Net Working Capital* is measured as net working capital minus cash, divided by total assets. *R&D/Sales* is the ratio of R&D to sales. *Capital Expenditure* is the ratio of capital expenditure to total assets. The variable *Acquisition Activity* is the corporation's costs related to acquisitions, scaled by total assets. Finally, the variable *Rated* is a dummy variable that is equal to 1 if the corporation is rated, and 0 otherwise.

In our investigation into the impact of the unconventional LTROs on the real economy, i.e., the investment and employment policies of the corporations, we follow the literature and use the ratio of capital expenditure to total assets as the proxy for investment. Following Table II, the average corporation in our sample uses 3.12% of its total assets on capital expenditure. As a proxy for employment compensation, we use *Wages*, which represents the corporations' total salaries and wages, given in logarithms. Our main controls in the investment and employment compensation model specifications are *Cash Flow/Assets*, *Market to Book*, *Size*, *Leverage* and *Rated*. As investment and employment may also be determined by the lagged ratios of alternative investment measures, e.g., R&D and acquisitions, as well as profitability and the degree of competition in the respective

industry, we also use these controls in extended specifications.<sup>21</sup> We also use measures for corporate profitability and industry competition in our investment and employment compensation specifications. Our proxy for profitability, *Sales*, is the operating income (before depreciation) and is scaled by total assets. Our measure for industry competition is the Herfindahl-Hirschman Index (HHI), which is given by the sum of the squared market shares of corporations within the same industry, for a given year.

As this paper is based upon Eurozone corporations and provides a cross-country study, we also include sovereign CDS spreads and countries' ratios of exports to GDP in our model specifications to control for sovereign credit risk and diversification of the economy across markets. As outlined in Table II, the median CDS spread over the sample period within the Eurozone is about 16.19 bps. The sovereign CDS spread variable shows a large amount of cross-country variation, which implies this is an interesting setting for our study of unconventional monetary policies within the Eurozone. Likewise, we find a large variation in the countries' dependence on exports, which gives us the ability to study the impact of liquidity intervention for corporations that are (or are not) located in countries that rely heavily on local markets.<sup>22</sup> In order to determine the driver of the changes in corporate policies resulting from the intervention, we also investigate the impact of country-specific unemployment and corporate tax rates, as well as indicators for perceptions of corruption. We use annual data on unemployment and corporate tax rates, provided by the World Bank.<sup>23</sup> For the Corruption Perception Index (CPI) we use data from Transparency International, an independent research organization. The CPI is a proxy for the threat to investor rights, and indicates a country's level relative to the other countries in the index in a given year. We follow the method proposed by Fan, Titman, and Twite (2012) and transpose the published CPI score into an index ranging from 0 to 10, with 10 indicating a highly corrupt country.

To capture the liquidity injection impact of the three-year LTROs, we use *LTRO Uptake* as our main measure.<sup>24</sup> *LTRO Uptake* measures the differences between countries in terms of participation in the three-year LTRO auctions, and hence reflects the country-

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<sup>21</sup>For alternative specifications of investment and employment models, see e.g. Almeida and Campello (2007), and Duchin, Ozbas, and Sensoy (2010).

<sup>22</sup>In Appendix Table B3, we provide summary statistics for the non-Eurozone sample. Except for the median sovereign CDS spread, which is significantly lower for Eurozone corporations, we find no general differences between Eurozone and non-Eurozone corporations.

<sup>23</sup>The corporate tax rates are measured as the total tax rates, drawn from World Development Indicators, and measure the amounts of taxes and mandatory contributions payable by businesses, after accounting for allowable deductions and exemptions, as a share of commercial profits.

<sup>24</sup>As an alternative and simplified measure, we use LTRO intervention, which is a dummy variable equal to 1 for year-quarter observations after the ECB had implemented the first three-year LTRO intervention (Q4-2011) (0 otherwise). Hence, LTRO intervention will be used to capture the overall impact of the three-year LTRO liquidity injection on corporate cash holdings.

specific uptake of liquidity. In particular, *LTRO Uptake* is equal to zero until the first round of the unconventional LTRO, Q4-2011, and equals the amount of each country’s total uptake through LTRO I and II, scaled by the country’s central government debt holdings in the year 2011, i.e.,

$$LTRO\ Uptake = \frac{\text{Total Uptake Amount}_{t,c}}{\text{Central Government Debt}_{2011,c}} \quad (1)$$

where  $t$  indicates the year-quarter and  $c$  refers to the country. The interpretation of the variable is as follows: A high value of *LTRO Uptake* implies that the uptake through the LTROs compared to the existing government debt was significant, and hence, all else being equal, would have affected the local banking sector more than another country’s banking sector that had a low uptake. Thus, the variable measures the country-specific significance of the unconventional monetary policy implemented by the ECB. The advantage of this specification is that the variable not only differentiates between countries that had a high or low uptake, respectively, but also takes into consideration whether the liquidity intervention was significant in relation to each country’s local banking sector. 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 terms of their liquidity management, financing, and investment policies.<sup>25</sup>

In section III., we analyze the stand-alone impact of the *LTRO Uptake* measure on corporate cash holdings, investment, and employment compensation. We also investigate the impact of the LTRO intervention on corporate debt financing, and then concatenate the relation to other changes in corporate policies. This helps us to determine the source of the change in corporate policy, and hence the actual transmission of liquidity provided by the ECB to the corporate sector.<sup>26</sup>

In the second part of the paper, we further investigate why the LTRO was ineffective at boosting investment. Specifically, our aim is to understand the details of the corporations’ response to the liquidity injections and the resulting impact on the real economy. To this end, we study the corporate policies in the different subsamples and analyze the interaction of our main intervention measure, *LTRO Uptake*, with corporate, industry, and country characteristics.

Overall, our investigation analyzes the two competing drivers of changes in corporate policies: the credit supply shock (credit supply uncertainty) versus uncertainty related to

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<sup>25</sup>For robustness, we also use the ratio of country-specific LTRO uptake to the countries’ GDPs. In contrast to our main measure, this ratio also reflects the importance of the LTRO liquidity intervention relative to the size of each country’s economy. Our main results are robust to this alternative definition of the countries’ LTRO uptake.

<sup>26</sup>A full description of all our variables can be found in Appendix Table B1.

the demand for, and cost of, their products (economic uncertainty). We first analyze corporations' reliance on bank debt. If corporations indeed interpreted the liquidity injection as a credit supply shock, their increased cash holdings may simply have been funded by increases in their bank debt holdings. However, if the uncertainty of future demand and costs dominated, the real economy would not have been rejuvenated by the liquidity injection since the corporate reaction would have been tepid. We test the demand uncertainty argument by investigating the role of industry competition, and country-specific levels of exportation and credit risk.

### III. LTRO and Corporate Policies

In this section, we investigate the impact of an unconventional liquidity intervention on corporate policies. We focus on the three-year LTRO interventions (macro-liquidity) made by the ECB and corporate liquidity management in terms of the precautionary demand for cash holdings (micro-liquidity). We also investigate the LTRO's impact on corporations' debt financing policies, as a channel for changes in their cash holdings, and the consequent effect on corporate investment and employment compensation.

#### A. Cash Holdings

Macro-liquidity injections, like the ECB's unconventional LTROs, do not necessarily translate (directly) into corporate liquidity. An analysis of both the supply-side, in this case provided by the banking sector, and the demand-side action, i.e., the corporate response, is necessary if we are to understand such liquidity transmissions. On the one hand, unconventional liquidity interventions may boost bank liquidity, making it less necessary for corporations to hold precautionary cash. If this were the outcome of the liquidity injection, this would, from a corporate liquidity perspective, have achieved the ECB's goal in making the intervention. On the other hand, banks may use the LOLR funding to take on additional sovereign risk, rather than lend to corporations. Further, the risk taking by banks may accentuate the corporations' precautionary motives for holding cash. As a result, corporations may save more cash from their operating cash flows, or even borrow more and save the proceeds as additional cash holdings (cash hoarding). If the latter effect dominates, we would expect to see corporations in the Eurozone, and particularly those situated in countries with a high LTRO uptake, to have increased their precautionary cash holdings following the LTRO intervention.

Whether a boost in bank liquidity, and hence the transmission of liquidity to the corporate sector, will be effective or not depends, not only on the supply side, but also on the demand for, and cost of, the corporations' products and services. At the onset of

the European sovereign debt crisis, aggregate demand was clearly down; indeed, when the unconventional LTROs were introduced in late 2011, demand across European countries and markets remained slack. Thus, in this framework of high demand uncertainty, corporations would have been likely to maintain their precautionary motives for holding significant amounts of cash. Consequently, and independent of the supply-side effect, it is very unlikely that a liquidity injection into the banking sector would have led to decreases in corporate cash holdings. Thus, if corporate demand uncertainty remained large, and thus impaired the lending supply shock effect, we expect that corporations in the Eurozone, and particularly those based in countries with a high LTRO uptake, would have increased their precautionary cash holdings following the LTRO intervention. While, in a later section, we analyze the effectiveness of the LTRO intervention in terms of supply and demand, we first investigate the impact on corporate cash holdings itself.

To investigate the corporate response to the LTRO intervention, we first of all note the determinants of cash holdings used in the model proposed by Opler, Pinkowitz, Stulz, and Williamson (1999) and Bates, Kahle, and Stulz (2009). In addition to the conventional determinants of corporate cash holdings, we then include the variable *LTRO Uptake* as our main variable of interest. We conduct the analysis in the sample of Eurozone corporations and the results are presented in Table III, Model 1. As seen in Model 1, we find a positive and significant coefficient estimate for *LTRO Uptake* at a 1% level, suggesting that Eurozone corporate cash holdings increased following the unconventional LTRO liquidity injection. In particular, we find that the effect increases with *LTRO Uptake*, i.e., that corporations located in countries where the excess inflow of liquidity to their lenders was high increased their cash holdings more than others. The coefficients for the other control variables are generally consistent with prior findings. Corporations with high *Market to Book* and *R&D/Sales* ratios have greater precautionary cash holdings, since it is more costly for them to be financially constrained. Large corporations generally have less cash due to the economies of scale of holding cash. *Capital Expenditure* and *Acquisition Activity*, which create assets that can be used as collateral for borrowing, lead to a decrease in precautionary cash holdings. With regard to our specified country controls, *Sovereign CDS* and *Sovereign Export*, we find that countries with higher credit risk and lower export intensity hold more cash, in general. This is in line with the precautionary motive for holding cash.

The three-year LTRO intervention by the ECB provided a significant liquidity injection to banks in the Eurozone. Such a macro-liquidity injection may generate a positive *bank lending* shock, and thus not only create an immediate source of additional borrowing for corporations but, in particular, mitigate the corporations' uncertainty in terms of future credit supply. With a positive bank lending shock, the corporate cash holdings

and capital expenditure of corporations that are reliant on bank borrowing will fall and rise, respectively. Hence, we expect corporations that, before the intervention, relied on bank debt and thus had access to bank debt as an external financing source, to have been more strongly affected by the macro-liquidity injection, all else being equal. However, if macro-liquidity injections cannot mitigate corporate uncertainty about the future (bank) lending supply, we would expect to observe a greater increase in cash holdings, and an even larger decrease in investment, for bank-reliant corporations.

Based upon the above argument, we use corporate reliance on bank debt to initially test the impact of the LTRO intervention on cash holdings. In particular, we separate corporations into subsamples with *High Bank Debt* and *Low Bank Debt*. The separation is based upon the corporations' bank debt obligations (*Bank Debt*) one year before the first three-year LTRO intervention (Q4-2010). *Bank Debt* is the debt in the form of bank loans divided by total assets. Then, the *High Bank Debt* (*Low Bank Debt*) subsample includes corporations with a bank debt to asset ratio above (below) the median. In Table III, Models 2 and 3, we present our results for corporate cash holdings.

As shown in Table III, Model 2, we find a positive and significant coefficient for corporations that use bank-related loans and credits as their main source of debt financing. In contrast, the coefficient is positive, but insignificant, for less bank-reliant corporations. Hence, the results suggests that corporations that used bank loans as their main source of debt financing prior to the LTRO interventions, and were accordingly more closely related to their banks, increased their cash holdings more than corporations with no, or only minor, use of bank debt did. Thus, while all corporations may have had a heightened precautionary motive for holding cash, only those that had a (significant) amount of bank borrowing actually increased their liquidity, i.e., their cash holdings. This may underscore the fact that at least one source of our finding of increased cash holdings is the increase in existing bank borrowing that followed the LTRO intervention and the subsequent bank-lending shock. In particular, corporations may have been able to refinance existing loans (debt renegotiation, including improved borrowing conditions), or take up new loans.<sup>27</sup> In both cases, corporations may have been able to hoard the additional proceeds from bank borrowing as cash.<sup>28</sup>

In Appendix Table B4, we provide an analysis of the sample of *all* corporations in the

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<sup>27</sup>For more information, see e.g. a special report provided by Fitch Ratings on European banks' use of LTRO ([http://inwestycje.pl/resources/Attachment/2012/02\\_28/file13936.pdf](http://inwestycje.pl/resources/Attachment/2012/02_28/file13936.pdf)).

<sup>28</sup>In line with this argument, large corporations in particular should have better access to lending and are less constrained. They should, therefore, have exploited the bank lending supply shock more. We therefore expect that the increase in cash holdings after the LTRO intervention will have been more pronounced for large corporations. When we classify our sample into large and small corporations in our robustness test, our results confirm this hypothesis.

EU, i.e., the combined sample of Eurozone and non-Eurozone corporations. As the ECB’s monetary intervention programs were only available for banks in the Eurozone, the main variable of interest is the interaction term  $LTRO\ Dummy \times EURO$ .  $LTRO\ Dummy$  is a dummy variable that is equal to 1 after the implementation of the first LTRO (Q4-2011) and captures the start of the unconventional three-year LTRO intervention (Q4-2011). The variable  $EURO$  is a dummy variable equal to 1 if the corporation is located in a Eurozone country (0 otherwise). Compared to corporations outside the Eurozone, we find that Eurozone corporations were more heavily affected by the LTRO intervention. In particular, we observe a positive and significant coefficient for  $LTRO\ Dummy \times EURO$  (0.932%), indicating that corporations in the Eurozone increased their precautionary cash holdings even more than those outside it.

