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Financial Structure Heterogeneity and the Bank Lending Channel of Monetary Policy: A Cross-Country Analysis

Author:
Chris Oudshoorn

Supervisor:
dr. S.H. Bijkerk

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ERASMUS UNIVERSITEIT ROTTERDAM

Abstract

Using micro-data on syndicated loan contracts, this paper focuses on the impact of financial structure heterogeneity on the Bank Lending Channel (BLC) of monetary policy transmission. Our theoretical model claims that, due to a larger reliance of the non-financial private sector on bank finance vis-à-vis non-bank finance, a monetary policy shock should − via the BLC − have a larger impact on the pricing of loan contracts in bank-based versus market-based economies. We test this hypothesis empirically, and determine the impact of the Central Bank policy interest rate on the interest rate of syndicated loans in two economies with a large historical difference in financial structure: the U.S. and the Eurozone. Our results indicate that financial structure heterogeneity does not result in a stronger Interest Rate Pass-Through (IRPT) in the Eurozone than in the U.S. via the BLC.

Keywords: Monetary Transmission, Bank Lending Channel, Syndicated Loans, Financial Structure, Interest Rate Pass-Through

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List of Abbreviations

BLC Bank Lending Channel

BSC Balance Sheet Channel

CD Certificate of Deposit

DD Demand Deposit

ECB European Central Bank

EMU European Monetary Union

FFR Federal Funds Rate

IRC Interest Rate Channel

MRO Main Refinancing Operation

MTM Monetary Transmission Mechanism

MMR Money Market Rate

OMO Open Market Operation

SIC Standard Industry Classification

TC Trade Credit

1 Introduction

Monetary policy aims to influence inflation, output and employment in an economy. Identifying the real economic impact of a monetary policy shock is vital for monetary policymakers. The pass-through of the Central Bank policy interest rate to commercial interest rates on business and household bank loans (i.e. the Interest Rate Pass-Through (IRPT)) is one of the main Monetary Transmission Mechanisms (MTMs). In the conventional 'money view' of monetary policy transmission, financial market imperfections (such as asymmetric information and moral hazard) do not play a role in this IRPT (Friedman & Schwarz, 1963). In contrast, the 'credit view' of monetary policy transmission hinges on financial market imperfections, and this view states that the IRPT is affected by these imperfections (Bernanke & Blinder, 1988; Bernanke & Gertler, 1989; Bernanke, 1993). In particular, an economies' financial structure has a direct impact on the strength of the IRPT in the credit view (Mojon, 2000; Cottarelli & Kourelis, 1994; Borio & Fritz, 1995).

A major element of this financial structure of an economy is concerned with the use of bank versus non-bank financing by the non-financial private sector. A bank-based financial structure implies that the non-financial private sector predominantly relies on bank debt as a source of financing. In the case of a market-based financial structure, this sector predominantly relies on non-bank sources of finance such as commercial paper issuance. Differences in financial structure impact the credit view of monetary policy transmission via its two monetary transmission channels: the 'Balance Sheet Channel' (BSC) and the 'Bank Lending Channel' (BLC) (Bernanke & Gertler, 1995).

The BSC focuses on the impact of a change in the Central Bank policy interest rate on the balance sheets of firms in the non-financial private sector. A change in the Central Bank policy rate influences the net worth of companies via altered interest expenses and changes in asset prices (Mishkin, 1996). From the perspective of the commercial bank, the risk premium of lending is higher if the net worth of a company is lower. The change in net worth thus results in a reassessment of loan interest rates by commercial banks. A lower net worth of a company due to a higher Central Bank policy interest rate results in higher loan interest rates charged by commercial banks. As firms in a bank- and market-based financial system differ in their balance sheet composition (i.e. reliance on bank and non-bank debt), the interest expense and asset price changes may vary across these firms (Mojon, 2000). To this end, the BSC differs in its effectiveness between financial structures.