Overall, the latter results suggest that corporations in the Eurozone increased their cash holdings following the LTRO liquidity injection. However, the impact of a macro-liquidity injection on corporate liquidity policies may also depend on the corporate precautionary motive and the marginal value of cash. When the marginal value of cash is high, corporations have a greater precautionary demand for cash holdings. We therefore expect that these corporations would have been more likely to increase their cash holdings following the announcement of an unconventional liquidity injection. In Appendix Table B5, we use the corporations’ credit rating and leverage ratios as proxies for the precautionary demand for cash holdings, and show that the impact of the unconventional LTROs on cash holdings is amplified for more risky corporations, i.e. those with a higher precautionary motive for holding cash.<sup>29</sup>

### *B. Leverage Policies*

To investigate whether the LTRO intervention may indeed have increased the corporations’ cash holdings due to an increase in corporate borrowing, we next analyze the impact of the unconventional LTROs on corporate debt financing policies. For this investigation, we use several corporate debt financing measures, and the results for all alternative specifications are presented in Table IV. As before, the variable of interest is  $LTRO\ Uptake$ . As indicated in Table IV, we do find positive and significant coefficients for corporate leverage and net debt holdings, while short-term debt holdings are lower for corporations that are located

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<sup>29</sup>Corporations with non-investment-grade ratings not only have higher credit risk, but, compared to investment-grade-rated corporations, will also be more constrained, financially, having more limited access to debt markets and thus having to borrow at a higher cost. Similarly to low-rated corporations, highly leveraged corporations have greater default risk, and may thus face lower costs of carrying cash. Following the argument of Azar, Kagy, and Schmalz (2016), this may lead to greater cash holdings. In addition, concerns about debt-servicing costs may lead to an increased precautionary demand for cash holdings (Bolton, Chen, and Wang (2014)). This implies that the value of cash becomes strictly higher for corporations with high leverage and a high cost of debt.

in (high) LTRO-uptake countries. As outlined in Models 1 and 2, we find that the increase in corporate leverage is even larger than the increase in cash holdings, suggesting that cash is not equivalent to negative debt. In addition, we find a positive and significant coefficient for *LTRO Uptake* in the model of *Net Debt*, which is defined as the ratio of current plus non-current liabilities minus cash holdings to total assets. For *Short-term Debt*, which include all current liabilities of the corporations, we find a negative impact. This suggests that corporations may have replaced shorter-term with longer-term liabilities. Recall that the LTRO intervention was an unconventional monetary policy that, for the first time, included three-year funding opportunities for Eurozone banks.<sup>30</sup> Not only would the participating banks' replacement of their own short-term borrowing with longer-term borrowing have increased bank lending to the corporate sector in general, but it may also have caused banks to offer to the corporate sector loans with longer maturities. A related discussion in the case of French corporations can be found in Andrade, Cahn, Fraisse, and Mésonnier (2015). The results showing decreased short-term holdings are thus in line with our expectations.

In line with the findings by Darracq-Paries and Santis (2013), we conclude from our own results that corporations increased their reliance on debt financing following the macro-liquidity injection. In particular, the results show that the three-year LTROs significantly increased the chances of loans being provided to non-financial corporations. This supports the view that the three-year LTROs can be interpreted as a favorable credit supply shock. Thus, the bank liquidity shock may indeed have been transformed into a bank lending shock, through which Eurozone corporations were able to increase their debt financing. Given the results showing increased corporate cash holdings, in particular for corporations that are highly reliant on bank debt, and increased leverage, we can infer that increased borrowing may have been an important source of the increase in cash holdings. We emphasize that, based only on this analysis we cannot exclude the possibility that there may have been other sources of funding for that increase.

### C. *Investment and Employment Compensation*

The implementation of the liquidity intervention by the ECB may not only have affected corporate liquidity management but also had an impact on corporate investment and employment decisions. Corporate access to debt markets has an impact on investment (Harford and Uysal (2014)) and financing frictions do affect corporate investment decisions (Almeida and Campello (2007)). Thus, the availability of debt financing, and hence the credit supply shock, will have an impact on corporations' investment policies. Likewise,

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<sup>30</sup>For details, please see Appendix A.

we expect that increased availability of debt financing may have increased employment compensation. In particular, the impact on employment compensation could either be due to an increase in the level of wages, or an increase in the number of employees. Both a positive effect on investment and increased employment compensation would suggest an ameliorating impact of the LTRO on the real economy. However, as do corporate cash holdings, both corporate investment decisions and employment compensation depend upon economic uncertainty, and in particular uncertainty of product demand (Guiso and Parigi (1999)). If product demand is low, then corporations will be more reluctant to invest (in terms of property, plant, equipment, and employees). In this framework, the LTRO intervention and the related increase in corporations' debt financing may not necessarily have led to increased investment. As demand uncertainty at the time of the LTRO implementation was clearly high, it would have been optimistic to have expected a positive impact on either corporate investment or employee compensation: In other words, we would not expect that the intervention alone would have been able to resolve the problem of demand uncertainty. In terms of the ECB's intended objective with the introduction of the LTRO, this would mean that the unconventional LTROs would not necessarily have helped the real economy, and thus not achieved the ECB's goal, at least at the corporate level.

To investigate whether the LTRO intervention had an impact on corporate investment and employment decisions, we next present the results for our investigation into proxies for corporate investment and employment compensation. The analysis is conducted among the sample of all corporations in the Eurozone, and the results are presented in Table V. The variable of interest is *LTRO Uptake*. In Models 1 and 2, we use the ratio of capital expenditure to total assets as our proxy for corporate investment. In Model 1, we only add controls that affect the corporate capital expenditure decision. In Model 2, we add lagged versions of alternative investment measures such as dividend payment, R&D investment, and acquisition activities, as well as other controls, as a robustness check. As the table shows, when controlling for corporate fundamentals, we find a negative and significant coefficient for the country-specific LTRO uptake measure. This indicates that corporations located in countries with a high uptake of additional liquidity in the banking sector actually *decreased* investment, following the LTRO intervention. One explanation is that the LTRO implementation came along with additional baggage in terms of the use of the increased liquidity by banks for purposes other than corporate lending, such as investment in high-yield sovereign bonds. This may have increased uncertainty about future product demand, and hence corporations may have become more reluctant to invest. This argument is in line with our previous finding of increased precautionary cash holdings. The effect of decreased investment may also have been amplified by the fact that countries

with high LTRO uptakes were countries with low investment, in general.

In Table V, Models 3 and 4, we provide the same analysis for corporate employment compensation. As a proxy for employment compensation, we use corporations' total expenses related to wages (on a logarithmic scale). Here, we do not find a significant effect for the LTRO uptake measure. Hence, similarly to the case of corporate investment, the corporate spending on employees was not affected positively by the introduction of the unconventional LTRO. Our tentative conclusion is thus that, while corporations may have had access to more debt financing, they did not use the proceeds from the additional borrowing to invest in their businesses, but instead hoarded them as cash.

#### D. *LTRO-Bank Relations and Corporate Policies*

While our main focus in the paper is to examine the aggregate impact of the LTRO intervention on corporate policies, it should be stressed that the effectiveness of the liquidity transmission to the corporate sector depends, to a large extent, on the response of, and the changes in, the lending behavior of banks that participated in the three-year LTRO auctions. In other words, corporations with a relation to such a "LTRO-bank" should, in general, be more affected by the ECB's LTRO intervention, if it was indeed effective. On the one hand, the LTRO-bank relation establishes a direct link of some corporations to the injected liquidity. On the other hand, however, these corporations would also be more exposed to additional risk taking by the LTRO-banks.

To provide a deeper investigation of the impact of the LTRO-bank relation, we collect syndicated loan information from the SDC Dealscan database and create a subsample of corporations with lender and loan information. In particular, we match the information on banks that participated in the LTRO auctions with the lender-share and loan facility data in SDC Dealscan.<sup>31</sup> At the same time, we match our main sample of Eurozone corporations with the loan facility data in SDC Dealscan.<sup>32</sup> Then, by using the loan facility data, we are able to match the LTRO participating banks (as lenders) with a subsample of the Eurozone corporations (as borrowers) and, in particular, identify whether the corporations have a relation with a bank that participated in the LTRO auctions. For the respective analyses, we define the variable *LTRO-Bank Relation* as is equal to 1, if in the five years prior to the first LTRO auction the corporation had a loan that was made by a bank that participated in the three-year LTRO auctions. We use this variable to differentiate between corporations that did (did not) have a direct access to the ECB

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<sup>31</sup>Based upon our data on bank-level uptake information for Eurozone banks that participated in the LTRO auctions we are able to identify 89 bank as lenders with syndicated loans covered in SDC Dealscan.

<sup>32</sup>We match corporations by using the Dealscan-Compustat Link provided by Chava (2008) as well as by hand-matching corporations by name and country of origin.

liquidity injection in the lender-matched sample. In total, we are able to match 862 corporations, using this procedure, of which 443 have a *LTRO-Bank* relation. Table VI, Panel A, shows the corporation-specific summary statistics and confirms that there is no major sample bias induced by our procedure for identifying loan relations.<sup>33</sup>

In Table VI, Panel B, we provide an analysis of the impact of the *LTRO* liquidity injections on corporate policies in the subsample of corporations, for which we have lender information. Model 1 in Table VI, Panel B, outlines the regression results for the cash model, where we add the interaction of *LTRO-Bank Relation* and *LTRO Uptake*. The interaction term *LTRO-Bank Relation*  $\times$  *LTRO Uptake* captures the effect of the *LTRO* intervention for corporations that not only are located in a high *LTRO* uptake country, but also had a relation to a bank that participated in the *LTRO* auctions, at the point of the intervention. In general, these corporations would be more likely to be affected by the *LTRO* credit supply shock. In line with this argument, we find a negative, statistically significant coefficient for *LTRO-Bank Relation*  $\times$  *LTRO Uptake*, which suggests that direct access to additional liquidity provided by the ECB may indeed have reduced the precautionary liquidity holdings of Eurozone corporations. However, as the coefficient for *LTRO Uptake* remains positive and significant, and is greater in magnitude, the aggregate effect of an increase in precautionary cash holdings after the *LTRO* intervention remains robust.<sup>34</sup>

Models 2, 3, and 4 in Table VI, Panel B, investigate the effect of corporations' direct access to ECB liquidity through their *LTRO-bank* relation on leverage policies. We find a positive and statistically significant coefficients for *LTRO-Bank Relation*  $\times$  *LTRO Uptake* in the regressions on *Leverage* and *Net Debt*. For short-term debt, however, the impact is insignificant. The results support our previous conclusions of increased lending after the *LTRO* intervention, and the pronounced effect for corporations with direct access to the additional credit from Eurozone banks. In Table VI, Panel B, Models 5 and 6, we also use the subsample of lender-matched corporations for which we have loan information to investigate the difference in corporate investment decisions among corporations with and without a direct access to the ECB liquidity. As seen, we find a negative and statistically significant coefficient for *LTRO-Bank Relation*  $\times$  *LTRO Uptake*, while the coefficient for *LTRO Uptake* is positive and statistically significant. The result for the former variable confirms the precautionary investment strategies corporations in the aftermath of the

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<sup>33</sup>SDC Dealscan provides loan pricing information on syndicated loans, which typically are only made to larger corporations. In line with this supposition, we observe a minor sample bias in terms of corporate size (corporations' asset size, given in logarithms).

<sup>34</sup>In the model specifications, we also include the *LTRO-Bank Relation* dummy variable itself. However, as it is omitted from the estimation due to the use of firm-fixed effects, we do not report these estimates in the table.

LTRO intervention.<sup>35</sup> Overall, the analyses in the restricted sample of corporations with bank lender information confirms our finding that firms increase their cash holdings and leverage and decrease their investment after LTRO liquidity injections.

#### IV. Why Was LTRO Ineffective in Boosting Investment?

In the previous section, we investigated corporate policies following the three-year LTRO intervention, and presented evidence of increased corporate liquidity holdings. We also showed that the liquidity injections did not necessarily help the real economy. In particular, corporations increased their debt obligations and hoarded the resulting cash proceeds, while their investment and employment compensation were unaffected by (or even decreased after) the intervention. In this section, we conduct several additional analyses to investigate why the LTRO was ineffective in boosting investment and employment. Investment and hiring decisions may depend on various factors, such as uncertainty about *future* credit supply (credit supply uncertainty), a firm's own supply incentives (affected by industry competition and tax policies), and the demand for the corporation's own products (economic uncertainty). In addition, the institutional environment may affect corporate policies, including financial policies. All of these factors may constrain or even impede the real effect of LTROs in boosting corporate investment.

Overall, we expect that a positive lending supply shock may reduce corporations' credit supply uncertainty and boost their investment. Considering that the LTRO injections operated throughout the banking system, the investment-boosting effect should have been more prominent for firms with a greater dependency on bank debt. However, industry competition and tax policies may also affect corporate investment incentives, which may accentuate or impede the LTRO effect. Moreover, corporations facing greater economic uncertainty may decrease their investment even when there is an increased bank credit supply following LTRO liquidity injections. The institutional environment also plays an important role in influencing corporate policies, and could have pushed them in the intended direction or otherwise. Thus, the impact of a LTRO liquidity injection on corporate investment and employment really depends on corporations' simultaneous consideration of these various factors. In the following analysis, we construct proxies for factors that affect corporate investment policies, to address this issue. If the liquidity injection was efficient in terms of resolving at least some of these considerations, then we would expect to see that corporations responded by increasing their investment and employment compensation.

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<sup>35</sup>The result also stays robust (in terms of magnitude) when taking the aggregated effect of *LTRO-Bank Relation*  $\times$  *LTRO Uptake* and *LTRO Uptake*.

### A. *Bank Debt Reliance*

The three-year LTRO intervention implemented by the ECB provided a significant liquidity injection to banks in the Eurozone. The stated hope of the program was that, with a positive bank lending shock, corporate investment might increase due to a loosening of financial constraints and, hence, the provision of additional financing for new corporate investments. In particular, the ECB hoped that investment might increase for those corporations that relied more on bank financing and might not have had access to alternative sources of funding. However, if macro-liquidity injections do not mitigate corporate uncertainty about the future, then we would expect to observe no change or even a decrease in investment for all corporations. Therefore, an analysis of corporate investment, conditional on corporate dependency on bank debt, will provide additional evidence in our investigation of the LTRO's impact on the real economy.

To this end, in Table VII, 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 (Q4-2010). Then, we run the same subsample analysis for corporate investment and employment compensation policies as for corporate cash holdings. For our measure of investment, *Capital Expenditure*, we find negative and significant coefficients for the LTRO uptake measure in all specifications. In terms of magnitude, the coefficients are quite similar for high- and low-bank-reliant corporations, suggesting there is no significant difference between the two samples. Models 3 and 4 in Table VII present our results for our measure of employment compensation, *Wages*, conditional on bank debt dependency. In contrast to our investigation of cash holdings and investment, we do not find any significant effect when we investigate the bank-reliance impact and the effect on employment compensation, following the LTRO intervention. Thus, conditional on corporations' reliance on bank debt, we again find no evidence of a positive impact of the liquidity interventions on corporate employment compensation. These results may be partially driven by the stickiness of corporate employment and compensation policies in general. It is possible that the real effects of monetary policy on employment take much longer to manifest themselves and are not observable in just a few years.

Overall, the investment results conditional on bank debt dependency presented in this section provide additional evidence that the LTRO intervention does not necessarily boost the real economy at least in the medium term. The negative coefficients for *LTRO Uptake* for both the high- and low-bank-debt subsamples suggest that there might be other factors that explain the decrease in investment that occurred following the LTRO liquidity injections. In the following sections, we construct proxies for some of these factors

that affect corporate investment policies, to develop a better understanding of the LTRO impact in their presence.

### *B. Corporate Supply Incentive*

Industry competition and tax policies may affect the corporate supply incentive, which in turn plays a role in shaping corporate investment decisions. Accordingly, the finding of reduced investment following LTRO liquidity injections might be driven by corporate supply incentives. In this section, we construct proxies for corporate supply incentives, i.e., industry competition and tax policies, and investigate their potential impact on the LTRO effects on corporate investment.

#### *B.1. Industry Competition*

The environmental framework and structure of a corporation's industry might be an important factor affecting its policies. Valta (2012) finds that corporations operating in competitive product markets generally face a higher cost of bank debt. Akdoğu and MacKay (2008) document that corporations in monopolistic industries are slower to invest than corporations in competitive industries for which investment opportunities are contestable. Hence, we expect that, in this framework, corporations in highly competitive industries would be more aggressive in increasing their investment, generally. Therefore, compared to corporations operating in less competitive industries, we are more likely to observe the positive effects of LTROs on investment for corporations operating in more competitive industries. On the other hand, deferring irreversible investment is valuable in the face of uncertainty. In a period of crisis, it might not be industry competition but rather the larger concerns of the macro-economic environment that act as the driving force behind corporate investment decisions and the transmission of LTROs' real effects.

We test the impact of industry structure on LTRO effects by separating corporations into *High Competition* and *Low Competition* subsamples. We use the HHI as our proxy for industry competition, basing the separation on the corporations' individual SIC-code classification. A company is classified into the *High Competition* (*Low Competition*) group if it operates in an industry with an above (below)-median HHI, in a given year. The results are presented in Models 1 and 2 of Table VIII. We find negative and significant coefficients for corporations in both the *High Competition* and *Low Competition* samples. Furthermore, the impacts on investments seem quite similar, in terms of magnitude, for the two subsamples, suggesting there is no significant difference between investment policies across different levels of industry competition. However, the results also indicate that investment declined after the LTRO intervention. Thus, overall, it seems that industry

competition does not drive the finding of a decrease in investment following the liquidity injections.

### B.2. Corporate Taxes

Tax policy is another factor that may affect corporate incentives to increase investment. Based on survey data, Djankov, Ganser, McLiesh, Ramalho, and Shleifer (2010) document a large adverse impact of corporate tax rates on aggregate investments. Becker, Jacob, and Jacob (2013) also find evidence of an impact of dividend payout taxes on corporate investment. The consideration of current and/or future tax policies when making investment decisions may impede the transmission of positive effects from the LTRO to the real economy.

Accordingly, we study the LTRO impact, conditional on corporate taxes. To investigate the role of corporate tax rates we separate firms into *High Corporate Tax* and *Low Corporate Tax* samples, based upon the countries' corporate tax rates. A company is classified into the *High Corporate Tax* (*Low Corporate Tax*) group if it operates in a country that has an above (below)-median corporate tax rate one year before the first three-year LTRO intervention (2010). The results are presented in Models 3 and 4 of Table VIII. We find negative and significant coefficients for *LTRO Uptake* in both the *High Corporate Tax* and *Low Corporate Tax* samples. Therefore, the results suggest that investment declined after the LTRO intervention, irrespective of the corporate tax rate. Together with the findings for industry competition, the results suggest that the finding of a decrease in investment following the LTRO liquidity injections was not driven by corporate supply incentives (proxied by industry competition and tax policy).<sup>36</sup>

### C. Demand Uncertainty

In the previous sections, we found evidence that the corporate-bank relationship and supply incentives were not necessarily the drivers of the reduced investment following the LTRO liquidity injections. In this section, we further investigate this effect by analyzing the impact of general economic uncertainty on the corporate response to the liquidity

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<sup>36</sup>We also investigate the role of financial constraints. One could argue that corporations that are more financially constrained would be more cautious with regard to their investment and, accordingly, be more reluctant to increase their product supply (Buchuk, Larrain, Muñoz, and I. (2014)). In Appendix Table B6, we use industry capital intensity and corporate cash flows as proxies for financial constraints. Capital intensity, in particular, measures the corporation's reliance on tangible (fixed) assets. Similarly, corporate cash flows measure firm profitability, another source for investment financing. Even when these two variables are included in the estimation, we find that firms reduce their investment after the LTRO intervention, *independent* of industry capital intensity and corporate cash flows. These results support our main finding that the decrease in investment was not driven by differences in corporate supply incentives.

injections. For instance, demand uncertainty for a corporation's products and services may affect its corporate policies. Considering the recent crisis in Europe, economic uncertainty is generally higher for Eurozone corporations that face greater industry competition, that rely more heavily on domestic demand, and that are situated in periphery, i.e., high-risk countries. Accordingly, the corporate response might be different for corporations facing different levels of economic uncertainty, e.g., product demand uncertainty (Kahle and Stulz (2013)).<sup>37</sup> If the liquidity injections resolved at least some of the product demand/cost uncertainties by creating more solutions, then corporations with greater uncertainty about macro-economic conditions before the intervention may have decreased their precautionary cash holdings, increased their investment, and even paid higher wages to their employees or hired more of them. Otherwise, regardless of the conditions confirming a positive bank lending shock, if the liquidity injection did not help to resolve the product-demand/cost uncertainties, then corporations with greater uncertainty before the intervention may have had an even greater precautionary demand to hold cash afterwards.

Corporations with a greater reliance on the domestic market may, in general, face greater future product demand uncertainties. This is especially true for Eurozone corporations that are an integral part of the European Union, and during long-lasting economic downturns, such as the Eurozone sovereign debt crisis. One important measure of a country's external economic dependency in terms of markets is the level of their exports. Countries that are highly reliant on income from export markets will be more exposed to changes in global demand. Thus, export-oriented countries may be the ones that suffer the most when there is a global downturn. However, when the downturn is local, rather than global, export-oriented countries may actually be better off than countries primarily reliant on domestic markets. Indeed, the unconventional monetary policy of the LTRO was initiated in response to the severe economic downturn in the European economies. In this framework, being a highly export-oriented country may actually have been an advantage in terms of providing stable cash flows and profits, and adequate liquidity needs to face any rebound in the global economy. Thus, our expectation with respect to cross-country dependency is that corporations located in countries that rely on their domestic market would have been the ones exposed most heavily to the Eurozone sovereign debt crisis. Accordingly, we expect the liquidity injection through the LTROs to have had the largest impact on corporations in countries with a high reliance on domestic demand, i.e., low-export countries.

To investigate this impact, we separate our sample of Eurozone corporations into *High Export* and *Low Export* corporations. A corporation is included in the *High Export* (*Low*

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<sup>37</sup>In the same vein, Gennaioli, Ma, and Shleifer (2016) emphasize the impact of corporations market expectation on investment policies.

*Export*) subsample if it is located in a country with an export-to-GDP ratio above (below) the median, in a given year. Based on the sample of corporations in the Eurozone, the analysis is then conducted within the two subsamples. The results are presented in Table IX, where we find that corporations situated in countries with greater reliance on domestic markets (*Low Export*), in contrast to those in high-export-oriented economies (*High Export*), significantly decreased their investment following the LTRO liquidity injections. Since the objective of the LTRO liquidity injections was to stimulate the real economy in the Eurozone, the greater decrease in investment for corporations with high dependency on the domestic market provide evidence suggesting that the interventions did not necessarily succeed.<sup>38</sup> Moreover, demand uncertainty may have been the driver of the key finding of decreased investment following the LTRO, and hence little impact from the liquidity interventions.

#### D. Institutional Environment: Corruption and Government Debt

As argued earlier, the institutional environment may affect corporate policies. Uncertainty in the institutional setting in a corporation’s home country is particularly relevant during periods of financial crisis. As Julio and Yook (2012) discussed, the uncertainty “itself may be hindering a recovery by inducing firms to delay investment until the uncertainty related to future financial regulation and macroeconomic policy is resolved.” They document that corporations decrease their investment due to political uncertainty. Using aggregate data, Pindyck and Solimano (1993) and Mauro (1995) also finds that political uncertainty lowers investment and economic growth. In addition, Graham, Leary, and Roberts (2014) find that government debt is strongly negatively correlated with corporate investment, but positively correlated with corporate liquidity.

Considering the importance of the institutional environment, we expect that corporate policies around macro-liquidity injections may change the institutional environment of the country in which a corporation is situated. On the one hand, corporations in countries with a relatively poor institutional environment (such as more corrupt or high-sovereign-debt countries) are likely to be more conservative, and experience a greater decrease in their investment following the LTRO intervention, i.e., a bank lending shock. On the other hand, such countries, like Greece, may already have been facing severe austerity at the start of the European crisis, leaving little room for further decreases in investment. Of course, in the face of future demand uncertainty in the European area, a decrease in investment in countries with a strong institutional environment might also be observed.

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<sup>38</sup>In a similar test on corporate employment compensation, we find for neither high- nor low-export-oriented corporations a significant change in employment compensation. This confirms the finding that the interventions did not necessarily succeed.

Therefore, poor institutional environment might not have been the driver of the decreased investment following the LTRO liquidity injections.

To investigate the impact of the institutional environment on corporate policies after the liquidity injections, we analyze the impact of the country-level CPI and the sovereign debt levels as proxies for the institutional environment. The CPI is a proxy for the threat to investor rights and is published by Transparency International, an independent agency, as the country’s ordinal position relative to the other countries in the index. We follow the method proposed by Fan, Titman, and Twite (2012) and transpose the published CPI score into an index ranging from 0 to 10, with 10 indicating a highly corrupt country. Then, we classify firms into subsamples based on their home country’s CPI index. High-CPI countries are those with a CPI greater than 5 in a given year. We then conduct our investment analysis within the subsamples of firms located in *High Corruption* and *Low Corruption* countries, respectively. We present our results in Models 1 and 2 of Table X. We find that the decrease in investment following the liquidity injection is concentrated in countries with a low corruption index, i.e., less corrupt countries. In Models 3 and 4, we further classify firms into subsamples based on their government debt levels. *High Gov. Debt* (*Low Gov. Debt*) are countries with government debt to GDP ratios above (below) the median in a given year. Then, we conduct the investment analysis within the high and low government debt subsamples. The results indicate that the decrease in investment following the LTRO liquidity injection was concentrated among countries with low government debt. These findings make intuitive sense, since corporations in more corrupt and high-government-debt countries may already have very low investment levels. Although corporations in these countries will be more concerned about political uncertainty, there is little room for any further reduction in investment. As a result, the decrease in investment following the LTRO liquidity injection is driven mainly by corporations in relatively “good” countries, i.e., those with lower levels of corruption and government debt.

#### *E. Counter-factual Analysis*

The results from the previous sections suggest that the LTRO was ineffective in boosting corporate investment, since corporations have other concerns besides the availability of macro-liquidity when making their investment decisions. In particular, corporations’ concerns about the uncertainty of demand for their products may have impeded the positive impact of the LTRO on the real economy. Moreover, our results suggest that corporations tended to hold more cash reserves after the LTRO liquidity injection. We also find evidence that corporations in “good countries” are the drivers of the poor investment.

These findings help us to develop a better understanding of the real effects of the LTRO intervention, and may have implications for the design of future monetary policies. However, in order to emphasize that our results do *not* imply that LTRO is bad for corporate investment (or that LTRO induces corporate non-investment), we conduct several counter-factual analyses in this section so as to try to understand the proper benchmark effect for the evaluation of LTROs. Specifically, we want to identify what the corporate policies may have been in the absence of the LTRO intervention.