The BLC operates via Central Bank Open Market Operations (OMOs), directly influencing a commercial bank's loan supply as well as the Central Bank policy interest rate. The OMOs consist of repurchase agreements in case of a monetary expansion and reverse repurchase agreements in case of a monetary contraction. Under a repurchase agreement, the Central Bank buys a security from a commercial bank (for instance, a government bond) and agrees to sell this security at a premium to the same bank in the future. In fact, the Central Bank thus provides a collateralized loan towards the borrower. Commercial banks are affected by these operations via regulatory reserve requirements. The reserve requirement states that commercial banks must hold a certain share of their deposits as reserves at the Central Bank over a time period. To this end, commercial banks hold a reserve account at the Central Bank and meet the reserve requirement via the OMOs. A change in OMOs thus directly alters the level of reserves held at the Central Bank. Subsequently, commercial bank loan supply is affected via the impact of the OMOs on commercial bank deposits. Following Peek and Rosengren (1995), the monetary policy shock results in a change in the level of commercial bank deposits via i) the commercial bank's ability to meet the reserve requirement and ii) the inverse relationship between the Central Bank policy interest rate and the supply of deposits by the non-financial private sector. As the required reserves are a fraction of commercial bank deposits, a change in the level of reserves results in an altered willingness of the commercial bank to take on deposits. Furthermore, as the Central Bank policy interest rate is directly linked to OMOs, an increase in OMOs (lowering the policy interest rate) results in an increase in commercial bank deposits. Peek and Rosengren (1995) argue that this inverse relationship arises due to the close relationship between the Central Bank policy interest rate and interest rates on assets held by the non-financial private sector. As the return on these assets fall after an expansionary monetary policy shock, the non-financial private sector increases its demand for commercial bank deposits. As deposits are used as a means of financing bank loans, OMOs have an impact on commercial bank loan supply via this channel.

Strength of the BLC is influenced by a borrowing firm's ability to switch between bank and non-bank debt. A high ability to switch between debt types corresponds to a high interest rate elasticity of demand for bank loans. Consider a contractionary monetary policy shock, forcing the commercial bank to lower loan supply due to a decline in deposits. As a result of the high interest rate elasticity of demand for bank loans of bank borrowers, the commercial bank is not forced to alter loan interest rates to a large extent in order to alter its loan supply. Due to a relative abundance of non-bank sources of finance, the ability to switch between bank and non-bank funds is higher in a market-based than a bank-based economy. Via the BLC, the pricing of commercial bank loans after a monetary policy shock thus differs between financial structures.

This paper focuses on the impact of financial structure heterogeneity on the BLC of monetary policy transmission. We focus on two economies with large historical differences in financial structure: the U.S. and the Eurozone. The private sector in the Eurozone relies on bank loans as a source of external financing to a larger extent than the U.S. private sector does. On average − between 2002 and 2016 − the non-financial corporate financing mix in the Eurozone consisted for 50% of bank loans, where bank financing accounted for 25% of the U.S. external finance mix (ECB, 2016). We link this finding to heterogeneity in a firms' ability to switch between bank and non-bank debt, and determine its impact on the BLC via a theoretical model. The theoretical model, based on the model in Peek and Rosengren (1995), provides us with the following research question:

Did financial structure heterogeneity result in a larger impact of Open Market Operations on the interest rate of bank loans in the Eurozone, in comparison with the U.S. in the period 1999:2016?

Answering this research question provides us with a twofold result. Firstly, we are able to determine the existence of the BLC via financial structure heterogeneity in both the U.S. and the Eurozone. Secondly, we determine the impact of the BLC on the IRPT. These findings add to the current literature by assessing the BLC in a cross-country manner. In related literature, identification of the BLC has predominantly been conducted by observing cross-sectional heterogeneity between types of lenders and borrowers (Kashyap et al., 1993; Gertler & Gilchrist, 1994; Kashyap & Stein, 1997). Determining whether country-specific factors are relevant in explaining differences in the strength of the BLC provides us with insights into differences in monetary transmission between economies. De Haan and Sterken (2006) do focus on country-specific factors influencing the BLC, but use the impact of the BLC on the amount of loans supplied. We focus on the pricing (interest rate) of loans, and thereby identify both the BLC as well as its role in the IRPT. We take into account the endogeneity issues involved with monetary policy measures by measuring the monetary policy variable one quarter prior to our dependent variable. We use micro-data on syndicated loan contracts and balance sheets of U.S. and Eurozone borrowers, as well as macro-data on financial structure variables of the U.S. and the Eurozone.

This paper proceeds as follows. Section 2 gives an overview of the literature on monetary transmission and its relationship with financial structure. Section 3 introduces the theoretical model, and concludes with the research question. Section 4 presents the data and methodology. The results are presented in section 5, after which section 6 provides a robustness test. Section 7 gives the concluding remarks.