To estimate the counter-factual effect of the LTRO intervention, we investigate corporate policies after the LTRO intervention took place, in a sample of corporations located in the EU, with non-Eurozone corporations used as the control group for the LTRO effects. While 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.<sup>39</sup> In order to account for major differences in economic conditions between countries, and the respective deferred impact, we match the EU sample countries based upon their sovereign risk, when investigating the impact of the LTRO. In particular, we measure country risk using the country's CDS spreads two years before the LTRO intervention. *High (Low) Sovereign Risk* is defined as a CDS spread above (below) the median in the pre-intervention and crisis period (2009 and 2010). In Appendix Figure B3, we first compare the market-to-book values of Eurozone and non-Eurozone corporations across years. The market-to-book ratio is a relative metric that measures the valuation of a corporation, with a market-to-book value greater than 1 indicating a highly valued corporation. We observe an increasing trend in the market-to-book ratios for both Eurozone and non-Eurozone corporations following the LTRO injections. Most interestingly, we see that, while the difference between the market-to-book ratios of corporations from high and respectively low-risk countries in the Eurozone widened following the financial crisis, the spread actually declined following the LTRO intervention period. The decrease in the spread is, in particular, driven by Eurozone corporations in countries with high sovereign credit risk, as these corporations exhibited a greater increase in spread. In the meantime, the spread in the market-to-book ratios between the high and low-risk groups of corporations *outside* the Eurozone increased even more following the intervention.

Next, we conduct a regression analysis within a sample of corporations located in the EU, using non-Eurozone corporations as our control group. The results for cash holdings, investment, and employee payments are presented in Table XI Panels A, B, and C, respectively. In Model 1 of all panels, we use the full sample of corporations. The

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<sup>39</sup>This is valid with the exception of non-Eurozone banks with bank subsidiaries located in the Eurozone. Also, we do not account for other stimulus measures that may have been implemented in the non-Eurozone countries during the same period.

variable *LTRO Dummy* is a time dummy variable, equal to 1 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 1 for corporations located in countries that do not belong to the Eurozone. The variable *Non-Eurozone*  $\times$  *LTRO Dummy* is the interaction term between the LTRO intervention and non-Eurozone dummies, and is accordingly equal to 1 for non-Eurozone corporations in year-quarters coming after the first LTRO intervention. The coefficient of interest is that of that variable, capturing the effect of the liquidity intervention on corporate policies in non-LTRO countries (the counter-factual effect). As seen from for the term *Non-Eurozone*  $\times$  *LTRO Dummy*, compared to corporations in the Eurozone, non-Eurozone firms have lower cash holdings during the post LTRO intervention period. Moreover, we find a negative and significant coefficient for the term *Non-Eurozone*  $\times$  *LTRO Dummy* for both the investment and wages analyses. This suggests that non-Eurozone corporations may have experienced an even greater decrease in investment than those in the Eurozone.<sup>40</sup>

In Models 2 and 3 of Table XI Panels A, B, and C, 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. The separation is similar to that used in Figure B3. We then compare corporate policies during the post-LTRO intervention period for the high and low-sovereign-risk groups. In the sample of corporations in low-risk countries, we find that Eurozone corporations have a greater increase in their cash holdings following the LTRO than non-Eurozone corporations (the counter-factual). However, the difference is not significant for the high-risk group. We further find that Eurozone corporations generally experienced a greater decrease in their investment and wages, in both the high and low-risk groups, following the LTRO, than did non-Eurozone corporations. In Figure II, we also plot the level of cash holdings and investment of Eurozone and non-Eurozone corporations, matched by sovereign risk, around the LTRO liquidity injections. Before the LTRO, they generally showed similar trends in their cash holdings and investment, which validates the matching based on country risk. However, after the LTRO, the Eurozone corporations exhibited a greater increase in their cash holdings. We also observe a slight decrease in investment for Eurozone corporations.

If non-Eurozone corporations (or sovereign-risk-matched non-Eurozone corporations) are the appropriate counter-factual (subject to the caveats in previous footnotes), the results in this section would suggest that, although the LTRO was inefficient in boosting

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<sup>40</sup>In other, statistical robustness specifications, we also include the variables *LTRO Dummy* and *Non-Eurozone* itself. However, due to the use of firm- and time-fixed effects these variables are omitted from the estimation and, hence, the results in Table XI are robust to the extended model specification.

corporate investment, the economy might have fared even worse (with lower corporate liquidity, lower investment, and lower employee payments) without the LTRO intervention.

## V. Conclusions

Since the 2008 global financial crisis, major central banks around the world have virtually exhausted their conventional monetary policy tools for boosting the real economy; for instance, interest rates have reached the zero bound for many countries. Consequently, they have resorted to unconventional monetary policies such as asset purchases and liquidity injections, and seem willing to do “whatever it takes”, including targeting zero or even negative interest rate policies. There have been many studies on how such unconventional monetary policies affected asset prices, as well as the transmission of these monetary interventions to commercial banks, the most directly affected entities. Remarkably, there has been relatively little discussion of how corporations are affected, either positively or negatively, by these policies, and particularly with regard to actual liquidity injections. In this paper, we fill this void and investigate the policies of non-financial corporations in the Eurozone and the EU, more generally, following the unconventional interventions by the ECB. To this end, we provide direct evidence on the effects of central bank liquidity injections on the real economy.

Examining the impact of the ECB’s LTROs in 2011 and 2012, we find that non-financial corporations in the Eurozone held more cash after these massive LTRO liquidity injections. The cash increase is closely related to the *actual* uptake of the banks in the corporation’s country of domicile, under the LTRO program. In other words, when the commercial banks in a country received more funds from the ECB via the LTRO programs, non-financial corporations in the same country ended up with more cash. Moreover, we find that the increase in cash holdings is significant only for corporations with existing bank relationships. We conjecture that, for those corporations without an existing connection to any banks, it is unlikely that there would be a pass-through effect from a liquidity injection to the banking sector. Furthermore, even for those with a bank relationship, we find that such corporations increased both total debt and net debt, despite reducing their short-term debt after the LTRO, suggesting they indeed raised additional debt. However, in terms of the real economy, we do not find evidence of a positive impact of the liquidity intervention on corporate investment or employment, in any of our alternative model specifications. In fact, we find that corporations *decreased* their investment when the banks in their home countries received more money from the LTRO programs. Such a reduction in investment existed for corporations irrespective of whether or not they had a bank relationship.

We also find little evidence from the supply side to explain the investment results. Corporations reduced their investment after LTRO, regardless of their industry structure or taxation environment. However, the effect is even more pronounced for corporations located in countries with less exportation, lower corruption, or more modest government debt. These findings suggest that the efficacy of the ECB's unconventional liquidity policies was not only determined by the positive credit supply shock accompanying the intervention, but also by the economic uncertainty over future demand and costs, perceived by corporate decision makers, which was not alleviated by the policy intervention.

Our findings indicate that non-financial corporations in the Eurozone were indeed affected by the ECB liquidity injections, in terms of cash holdings and leverage. However, at least part of the impact turned out to be different from what the ECB intended. If corporations simply hoarded the cash that they borrowed from banks instead of hiring or investing, then the real economy could not have benefited from the flood of liquidity circulating around the banking system and on corporate balance sheets. Overall, our study casts doubt on the effectiveness of certain unconventional monetary policies in improving real economic output. Other unconventional monetary policies, including the ECB's TLTROs (and negative interest rates applied by the Bank of Japan and the ECB itself) or the more aggressive OMTs, may result in different outcomes, but they too should be carefully discussed and analyzed. We leave these issues for future study, to be carried out once additional data have become available.

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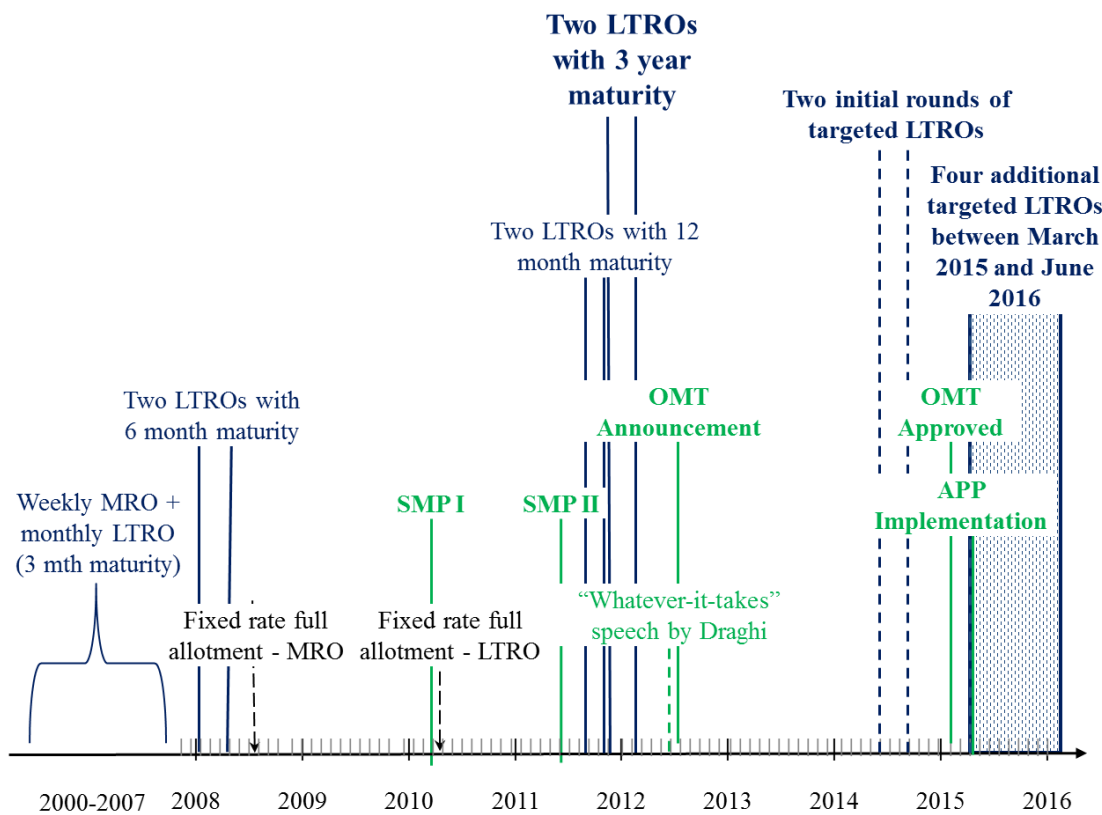
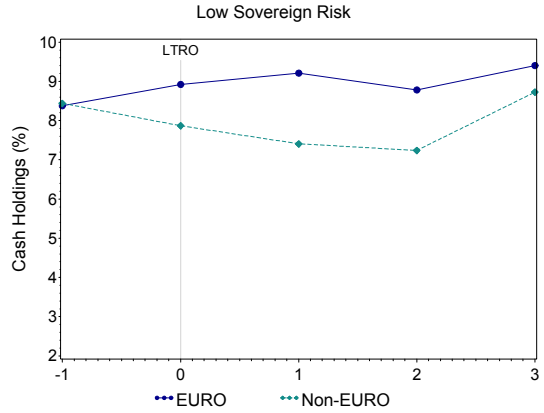
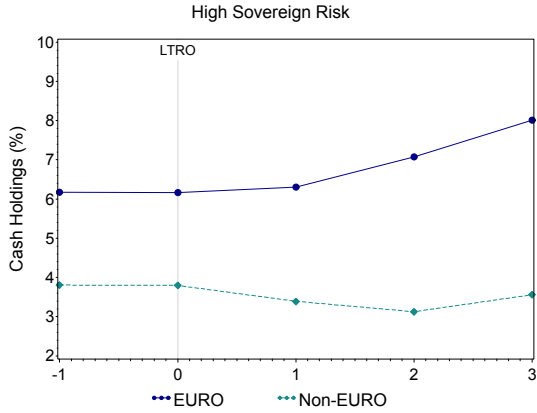


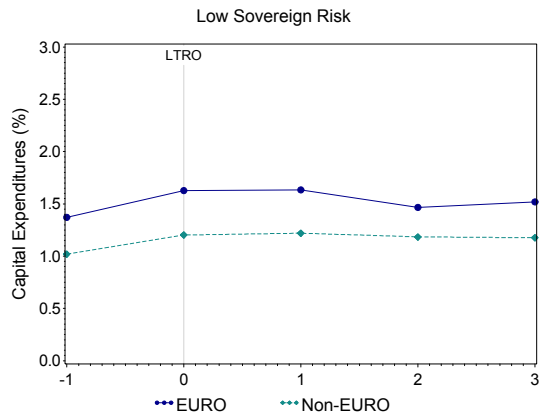
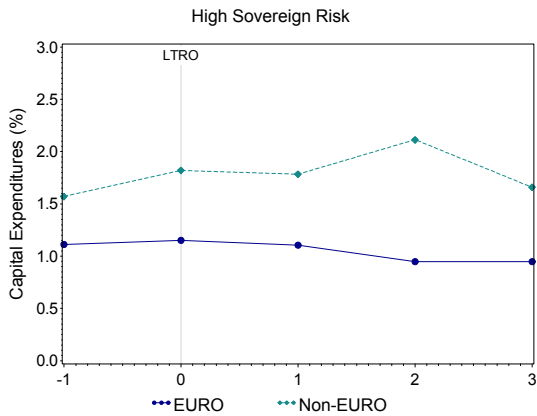
FIGURE I – ECB’S UNCONVENTIONAL MONETARY POLICIES

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. *LTRO* refers to Longer-term Refinancing Operations, while *TLTRO* refers to the recently introduced Targeted Longer-Term Refinancing Operations. *SMP*, the Securities Markets Program, was recently replaced by the Outright Monetary Transactions (*OMT*) program. *APP* represents the lately introduced Asset Purchase Program. The “*Whatever-it-takes*” event refers to a speech made by Mario Draghi, the President of the ECB, at the Global Investment Conference, London, July 26, 2012.



(a) Corporate cash holdings in high-sovereign-risk countries.

(b) Corporate cash holdings in low-sovereign-risk countries.



(c) Corporate investment in high-sovereign-risk countries.

(d) Corporate investment in low-sovereign-risk countries.

FIGURE II – TIME SERIES OF CORPORATE CASH HOLDINGS AND INVESTMENT BEFORE AND AFTER THE LTRO INTERVENTION

The figures outline the development in corporations' cash holdings (cash to assets ratio) and investment (capital expenditure to assets ratio) around the LTRO intervention in 2011/2012. Time "0" indicates the year of the first LTRO intervention (2011) and the variable for cash (investment) is the average of the quarterly observations of the corporations' cash to assets (capital expenditure to assets) ratio. Similarly, times "-1" ("1", "2", "3") indicate the year 2010 (2012, 2013, 2014). We separate corporations into *EURO* and *Non-EURO* samples based upon whether they are located in a Eurozone, respectively non-Eurozone, country. Further, we provide the analyses separately for *High Sovereign Risk* and *Low Sovereign Risk* countries, the separation being based upon countries' CDS spreads in the pre-intervention period (2009 and 2010).

TABLE I – LIQUIDITY INJECTION FROM THE ECB’S THREE-YEAR LONGER-TERM  
REFINANCING OPERATIONS

Country	LTRO I: Dec. 2011	LTRO II: Feb. 2012	Total	LTRO Uptake
	EUR billion (1)	EUR billion (2)	EUR billion (3)	% of government debt (4)
Austria	3.66	7.83	11.49	4.82
Belgium	45.28	43.71	88.99	25.02
France	5.59	6.52	12.12	0.61
Germany	12.25	13.13	25.38	1.67
Greece	60.94 <sup>a</sup>		60.94 <sup>a</sup>	25.54
Ireland	21.91	17.62	39.52	22.33
Italy	172.08	128.11	300.20	15.92
Netherlands	8.86	1.96	10.81	2.58
Portugal	24.54	24.76	49.30	29.37
Spain	153.21	165.53	318.74	51.44
Total	508.32	409.17	917.49	

*Notes.* This table presents the liquidity injections that Eurozone countries obtained from the three-year Longer-term Refinancing Operations (LTRO) that were initiated by the European Central Bank (ECB) on December 21, 2011 (LTRO I) and February 29, 2012 (LTRO II), respectively. The term *Uptake* refers to the amount that banks in the respective country obtained through LTRO I and II, with the numbers given in billions of Euros. The *Total* refers to the total uptake from the two LTROs. In column 4, we scale the *Total Uptake* for each country by the country’s central government debt obligations, as of December 2011. 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 for government debt by country is obtained from the World Bank Database.

<sup>a</sup> 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 out, the number is not directly comparable to the uptake numbers for the other countries.

TABLE II – SUMMARY STATISTICS

Country	DEU	FRA	ITA	GRC	NLD	FIN	ESP	BEL	AUT	IRL	PRT	Total
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
Investment	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
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 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
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/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
Ind. 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
NWC	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	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Competition	13.75	13.74	13.19	10.48	14.74	13.62	14.02	14.52	14.46	14.34	13.48	13.73
Sov. CDS	10.55	11.71	52.00	56.40	29.95	13.09	50.74	24.96	10.35	27.89	36.86	17.62
Sov. 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
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
Corruption	2.10	3.10	5.70	6.00	1.09	0.80	3.50	2.60	2.10	2.50	3.70	2.90
Corp. 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
# N	31333	30712	10825	9810	6594	6000	5443	4939	3376	2519	2392	113943
# Corp.	837	837	285	233	190	143	136	124	92	75	57	3009

*Notes.* This table provides sample averages (medians) of corporate characteristics for each country in our sample of Eurozone corporations. *Cash* is the ratio of cash and short-term investments to total assets. *Investment* 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 Debt* is the ratio of current liabilities to total assets. *Bank Debt* is the amount of debt from bank loans, divided by total assets. *Size* is the total assets, given in logarithms. *Market/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* is the ratio of acquisitions to total assets. *Industry Competition* is the Herfindahl-Hirschmann Index (HHI) industry competition measure. *Sovereign CDS* is the five-year sovereign CDS spread for the country. *Sovereign Export* is the country's export-to-GDP ratio. *Government Debt* is the country's central government debt to GDP ratio, given as a percentage. *Corruption* is the country's corruption perception index (CPI index), which ranges from 0 to 10, with 10 indicating the most corrupt country. *Corporate Tax* is the country's corporate tax rate given as a percentage. The sample period for each country is 2002-2014, and the variables are based on quarterly observations. For any data unavailable for a specific quarter, we replace the missing values with the yearly observations. Ratios are given in percentages.

TABLE III – LTRO UPTAKE AND BANK DEBT RELIANCE EFFECT ON CASH HOLDINGS

	Cash	Cash	
	(1)	High Bank Debt (2)	Low Bank Debt (3)
LTRO Uptake	2.169*** (0.56)	2.609*** (0.61)	0.166 (0.98)
Industry Sigma	0.021 (0.01)	0.102*** (0.02)	-0.016 (0.02)
Cash Flow/Assets	0.001 (0.00)	0.000 (0.00)	0.004 (0.00)
Market to Book	0.014*** (0.00)	0.015*** (0.00)	0.015*** (0.00)
Size	-0.113 (0.07)	-0.714*** (0.10)	0.662*** (0.12)
Net Working Capital	-0.124*** (0.00)	-0.064*** (0.00)	-0.188*** (0.00)
Capital Expenditure	-0.121*** (0.00)	-0.037*** (0.01)	-0.190*** (0.01)
Leverage	-0.167*** (0.00)	-0.140*** (0.00)	-0.199*** (0.00)
Div. Dummy	0.665*** (0.08)	0.388*** (0.11)	0.752*** (0.12)
R&D/Sales	0.015*** (0.00)	0.029*** (0.00)	0.019*** (0.00)
Acquisition Activity	-0.023*** (0.00)	0.035*** (0.01)	-0.047*** (0.01)
Sovereign CDS	1.491*** (0.29)	0.295 (0.26)	0.785** (0.39)
Sovereign Export	0.552** (0.24)	-0.036** (0.01)	-0.053*** (0.01)
Rated	-0.048*** (0.01)	0.846 (0.52)	1.862*** (0.37)
Time fixed effect	Yes	Yes	Yes
Firm fixed effect	Yes	Yes	Yes
R-square	0.767	0.589	0.778
N	82053	30126	43777

*Notes.* 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 (LTRO) on corporate cash holdings in a sample of corporations located in the Eurozone. *Cash* is defined as cash and cash equivalents, scaled by total assets. *Bank Debt* is the debt from bank loans, divided by total assets. Model 1 outlines our base cash model that, in addition to basic cash-holding determinants, includes the country-specific controls, *Sovereign CDS* and *Sovereign Export*. In Models 2 and 3, 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 *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 coefficient of interest is that of *LTRO Uptake*, which captures the effect of the country-specific significance of the liquidity intervention on corporate leverage policies. 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 IV – LTRO UPTAKE EFFECT ON LEVERAGE POLICIES

	Leverage (1)	Net Debt (2)	Short-term Debt (3)
LTRO Uptake	4.420*** (0.65)	3.554*** (1.15)	-0.012*** (0.00)
Industry Sigma	0.112*** (0.01)	0.106*** (0.03)	0.001*** (0.00)
Cash Flow/Assets	-0.059*** (0.00)	-0.123*** (0.00)	-0.000** (0.00)
Market to Book	0.008*** (0.00)	0.051*** (0.00)	0.000 (0.00)
Size	2.640*** (0.09)	-3.271*** (0.18)	0.001 (0.00)
Net Working Capital	-0.302*** (0.00)	-0.633*** (0.00)	-0.005*** (0.00)
Capital Expenditure	-0.173*** (0.01)	-0.239*** (0.01)	-0.001*** (0.00)
Cash	-0.228*** (0.00)	-0.549*** (0.00)	-0.002*** (0.00)
Div. Dummy	-1.271*** (0.09)	-1.196*** (0.18)	-0.005*** (0.00)
R&D/Sales	-0.013*** (0.00)	0.013* (0.00)	-0.000*** (0.00)
Acquisition Activity	0.064*** (0.01)	0.007 (0.01)	-0.000 (0.00)
Rated	0.020 (0.34)	-1.234* (0.65)	-0.002 (0.00)
Sovereign CDS	2.763*** (0.28)	0.559 (0.45)	0.010*** (0.00)
Sovereign Export	-0.106*** (0.01)	-0.021 (0.02)	-0.000 (0.00)
Time fixed effect	Yes	Yes	Yes
Firm fixed effect	Yes	Yes	Yes
R-square	0.795	0.778	0.801
N	82053	64040	57166

*Notes.* This table presents estimates of the effect of the liquidity uptake from the ECB's three-year Longer-term Refinancing Operations (LTRO) on leverage in a sample of corporations located in the Eurozone. *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 *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 coefficient of interest is that of *LTRO Uptake*, which captures the effect of the country-specific significance of the liquidity intervention on corporate leverage policies. 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 V – LTRO UPTAKE EFFECT ON INVESTMENT AND EMPLOYMENT

	Investments		Wages	
	(1)	(2)	(3)	(4)
LTRO Uptake	-1.695*** (0.24)	-1.350*** (0.25)	-0.145 (0.08)	-0.101 (0.09)
Cash Flow/Assets	0.009*** (0.00)	0.005** (0.00)	-0.004*** (0.00)	-0.007*** (0.00)
Market to Book	0.004*** (0.00)	0.004*** (0.00)	0.000*** (0.00)	0.000** (0.00)
Size	0.127*** (0.03)	0.218*** (0.04)	0.675*** (0.01)	0.365*** (0.02)
Leverage	-0.016*** (0.00)	-0.020*** (0.00)	-0.001** (0.00)	-0.001 (0.00)
Rated	0.332*** (0.12)	0.340** (0.14)	0.100 (0.06)	0.135** (0.06)
Sovereign CDS	-0.771*** (0.10)	-0.670*** (0.10)	-0.102** (0.05)	-0.055 (0.05)
Sovereign Export	-0.014*** (0.00)	-0.017*** (0.00)	0.004* (0.00)	0.004* (0.00)
Lagged Div. Dummy		0.118*** (0.04)		-0.019 (0.01)
Lagged R&D/Sales		0.580*** (0.13)		0.028 (0.05)
Lagged Acquisition Act		-2.409*** (0.36)		-0.481*** (0.15)
Industry Sigma		-0.014** (0.00)		-0.001 (0.00)
Net Working Capital		-0.007*** (0.00)		-0.000 (0.00)
Log Sales		0.148*** (0.03)		0.356*** (0.01)
Competition		0.001 (0.00)		-0.005*** (0.00)
Time fixed effect	Yes	Yes	Yes	Yes
Firm fixed effect	Yes	Yes	Yes	Yes
R-square	0.568	0.597	0.787	0.790
N	86392	64635	51997	47910

*Notes.* This table presents estimates of the effect of the liquidity uptake from the ECB's three-year Longer-term Refinancing Operations (LTRO) on corporate investment and employment compensation 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. Our measure for employment compensation is *Wages*, which is the corporation's total salaries and wages, given in logarithms. 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 *LTRO Uptake* is equal to zero until Q4-2011, and is equal to the country's total LTRO uptake amount, scaled by the country's central government debt, afterwards. The coefficient of interest is that of *LTRO Uptake*, which captures the country-specific significance of the liquidity intervention. 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 VI – LTRO-BANK RELATION AND CORPORATE POLICIES

<i>Panel A: Summary statistics for Eurozone sample with existing loan information</i>												
Country	DEU	FRA	ITA	GRC	NLD	FIN	ESP	BEL	AUT	IRL	PRT	Total
Cash	8.57	8.92	7.55	4.82	6.75	5.41	6.63	6.88	8.42	9.11	4.10	7.72
Investment	3.97	3.36	2.99	4.07	3.35	3.88	3.43	3.81	5.67	2.78	5.53	3.60
Wages	3.07	3.65	3.30	2.62	3.85	3.76	3.77	2.91	3.72	1.89	3.94	3.38
Leverage	22.4	24.2	30.8	41.6	24.9	28.2	32.9	26.0	25.0	29.3	38.0	26.4
Net Debt	60.5	63.0	69.0	65.3	61.6	59.5	67.2	60.7	54.5	62.9	71.3	62.5
Short Debt	0.05	0.05	0.10	0.15	0.04	0.08	0.08	0.05	0.08	0.02	0.08	0.06
Bank Debt	10.5	9.29	22.6	23.3	11.6	13.3	25.8	9.94	15.9	12.3	11.8	13.2
Size	6.32	6.83	6.64	6.07	7.19	6.78	7.02	6.52	6.44	7.11	7.62	6.73
Market/Book	118.6	121.3	117.3	98.51	131.7	121.8	117.3	119.2	120.8	143.4	128.9	120.4
Cash Flow	4.84	4.07	3.77	2.32	5.90	6.61	6.00	5.14	6.01	3.13	6.46	4.73
Ind. Sigma	6.52	5.05	3.13	2.69	4.76	4.12	2.53	4.73	3.31	2.98	2.78	4.57
NWC	5.44	-1.8	-1.4	0.03	1.66	3.02	-1.8	-3.5	8.35	0.91	-7.7	0.96
R&D/Sales	0.02	0.00	0.00	0.00	0.00	0.59	0.00	0.00	0.33	0.00	0.00	0.00
Acquisition	0.00	0.00	0.00	0.00	0.24	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Competition	13.9	13.9	13.2	13.5	14.4	15.7	14.4	14.2	15.9	14.6	13.3	14.1
# N	9678	9272	3036	1501	3536	2121	2747	1837	980	1180	423	36311
# Corp.	221	223	78	33	94	47	65	39	22	31	9	862
# LTRO- Bank Rel.	113	105	51	7	49	15	46	23	11	16	7	443

*Panel B: LTRO-bank relation and corporate policies*

	Cash (1)	Leverage (2)	Net Debt (3)	Short Debt (4)	Investment (5)	Wages (6)
LTRO-Bank Relation						
x LTRO Uptake	-2.666** (1.27)	3.253* (1.73)	5.470** (2.38)	0.013 (0.01)	-3.856*** (1.03)	0.207 (0.28)
LTRO Uptake	4.796*** (1.10)	2.187 (1.50)	2.507 (2.06)	-0.041*** (0.00)	2.004** (0.89)	-0.079 (0.24)
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Time fixed effect	Yes	Yes	Yes	Yes	Yes	Yes
Firm fixed effect	Yes	Yes	Yes	Yes	Yes	Yes
R-square	0.726	0.764	0.788	0.785	0.307	0.714
N	27247	27247	22108	20612	22194	17181