2 Literature Review

This paper focuses on the impact of an economies' financial structure on the BLC of monetary policy transmission. In the following we refer to financial structure as the dependency of the non-financial private sector on either bank or non-bank sources of finance. This dependency indicates whether an economy is 'bank-based' or 'market-based'. We determine the impact of financial structure heterogeneity on the pass-through of Central Bank policy interest rates to commercial bank loan interest rates. On the basis of differences in the IRPT between financial structures is the ability of a borrower to switch between bank and non-bank funds. Due to an abundant availability of non-bank debt, this ability to switch (and therefore the interest rate elasticity of demand for bank loans) is larger in market-based economies than in bank-based economies. For this reason, in order to alter loan supply after a monetary policy shock, a larger change in interest rates is required in the bank-based economy. In order to solely take into account the BLC when identifying the IRPT, we must control for alternative transmission channels being influenced by an economies' financial structure.

In order to determine which transmission channels we must control for, section 2.1 introduces the 'money view' and section 2.2 introduces the 'credit view' of monetary policy transmission. Furthermore, we must take into account factors besides financial structure having an impact on the strength of the BLC. To this end, section 2.3 focuses on empirical literature on the BLC. This section also provides insights in the manner of identifying the BLC. Section 2.4 focuses on the determinants of differences in financial structure between the U.S. and the Eurozone, and provides us with a basis for the theoretical model. Section 2.5 provides a graphical overview of the monetary transmission channels running from OMOs to bank loan interest rates.

2.1 The Money View

Friedman and Schwarz (1963) introduce the 'money view' of monetary policy transmission. Underlying this money view is a hypothetical world where the non-financial private sector holds two assets: money and bonds. Money is stored as deposits at commercial banks. Monetary policy influences the real economy by altering the amount of commercial bank reserves via liquidity-providing operations. These liquidity providing operations are referred to as Open Market Operations (OMOs) in the U.S. and Main Refinancing Operations (MROs) in the Eurozone. Both instruments operate in a similar manner. We refer to both operations as OMOs in the following. The main function of OMOs is to control the level of liquidity within the banking sector, thereby controlling the money supply and short-term interest rates. OMOs provide liquidity to commercial banks via repurchase agreements and contract liquidity via reverse repurchase agreement. With a repurchase agreement, the Central Bank buys a security (for instance, a government bond) from a commercial bank and agrees to sell this security at a premium in the future to the same party. In fact, the Central Bank thus provides a collateralized loan towards the borrower. In case of a reverse repurchase agreement, the Central Bank effectively borrows from a commercial bank. These operations result in real economic changes via regulatory reserve requirements. In both the U.S. and the Eurozone, banks which are subject to the reserve requirement are eligible for the OMOs. Over a maintenance period, commercial banks have to store a percentage of their deposits as reserves at the Central Bank. Commercial banks adhere to this requirement via the Central Bank OMOs. In case the Central Bank reduces the amount of liquidity (via reverse repurchase agreements), commercial banks meet the reserve requirement by lowering their level of deposits. As a result, in the Friedman and Schwarz (1963) world, the private sector holds less money (in deposits) and will hold more bonds. Thus, the monetary contraction results in a decline of money supply. A lower money supply subsequently results, via traditional IS-LM forces, in increasing nominal interest rates and ultimately affects (short-term, as well as long-term) real interest rates. In order for nominal interest rates to alter real interest rates, prices should not perfectly adjust after a monetary policy shock. That is, a certain level of price rigidity must exist in order for monetary policy to have real effects in the money view.

On the basis of the money view is the theorem created in Modigliani and Miller (1958) (the MM-theorem). The MM-theorem states that the manner of financing for a firm does not alter this firms' value. For this 'capital irrelevance theorem' to hold, the authors rely on the following assumptions: there is perfect competition as well as an absence of informational asymmetries in financial markets. With the MM-theorem in place, consider the two-asset world as created in Friedman and Schwarz (1963). As the value of a firm (or household) remains equal irrespective of this firm's portfolio of money and bonds, the monetary policy shock results in a costless reshuffling of assets for the private sector. For this reason, the Central Bank is able to immediately alter the amount of money and bonds held by the private sector. Subsequently, the money supply change results in nominal and real interest rate changes.

Several transmission channels rely on the MM-theorem, and are therefore related to the money view. These channels are referred to as; the interest rate channel, the exchange rate channel and the equity price channel (Mishkin, 1996). The following sections briefly explain the intuition behind these three channels. Important to note is the fact that the Central Bank policy interest rate has a direct link with the monetary liquidity-providing operations. The Federal Reserve targets its policy interest rate via OMOs and the ECB policy interest rate is equal to its interest rate on MROs. An increase in the amount of liquidity via OMOs thus corresponds to a lower Federal Funds Rate (ECB Refinancing Rate).