*Notes.* This table presents sample characteristics and the effect of corporations LTRO-bank relation in our subsample of Eurozone corporations with existing loan information in SPC Dealscan. Panel A provides for each country sample averages (medians) of corporate characteristics. # *LTRO-Bank Rel.* is the number of corporations that in the five years prior to the first LTRO intervention had a loan relation to a Eurozone bank that participated in the three-year LTRO auctions as of December 2011 and February 2012. Panel B presents estimates of the effect of corporations LTRO-bank relationship and the liquidity uptake from the ECB's three-year Longer-term Refinancing Operations (LTRO), on corporate policies. The analysis is based on a sample of corporations located in the Eurozone with existing loan information in SDC Dealscan. The variable *LTRO-Bank Relation* is a dummy variable equal to 1 for corporations that in the five years prior to the first LTRO intervention had a loan relation to a Eurozone bank that participated in the three-year LTRO auctions as of December 2011 and February 2012. 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 VII – BANK DEBT RELIANCE AND LTRO UPTAKE EFFECT ON CORPORATE POLICIES

	Investments		Wages	
	High Bank Debt (1)	Low Bank Debt (2)	High Bank Debt (3)	Low Bank Debt (4)
LTRO Uptake	-1.286*** (0.37)	-1.123*** (0.33)	-0.023 (0.10)	-0.199 (0.15)
Cash Flow/Assets	0.015*** (0.00)	0.007*** (0.00)	-0.006*** (0.00)	-0.004*** (0.00)
Market to Book	0.007*** (0.00)	0.004*** (0.00)	0.000 (0.00)	0.000*** (0.00)
Size	0.184*** (0.06)	0.087** (0.04)	0.712*** (0.02)	0.668*** (0.02)
Leverage	-0.019*** (0.00)	-0.013*** (0.00)	-0.001 (0.00)	-0.000 (0.00)
Rated	0.615** (0.30)	0.152 (0.12)	0.171 (0.10)	0.071 (0.07)
Sovereign CDS	-0.689*** (0.16)	-0.620*** (0.13)	-0.145** (0.06)	-0.055 (0.07)
Sovereign Export	-0.012 (0.01)	-0.020*** (0.00)	-0.003 (0.00)	0.006* (0.00)
Time fixed effect	Yes	Yes	Yes	Yes
Firm fixed effect	Yes	Yes	Yes	Yes
R-square	0.524	0.563	0.779	0.789
N	31262	45556	20201	28804

*Notes.* 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 (LTRO), on corporate policies, in a sample of corporations located in the Eurozone. *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). In Models 1 and 2, we analyze the impact on corporate investments (capital expenditure scaled by total assets), and in Models 3 and 4, wages (salaries on the logarithmic scale). The variable *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 coefficient of interest is that of *LTRO Uptake*, which captures the effect of the country-specific significance of the liquidity intervention on corporate leverage policies. 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 VIII – PRODUCT SUPPLY AND LTRO UPTAKE EFFECT ON INVESTMENT POLICIES

	Investments		Investments	
	High Competition (1)	Low Competition (2)	High Corp. Tax (3)	Low Corp. Tax (4)
LTRO Uptake	-1.575*** (0.27)	-1.324*** (0.43)	-1.188*** (0.29)	-2.644*** (0.76)
Cash Flow/Assets	0.010*** (0.00)	-0.000 (0.00)	0.005*** (0.00)	0.025*** (0.00)
Market to Book	0.003*** (0.00)	0.005*** (0.00)	0.004*** (0.00)	0.004*** (0.00)
Size	0.302*** (0.04)	0.472*** (0.06)	0.041 (0.03)	0.351*** (0.07)
Leverage	-0.013*** (0.00)	-0.022*** (0.00)	-0.016*** (0.00)	-0.014*** (0.00)
Rated	0.167 (0.14)	0.569*** (0.21)	0.344*** (0.12)	0.064 (0.35)
Sovereign CDS	-0.623*** (0.11)	-0.786*** (0.19)	-12.483*** (3.55)	-0.757*** (0.13)
Sovereign Export	-0.015** (0.00)	-0.009 (0.01)	-0.030*** (0.00)	0.002 (0.00)
Time fixed effect	Yes	Yes	Yes	Yes
Firm fixed effect	Yes	Yes	Yes	Yes
R-square	0.625	0.660	0.575	0.551
N	55646	30363	63693	22699

*Notes.* This table presents estimates of the effect of product supply, and the liquidity uptake from the ECB's three-year Longer-term Refinancing Operations (LTRO), on investment policies in a sample of corporates located in the Eurozone. Our measure for investment is *Investments*, which is the corporation's capital expenditure scaled by total assets. In Models 1 and 2, corporations are separated into those with high and low industry competition, based on the corporates' SIC-code classifications and the related industry's Herfindahl-Hirschman index (HHI). The HHI is given by the sum of the squared market shares of corporates within the same industry, for each given year. *High (Low) Competition* is defined by an HHI below (above) the median in a given year. In Models 3 and 4, corporations are separated into high and low tax groups, based on their location and each country's corporate tax rate. The corporate tax rate is given on a yearly basis. Specifically, *High (Low) Corporate Tax* is defined as a corporate tax rate below (above) the median, one year before the first three-year LTRO intervention (2010). The variable *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 coefficient of interest is that of *LTRO Uptake*, which captures the effect of the country-specific significance of the liquidity intervention on corporate policies. 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 IX – EXPORT DEPENDENCE AND LTRO UPTAKE EFFECT ON INVESTMENT

	Investments	
	Low Export (1)	High Export (2)
LTRO Uptake	-1.504*** (0.26)	-0.411 (0.59)
Cash Flow/Assets	0.006*** (0.00)	0.009*** (0.00)
Market to Book	0.004*** (0.00)	0.004*** (0.00)
Size	-0.013 (0.04)	0.467*** (0.06)
Leverage	-0.013*** (0.00)	-0.015*** (0.00)
Rated	0.194 (0.14)	0.721*** (0.26)
Sovereign CDS	-0.680*** (0.10)	-1.740 (4.06)
Sovereign Export	-0.070*** (0.00)	0.011 (0.00)
Time fixed effect	Yes	Yes
Firm fixed effect	Yes	Yes
R-square	0.591	0.625
N	61206	25186

*Notes.* This table presents estimates of the effect of the liquidity uptake from the ECB's three-year Longer-term Refinancing Operations (LTRO) on corporate investment in a sample of corporations located in the Eurozone. Our measure for corporates' investment is *Capital Expenditure*, which is the corporate capital expenditure scaled by total assets. The variable *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. In Models 1 and 2, corporations are separated into those with low and high sovereign exports, based on the home countries' exports-to-GDP ratio. The export data are on a yearly basis. High (Low) Export is defined as an export-to-GDP ratio above (below) the median in a given year. The coefficient of interest is that of *LTRO Uptake*, which captures the effect of the country-specific significance of the liquidity intervention on corporate cash holdings. 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 X – INSTITUTIONAL ENVIRONMENT AND LTRO UPTAKE EFFECT ON INVESTMENT POLICIES

	Investments		Investments	
	High Corruption (1)	Low Corruption (2)	High Gov. Debt (3)	Low Gov. Debt (4)
LTRO Uptake	2.515 (2.67)	-1.909*** (0.25)	2.113*** (0.78)	-1.346*** (0.31)
Cash Flow/Assets	0.034*** (0.00)	0.008*** (0.00)	0.017*** (0.00)	0.005** (0.00)
Market to Book	0.003*** (0.00)	0.004*** (0.00)	0.004*** (0.00)	0.003*** (0.00)
Size	0.320*** (0.10)	0.111*** (0.03)	0.146*** (0.05)	0.214*** (0.04)
Leverage	-0.007** (0.00)	-0.015*** (0.00)	-0.012*** (0.00)	-0.017*** (0.00)
Rated	-0.376 (0.40)	0.380*** (0.12)	0.239 (0.20)	0.413** (0.16)
Sovereign CDS	-0.240 (0.18)	-5.413*** (2.08)	-0.334** (0.13)	-17.803*** (4.82)
Sovereign Export	-0.137* (0.07)	-0.003 (0.00)	-0.056*** (0.01)	0.008 (0.00)
Time fixed effect	Yes	Yes	Yes	Yes
Firm fixed effect	Yes	Yes	Yes	Yes
R-square	0.525	0.586	0.612	0.605
N	13206	73186	36552	49840

*Notes.* This table presents estimates of the effect of the institutional environment and the liquidity uptake from the ECB's three-year Longer-term Refinancing Operations (LTRO), on corporate policies in a sample of corporates located in the Eurozone. Our measure for investment is *Investments*, which is the corporation's capital expenditure scaled by total assets. In Models 1 and 2, corporations are separated into low and high corruption groups, based on their home countries' CPI index, which ranges from 0 to 10, with 10 indicating a highly corrupt country. The CPI index is given on a yearly basis. *High (Low) Corruption* is defined as a corruption index higher than 5 in a given year. In Models 3 and 4, corporations are separated into those with high and low government debt, based on the respective country's government debt to total assets. The ratio has an annual basis. *High (Low) Gov. Debt* is defined as a government debt to GDP ratio above (below) the median in a given year. The variable *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 coefficient of interest is that of LTRO Uptake, which captures the effect of the country-specific significance of the liquidity intervention on corporate policies. 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 XI – COUNTER-FACTUAL ANALYSIS OF THE LTROs AND CORPORATE POLICIES FOR HIGH AND LOW-RISK COUNTRIES

<i>Panel A: Cash Holdings</i>			
	Cash	Cash	
	Full sample	High-Risk Sovereign	Low-Risk Sovereign
	(1)	(2)	(3)
LTRO Dummy x Non-Eurozone	-0.969*** (0.11)	0.020 (0.21)	-1.050*** (0.15)
R-square	0.751	0.677	0.762
N	143731	35385	103686
<i>Panel B: Investment</i>			
	Investment	Investments	
	Full sample	High-Risk Sovereign	Low-Risk Sovereign
	(1)	(2)	(3)
LTRO Dummy x Non-Eurozone	-0.519*** (0.05)	-0.979*** (0.11)	-0.408*** (0.06)
R-square	0.583	0.518	0.617
N	149798	37088	107834
<i>Panel C: Employment Compensation</i>			
	Wages	Wages	
	Full sample	High-Risk Sovereign	Low-Risk Sovereign
	(1)	(2)	(3)
LTRO Dummy x Non-Eurozone	-0.068*** (0.02)	-0.088*** (0.03)	-0.153*** (0.02)
R-square	0.772	0.832	0.769
N	91049	19222	69184
Controls	Yes	Yes	Yes
Time and Firm fixed effect	Yes	Yes	Yes

*Notes.* This table presents estimates of the counter-factual effect of the liquidity uptake from the ECB's three-year Longer-term Refinancing Operations (LTRO), on corporate policies, in a sample of corporations located in the European Union (EU) but either inside or outside the Eurozone. To estimate the counter-factual effect of the LTRO intervention, we add counter-factual controls to our base model for corporate cash holdings (investments and wages). The variable *LTRO Dummy* is a dummy variable equal to 1 for year-quarter observations after the ECB had implemented the first three-year LTRO intervention (Q4-2011). The variable *Non-Eurozone* is a dummy equal to 1 for corporations located in countries outside the Eurozone (for details see Appendix B2). The variable *Non-Eurozone x LTRO Dummy* is the interaction variable between the LTRO intervention and non-Eurozone dummies, and, accordingly, equal to 1 for non-Eurozone corporations after the first LTRO intervention. 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. *High (Low) Sovereign Risk* is defined as a CDS spread above (below) the median in the pre-intervention and crisis period (2009 and 2010). In Panel A we present the estimates from our analysis of corporate cash holdings, in Panel B those for corporate investment, and in Panel C for corporate wages. The coefficient of interest is that of *Non-Eurozone x LTRO Dummy*, which captures the effect of the liquidity intervention on corporate policies in non-LTRO countries (counter-factual effect). 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.)

## APPENDICES

## Appendix A Background on the ECB Open Market Operations

The operational framework of the ECB consists of the open market operations, standing facilities, minimum reserve, and non-standard monetary policy measures. In particular, 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. We can classify the ECB open market operations into regular open market operations (MROs and three-month LTROs) and non-standard monetary policies (six-, twelve-month, three-year LTROs, TLTROs, APP).<sup>41</sup>

The regular open market operations consist of main refinancing operations (MROs) and three-month longer-term refinancing operations (three-month LTROs). MROs refer to the regular one-week liquidity providing reverse transactions, which are the ECBs primary regular open market operations.<sup>42</sup> To provide additional, longer-term refinancing to the financial sector, ECB also implemented three-month LTROs, which are far from negligible. In 2003, refinancing via LTROs amounted to 45 billion Euro, which, at that point in time, was about 20% of the overall liquidity provided by the ECB.

In recent years, the regular open market operations are complemented by a set of non-standard monetary policies. On 28 March 2008, six-month LTROs are announced, while the regular 3-month LTROs remained unaffected. The six-month LTRO came in two rounds (allotted on 2 April and 9 July 2008) and both were present with an amount of 25 billion Euro.<sup>43</sup> On 6 October 2011, two twelve-month LTROs were announced, which were conducted in October and December 2011, respectively. The operations were introduced as fixed-rate tender procedures with full allotment, and were conducted in addition to the regular and special term refinancing operations.

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, with the option of early repayment after one year. Moreover, it was stated, “there is no limit on what the banks can do with the money”.<sup>44</sup> The LTROs were allotted on December 21, 2011 (LTRO I) and February 29, 2012 (LTRO II), respectively.<sup>45</sup> The interest rate on the two

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<sup>41</sup>There are five types of financial instruments that can be used to achieve the open market transactions, including reverse transaction, outright transactions, issuance of debt certificates, foreign exchange swaps, collection of fixed term deposits. The reverse transaction can be in the form of a repurchase agreement or a collateralized loan. Outright transactions refer to bank purchases in “secondary, sovereign bond markets, under certain conditions, of bonds issued by Eurozone member-states. For details, see <https://www.ecb.europa.eu/mopo/implement/html/index.en.html> and <https://www.ecb.europa.eu/mopo/implement/omo/html/index.en.html>.

<sup>42</sup>In October 2008, the ECB switched to a fixed-rate full allotment mode for its refinancing operations. This implied that the Eurozone banks, from this time on, would be able to obtain unlimited short-term liquidity from the central bank at a fixed rate, provided they pledged sufficient eligible collateral.

<sup>43</sup>The three- and six-month LTROs were carried out through a variable-rate standard tender procedure. On 10 June 2010, the Governing Council of the ECB decided to adopt a fixed-rate tender procedure with full allotment in the regular three-month LTROs, to be allotted on 28 July, 25 August, and 29 September 2010.

<sup>44</sup>Source: [http://www.nytimes.com/2011/12/22/business/a-central-bank-doing-what-central-banks-do.html?\\_r=0](http://www.nytimes.com/2011/12/22/business/a-central-bank-doing-what-central-banks-do.html?_r=0).

<sup>45</sup>The loans were settled one day after the allotment, on December 22, 2011 and March 1, 2012, respectively, with maturities January 29, 2015 and February 26, 2015, respectively.

long-term loans was the average MRO rate over the life of the operation, which was very low at 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. Banks used the two LTRO loans to both rollover previous central bank borrowing and obtain new borrowing.

In total, 523 credit institutions participated in the first LTRO, and were provided with 489.2 billion Euro, which amounted to a net injection of 210 billion Euro<sup>46</sup>. As outlined by Fitch Ratings, the participants in the first LTRO round can roughly be divided into two groups.<sup>47</sup> On the one hand, banks from the periphery countries were highly active due to their actual capital needs, as the LTROs provided them with the only option for accessing medium-term funding. However, for many banks/countries, participating in the unconventional LTROs simply provided an opportunity for them to replace shorter-term funds with 1% three-year borrowing. As outlined by the ECB, 45.72 billion Euro of the total uptake was used to replace the 12-month allotment that had taken place in October 2011.<sup>48</sup> Specifically, a total of 123 counter-parties chose this option, many of which were located in highly rated, safe countries such as France and Germany, which took up a significant share. In particular, the ECB outlines that the banks that placed the highest bids were those that (1) had the highest upcoming rollover needs and (2) had the lowest maturity structures (average tenor). On the other hand, it was also claimed that certain banks had avoided the LTROs due to concerns that participating banks would be stigmatized as troubled institutions.<sup>49</sup>

Since 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 the LTRO uptake in the second round. For instance, the rating threshold was reduced for certain asset-backed securities (ABS), and rated corporate loans were allowed to be used as collateral, as long as they were processed through national central banks and an appropriate haircut was taken.<sup>50</sup> The second round of LTRO provided a liquidity injection of 529.5 billion Euro (310 billion Euro in net terms) to 800 credit institutions. Table I provides the LTRO uptake numbers by country.

In June 2014, to “further ease private sector credit conditions and stimulate bank lending to the real economy”, ECB announced targeted LTROs (TLTROs) which provide financing to credit institutions with maturity up to four years. Under TLTRO, counter-parties were only allowed to borrow an amount that was capped in accordance with their

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<sup>46</sup>This amount is the injection net of other operations conducted in the same weeks (such as three-month operations and regular weekly operations) and operations maturing on these dates.

<sup>47</sup>Source: Fitch Ratings Special Report “European Banks’ Use of LTRO” as of February 28, 2012

<sup>48</sup>Source: ECB Monthly Bulletin, January 2012.

<sup>49</sup>See, for instance, <http://www.zerohedge.com/contributed/ltro-users-manual>

<sup>50</sup>In general, the ECB had always provided liquidity through MROs and LTROs on a collateral basis, but during the crisis the range of securities allowed in the ECB’s operations were widened, and the use of non-marketable securities such as fixed-term deposits and retail mortgage-backed debt instruments as collateral, particularly increased. Source: Nordea Market Analysis “The liquidity management of the ECB”, March 2014.

lending to the corporate sector. In September and December 2014, the ECB initially introduced two successive TLTROs, in which counter-parties were able to borrow an amount in accordance with their initial allowance, at a rate equal to a 10 basis point spread over the MRO rate. In January 2015, the ECB eliminated this excess MRO spread, which would be applied for the series of four rounds of TLTRO that were to be conducted between March 2015 and June 2016. The TLTROs will all mature on September 26, 2018, while the dates for voluntary early repayment differ in accordance with the actual settlement dates.

In addition to the MROs, LTROs and TLTROs, several outright asset purchase programmes (APP) have been implemented since 2009. Under expanded APP, ECB purchases marketable debt instruments from both public and private sector to inject liquidity into the banking system, with monthly purchase target of 80 billion euros<sup>51</sup>. The active APP consists of the third covered bond purchase programme (CBPP3), asset-backed securities purchase programme (ABSPP), and public sector purchase programme (PSPP). The starting dates for CBPP3, ABSPP, and PSPP are 20 October 2014, 21 November 2014, and 9 March 2015, respectively. These programmes are 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 of the active APP, there are several terminated APP programmes in the past years, including first covered bond purchase programme (CBPP), second covered bond purchase programme (CBPP2), and securities markets programmes (SMP). CBPP was launched on 2 July 2009, and ended on 30 June 2010 when it reached a nominal amount of 60 billion euro. CBPP2 was launched in November 2011, and ended on 31 October 2012 when it reached a nominal amount of 16.4 billion euro. SMP was started on 10 May 2010 with the aim of “addressing the severe tensions in certain market segments which had been hampering the monetary policy transmission mechanism”. The SMP focused on liquidity provision in the secondary sovereign bond markets in particular countries. However, following an ECB decision on 6 September 2012, SMP was terminated, and outright monetary transactions (OMT) was introduced. OMT will be considered by the ECB once a Eurozone government asks for financial assistance. Therefore, OMT is attached to the bailout program of European Financial Stability Facility (EFSF) or European Stability Mechanism (ESM)<sup>52</sup>.

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<sup>51</sup>This number was 60 billion euros from March 2015 until March 2016.

<sup>52</sup>European Stability Mechanism (ESM) is a permanent bailout funding programme introduced in 2012. It replaced the previous temporary European Financial Stability Facility (EFSF) and European Financial Stabilization Mechanism.

## Appendix B Additional Figures and Tables

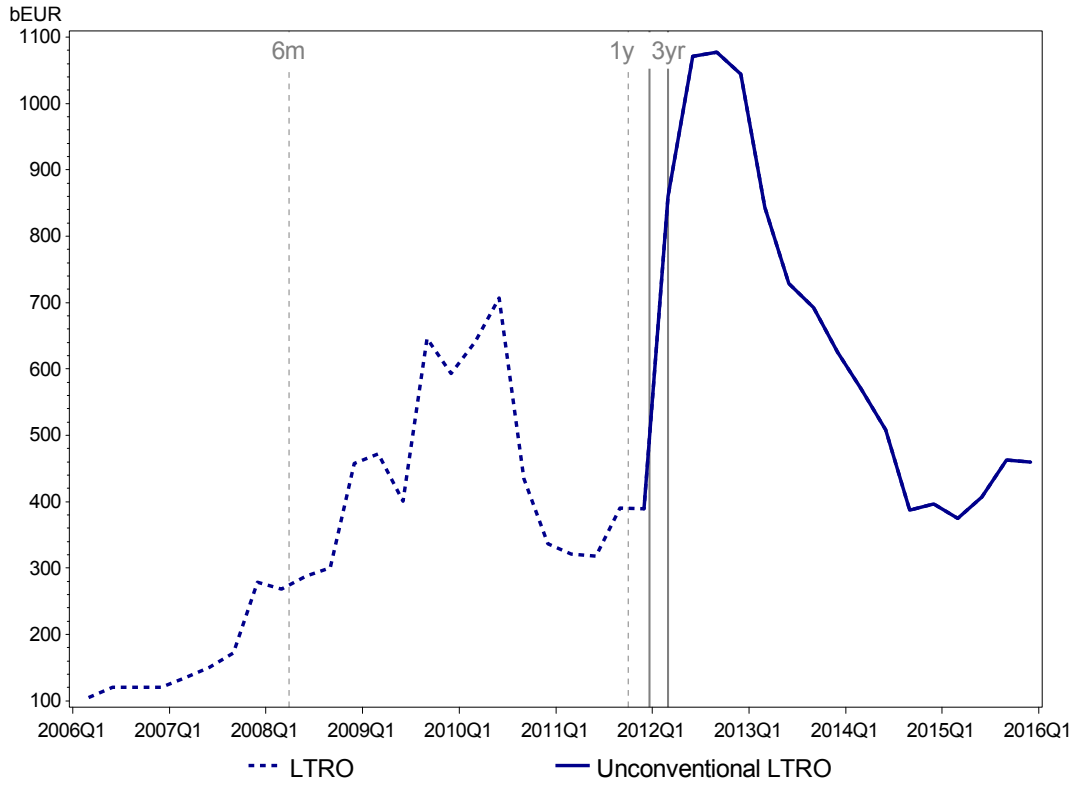


FIGURE B1 – TIME SERIES OF LONGER-TERM REFINANCING OPERATION AND SECURITIES MARKETS PROGRAM

This figure plots the amounts of the ECB's Longer-Term Refinancing Operations (LTROs) and the Securities Markets Program. The numbers are given in billions of Euros. Unconventional LTROs refers to the two three-year LTROs. The data source is the ECB Statistical Warehouse, which publishes monthly numbers for the outstanding amounts.



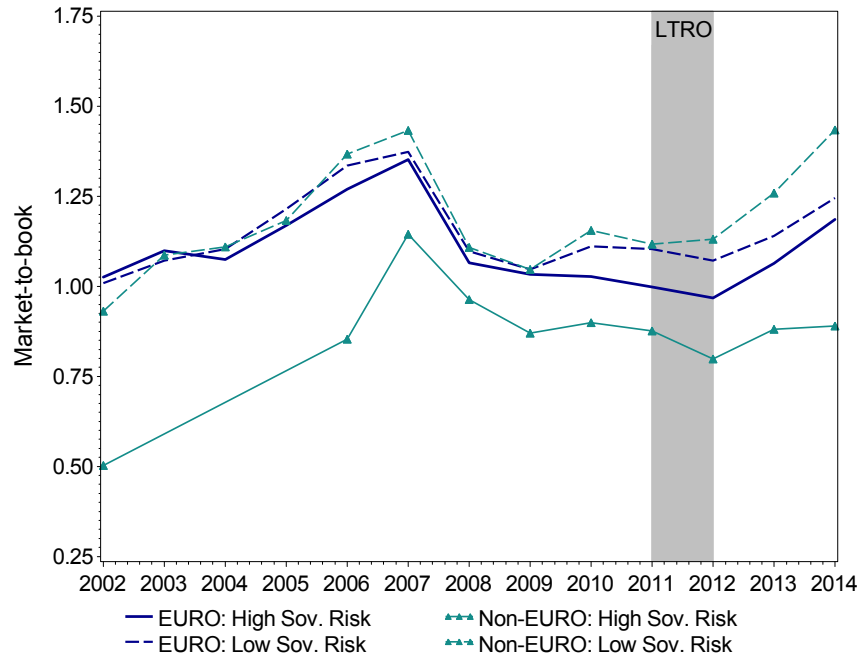


FIGURE B3 – TIME SERIES OF THE CORPORATIONS’ MARKET-TO-BOOK RATIOS AND THE LTRO ANNOUNCEMENT AND IMPLEMENTATION

This figure outlines the corporations’ average (median) market-to-book ratios as a proxy for the stock market reaction to the ECB’s interventions. Market-to-book is measured by the ratio of corporations’ market value of equity to book value of equity and given on a yearly basis. The yearly measure is the median of quarterly observations. The time series are conducted for low and high-sovereign-risk countries as well as Eurozone (EURO) and non-Eurozone (non-EURO) countries, respectively. The subsamples of high and low-sovereign-risk countries are based upon a country’s CDS spreads two years before the LTRO intervention.

TABLE B1 – DESCRIPTION OF MAIN VARIABLES

<i>Dependent Variables</i>		<i>Description</i>
Cash	$\frac{\text{Cash}_t}{\text{Total Assets}_t}$	Cash is defined as cash including marketable securities. Source: Compustat.
Investment	$\frac{\text{Capital Expenditures}_t}{\text{Total Assets}_t}$	Corporate capital spending. Source: Compustat.
Wages	$\text{Log}(\text{Salaries and Wages})_t$	The natural logarithm of total expenses related to salaries and wages. Source: Compustat
Bank Debt	$\frac{\text{Bank Debt}_t}{\text{Total Assets}_t}$	Bank debt is the amount of debt from bank loans. Source: Capital IQ
Leverage	$\frac{\text{Debt}_t}{\text{Total Assets}_t}$	Debt is the book value of debt, i.e., the sum of current and long-term debt. Source: Compustat.
Net Debt	$\frac{\text{Total liabilities} - \text{Cash}_t}{\text{Total Assets}_t}$	Net debt is current plus non-current liabilities minus cash holdings. Source: Compustat.
Short-term Debt	$\frac{\text{Debt due in one year}_t}{\text{Total Assets}_t}$	Fraction of long-term debt that is due in one year
<i>ECB Intervention Controls</i>		<i>Description</i>
LTRO Dummy	Dummy	The variable is equal to 1 for the post-intervention period, i.e., Q1-2012 to Q4-2014, and 0 otherwise.
LTRO Uptake	$\frac{\text{Total Uptake}_{t,c}}{\text{CGD}_{2011,c}}$	The total 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 0 until time Q4-2011 (first round of three-year LTRO) and afterwards equal to each country's total uptake. We scale the total uptake by the central government debt holdings in the year 2011. Source: Bloomberg and the World Bank.
LTRO-Bank Relation	Dummy	The dummy variable is equal to 1 for corporations that in the five years prior to the first LTRO intervention had a loan relation to a Eurozone bank that participated in the three-year LTRO auctions as of December 2011 and February 2012. Source: SDC Dealscan.
Non-Eurozone	Dummy	Variable equal to 1 if the company is located in a country outside the Eurozone, as of 2014, and 0 otherwise. See also Appendix B2.

<i>Corporate Controls</i>		<i>Description</i>
Size	$\text{Log}(\text{Total Assets})_t$	Book value of assets. Source: Compustat.
Market to Book	$\frac{\text{Assets} - \text{Book E.} + \text{Market E.}_t}{\text{Total Assets}_t}$	Book equity is total assets minus total liabilities. Market equity is the amount of shares outstanding times the share price as of the end of the fiscal quarter/year. Source: Compustat.
Cash Flow /Assets	$\frac{\text{EBIT}_t}{\text{Assets}_t}$	EBIT is earnings after interest and taxes, but before depreciation. Source: Compustat.
Industry Sigma	Cash-flow risk	Average standard deviation of corporates' cash flow within the same two-digit SIC code (min. 3 obs.). Source: Compustat.
Net Working Capital	$\frac{(\text{Net working capital} - \text{Cash})_t}{\text{Total Assets}_t}$	The amount of working capital net of corporate cash holdings. Source: Compustat.
R&D/Sales	$\frac{\text{R\&D}_t}{\text{Total Sales}}$	Cost related to Research and Development. Source: Compustat.
Capital Expenditure	$\frac{\text{Capital Expenditures}_t}{\text{Total Assets}_t}$	Corporate capital spending. Source: Compustat.
Acquisition Activity	$\frac{\text{Acquisition}_t}{\text{Assets}_t}$	The amount used for M&A activities. Source: Compustat.
Dividends	Dummy	The variable is equal to 0 if the corporate has positive dividends in a given quarter/year, and 0 otherwise. Source: Compustat.
Rated	Dummy	The variable is equal to 0 if the corporate has a rating, and 0 otherwise. Source: S&P Capital IQ.
Sales		Operating income before interest and taxes (after depreciation). Source: Compustat.
<i>Industry and Country Controls</i>		<i>Description</i>
Competition	Herfindahl-Hirschmann index, i.e., squared sum of market shares within industries	The Herfindahl-Hirschmann index (HHI) measures the industry competition for industry $j$ at time $t$ . $s_{ijt}$ represents the market share of corporate $i$ in industry $j$ and is measured by the corporates' sales. Source: Compustat.
Sovereign CDS	5-year CDS spread	The variable is the end-of-quarter observation of the countries' 5-year CDS spreads. Source: Markit.
Sovereign Export	Exports of goods and services (% of GDP, by year)	Source: The World Bank.
Government Debt	Government Debt (% of GDP, by year)	Source: ECB Statistical Data Warehouse.
Corruption	Corruption Perception Index (ranging from 1 to 10, with 10 indicating the most corrupt, by year)	Source: Transparency International.
Corporate Tax	Corporate tax rate (% by year)	Source: The World Bank.

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

TABLE B2 – 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

*Notes.* 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 respective 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. The Credit Rating is based on information from Markit Data as of end 2011.

TABLE B3 – SUMMARY STATISTICS FOR NON-EUROZONE CORPORATES

Country	GBR	SWE	POL	DNK	ROU	BGR	LTU	LVA	HUN	CZE	Total
Cash	9.38	8.94	5.23	6.05	1.64	4.07	2.36	2.72	7.74	3.33	7.94
Investment	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
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 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
Size	3.82	5.57	4.72	6.51	5.23	5.29	5.22	2.04	10.43	8.70	4.47
Market/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
Ind. Sigma	11.23	13.66	6.17	5.87	4.18	3.33	6.14	5.56	3.12	4.23	9.19
NWC	-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	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Competition	14.46	13.48	10.09	14.00	14.46	14.26	14.53	17.23	15.26	18.08	14.00
Sov. CDS	42.11	13.66	79.50	20.08	213.09	180.56	110.20	125.86	45.50	32.00	34.14
Sov. 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
# Corp.	2213	574	461	159	78	30	30	30	22	14	3611

*Notes.* This table provides sample averages (medians) of corporate characteristics for each country in our sample of non-Eurozone corporates. *Cash* is the ratio of cash and short-term investments to total assets. *Investment* 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 Debt* is the ratio of current liabilities to total assets. *Bank Debt* is the amount of debt from bank loans, divided by total assets. *Size* is the total assets, given in logarithms. *Market/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* is the ratio of acquisitions to total assets. *Industry Competition* is the Herfindahl-Hirschmann Index (HHI) industry competition measure. *Sovereign CDS* is the five-year sovereign CDS spread for the country. *Sovereign Export* is the country's export-to-GDP ratio. *Government Debt* is the country's central government debt to GDP ratio, given as a percentage. *Corruption* is the country's corruption perception index (CPI index), which ranges from 0 to 10, with 10 indicating the most corrupt country. *Corporate Tax* is the country's corporate tax rate given as a percentage. The sample period for each country is 2002-2014, and the variables are based on quarterly observations. For any data unavailable for a specific quarter, we replace the missing values with the yearly observations. Ratios are given in percentages.

TABLE B4 – LTRO INTERVENTION EFFECT ON CASH HOLDINGS

	Cash	Cash	
	EU (1)	Eurozone (2)	Non-Eurozone (3)
LTRO Dummy * Eurozone	0.932*** (0.11)		
LTRO Dummy	-0.536*** (0.20)	0.069 (0.24)	0.356 (0.31)
Industry Sigma	-0.030*** (0.00)	0.022 (0.01)	-0.066*** (0.01)
Cash Flow/Assets	-0.005** (0.00)	0.001 (0.00)	-0.009** (0.00)
Market to Book	0.008*** (0.00)	0.014*** (0.00)	0.005*** (0.00)
Size	-0.628*** (0.06)	-0.110 (0.08)	-0.955*** (0.09)
Net Working Capital	-0.123*** (0.00)	-0.123*** (0.00)	-0.121*** (0.00)
Capital Expenditure	-0.079*** (0.00)	-0.121*** (0.00)	-0.041*** (0.00)
Leverage	-0.192*** (0.00)	-0.167*** (0.00)	-0.225*** (0.00)
Div. Dummy	0.588*** (0.07)	0.626*** (0.08)	0.547*** (0.12)
R&D/Sales	0.026*** (0.00)	0.017*** (0.00)	0.031*** (0.00)
Acquisition Activity	-0.038*** (0.00)	-0.022*** (0.00)	-0.055*** (0.00)
Rated	1.557*** (0.26)	1.508*** (0.29)	1.709*** (0.51)
Sovereign CDS	0.755*** (0.25)	0.521** (0.24)	48.023*** (9.44)
Sovereign Export	0.029*** (0.00)	-0.040*** (0.01)	0.149*** (0.01)
Time fixed effect	Yes	Yes	Yes
Firm fixed effect	Yes	Yes	Yes
R-square	0.751	0.766	0.740
N	144604	80279	64325

*Notes.* This table presents estimates of the effect of the LTRO intervention on corporate cash holdings in the European Union (EU). *Cash* is measured as cash and cash equivalents, scaled by total assets. The variable *LTRO Dummy* is a dummy variable equal to 1 for year-quarter observations after the ECB had implemented the first three-year LTRO intervention (Q4-2011) and indicates the timing of the LTRO intervention. The variable *Eurozone* is a dummy equal to 1 for corporations located countries that belong to the Eurozone (for details, see Appendix B2). The variable *Eurozone x LTRO Dummy* is the interaction between the LTRO intervention and Eurozone dummies, and accordingly equal to 1 for Eurozone corporations after the first LTRO intervention. Model 1 is based upon the full sample (EU), while in Models 2 and 3 the sample is restricted to countries located in the *Eurozone* and *non-Eurozone*, respectively. The coefficient of interest is that of *LTRO Dummy*, which captures the effect of the initiation of the three-year LTRO. 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 B5 – CORPORATE RISK AND LTRO UPTAKE EFFECT ON CASH HOLDINGS

	Cash		Cash	
	Investment Rating	Non-Investment Rating	High Leverage	Low Leverage
	(1)	(2)	(3)	(4)
LTRO Uptake	-4.223** (1.91)	2.435*** (0.57)	1.598*** (0.55)	0.657 (1.11)
Industry Sigma	-0.004 (0.04)	0.020 (0.01)	0.085*** (0.01)	-0.030 (0.02)
Cash Flow/Assets	-0.066** (0.02)	0.002 (0.00)	0.002 (0.00)	0.009 (0.00)
Market to Book	0.018*** (0.00)	0.013*** (0.00)	0.014*** (0.00)	0.014*** (0.00)
Size	0.517 (0.44)	-0.096 (0.08)	-0.167* (0.09)	0.292** (0.14)
Net Working Capital	-0.097*** (0.01)	-0.125*** (0.00)	-0.055*** (0.00)	-0.220*** (0.00)
Capital Expenditure	0.025 (0.05)	-0.123*** (0.00)	-0.021** (0.00)	-0.221*** (0.01)
Leverage	0.091*** (0.01)	-0.170*** (0.00)	-0.123*** (0.00)	-0.253*** (0.00)
Div. Dummy	0.697** (0.27)	0.662*** (0.08)	0.357*** (0.09)	0.881*** (0.14)
R&D/Sales	0.069*** (0.01)	0.015*** (0.00)	0.057*** (0.00)	0.002 (0.00)
Acquisition Activity	-0.019 (0.03)	-0.023*** (0.00)	0.014 (0.00)	-0.023 (0.01)
Rated	0.000 (0.00)	2.019*** (0.44)	0.365 (0.28)	3.549*** (0.62)
Sovereign CDS	2.491** (1.14)	0.568** (0.24)	0.045 (0.22)	1.600*** (0.56)
Sovereign Export	-0.155*** (0.03)	-0.047*** (0.01)	-0.071*** (0.01)	-0.032 (0.02)
Time fixed effect	Yes	Yes	Yes	Yes
Firm fixed effect	Yes	Yes	Yes	Yes
R-square	0.799	0.768	0.662	0.765
N	2037	80016	37525	36378

*Notes.* This table presents estimates of the effect of corporate risk and the liquidity uptake from the ECB's three-year Longer-term Refinancing Operations (LTROs) on corporate policies within a sample of corporates located in the Eurozone. *Cash* is determined as cash and cash equivalents scaled by total assets. In Models 1 and 2, corporates are separated into investment and non-investment groups, based on the companies' ratings. *Investment Rating* (*Non-Investment Rating*) refers to a S&P rating of BBB- or higher (CCC+ or lower). In Models 3 and 4, corporates are separated into high and low-leverage companies, where *High Leverage* (*Low Leverage*) includes companies that, one year before the first three-year LTRO intervention (Q4-2010), had a leverage ratio above (below) the median. The variable *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 coefficient of interest is that of *LTRO Uptake*, which captures the effect of the country-specific significance of the liquidity intervention on corporate leverage policies. 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 B6 – FINANCIAL CONSTRAINTS AND LTRO UPTAKE EFFECT ON CORPORATE INVESTMENT POLICIES

	Investments		Investment	
	High Capital Intensity (1)	Low Capital Intensity (2)	High Cash Flow (3)	Low Cash Flow (4)
LTRO Uptake	-1.935*** (0.46)	-1.269*** (0.28)	-2.632*** (0.32)	-0.705* (0.36)
Cash Flow/Assets	0.015*** (0.00)	0.008*** (0.00)	0.012*** (0.00)	0.008*** (0.00)
Market to Book	0.011*** (0.00)	0.003*** (0.00)	0.004*** (0.00)	0.005*** (0.00)
Size	-0.136 (0.08)	0.223*** (0.03)	-0.037 (0.04)	0.266*** (0.04)
Leverage	-0.027*** (0.00)	-0.013*** (0.00)	-0.027*** (0.00)	-0.011*** (0.00)
Rated	0.399* (0.23)	0.373*** (0.14)	0.571*** (0.15)	0.120 (0.20)
Sov. CDS	-0.461*** (0.17)	-0.875*** (0.13)	-1.968*** (0.36)	-0.700*** (0.11)
Sov. Export	0.007 (0.01)	-0.018*** (0.00)	-0.031*** (0.00)	-0.000 (0.00)
Time fixed effect	Yes	Yes	Yes	Yes
Firm fixed effect	Yes	Yes	Yes	Yes
R-square	0.518	0.581	0.584	0.498
N	24644	61688	38061	38757

*Notes.* This table presents estimates of the effect of corporates' financial constraints and the liquidity uptake from the ECB's three-year Longer-term Refinancing Operations (LTRO), on corporate investment, in a sample of corporations located in the Eurozone. In Models 1 and 2 corporations are separated into those operating in industries with *High* and *Low Capital Intensity* ratios, based upon the corporations' industry classification (2 digits SIC-code) and the industry's specific capital intensity ratio, respectively. *Capital Intensity* is the industry specific ratio of property, plant, and equipment (PPE), divided by total assets. *High (Low) Capital Intensity* is defined as industry PPE to total asset ratio above (below) the sample median. In Models 3 and 4 corporations are separated into those operating in industries with *High* and *Low Cash Flow*, based upon the corporations' cash flow ratio, which is given as the corporations earnings before interest and taxes (EBIT), divided by total assets. *High (Low) Cash Flow* is defined as a EBIT to total asset ratio above (below) the median one year before the first LTRO intervention (Q4-2010). The variable *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 coefficient of interest is that of *LTRO Uptake*, which captures the effect of the country-specific significance of the liquidity intervention on corporate leverage policies. 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.)