2.1.1 Interest Rate Channel

The interest rate channel focuses on the impact of a Central Bank policy interest rate change (via OMOs) on short- and long-term real interest rates. These real interest rates include bank loans to firms and households. These interest rates determine a firms' cost of capital. A change in the cost of capital has an impact on its investments, and hence an economies' aggregate demand.

The Central Bank policy interest rate influences bank loan interest rates via its impact on money market interest rates. As banks use money from the money market to finance loans, a change in the interest rate on money markets is directly translated into changes in the interest rate on bank loans. As in Friedman and Schwarz (1963), price stickiness is required for nominal interest rate changes to have an impact on real interest rates. Furthermore, short-term interest rates have an impact on long-term rates via the expectation hypothesis of the term structure of interest rates (Froot, 1989). According to this theory, long-term interest rates are determined purely by the current short-term interest rate and future expectations of short-term interest rates.

The existence of an interest rate channel has recently been subject to debate. In the run-up to − and the period following − the Global Financial Crisis, interest rates were low for an extended period of time. In both the U.S. and the Eurozone, this period of low interest rates induced risk-taking by commercial banks, in search for higher yields (Delis et al., 2011; Gambacorta, 2009; Dell'ariccia et al., 2016; Aghion et al., 2014). According to this 'risk-taking channel' a decline in the monetary policy interest rate results in an increase in bank loan interest rates via the search for yield (i.e. risk-taking) by commercial banks. This channel thus states that a monetary policy shock has an opposite impact on bank loan interest rates compared to the traditional interest rate channel.

2.1.2 Exchange Rate Channel

The real interest rate changes as shown in the interest rate channel give rise to an additional channel of monetary transmission; the exchange rate channel. Mishkin (1996) states that a contractionary monetary policy shock leads to an inflow of foreign capital via an increase in domestic real interest rates. The increase in real interest rates leads to a higher return on investments, and therefore foreign capital flows in. Foreign investors acquire the domestic currency in order to make investments. For this reason, the domestic currency appreciates vis-à-vis foreign currencies. Subsequently, the currency appreciation makes domestic products more expensive for foreigners, leading to a decline in net exports, which corresponds with a decline in output.

2.1.3 Equity Price Channel

The equity price channel of monetary policy transmission refers to a change in the price of equity following a monetary policy shock, influencing firm investments and household consumption. Consider a monetary contraction, lowering the money supply. Mishkin (1996) states that this decline in money supply results in a decline of equity prices via two mechanisms. Firstly, a lower money supply indicates that the private sector has less money available for spending in the stock market. This lower demand for stocks drives the price of equity down. Secondly, a decline in the money supply drives up interest rates, and increases the demand for bonds relative to equities. This relative increase in bond demand stems from the direct relationship between interest rates on bonds and the policy interest rate. As equity prices do not move with the Central Bank policy rate, the relative price of equity falls.

This change in the price of equity has an impact on the real economy via both firm and household spending. Tobin (1969) states that an equity price change results in a change in investments for firms via the ratio of this firms market value over its replacement cost of capital; referred to as 'Tobin's q'. A decline in the equity price lowers this q, and subsequently lowers the amount of firm investments. Households are affected via the wealth effect of a change in equity prices. Modigliani (1971) states that the lifetime resources of a consumer holding a large share of stocks falls with a decline in the prices of these stocks (equity). Subsequently, consumption falls. A decline in firm investments and household consumption results in a decline in output.

2.2 The Credit View

The money view left several issues related to the MTM unanswered. Bernanke and Gertler (1995) state that the cost-of-capital variable (underlying the interest rate channel) does not effectively explain differences in aggregate spending following a monetary policy shock. Rather, factors such as lagged output, sales or cash flow have the largest explanatory power. Furthermore, the money view claims that monetary policy has its largest impact on short-term interest rates. For this reason, Bernanke and Gertler (1995) find it puzzling that monetary policy has a large impact on the purchase of long-lived assets, being predominantly responsive to long-term interest rates.

To this end, Bernanke and Gertler (1995) focus on the 'credit view' of monetary transmission. The credit view hinges on imperfections in financial markets, hence violating the MM-theorem. These financial market imperfections refer to lender-borrower issues stemming from informational asymmetries, such as moral hazard and adverse selection. The authors state that these financial market imperfections create a wedge between a borrower's funds generated internally (i.e. via retained earnings) and obtained externally (via debt or equity issuance). This wedge is referred to as the 'external finance premium'. Asymmetric information between lender and borrower, for instance, creates the wedge. When lenders are unsure of the borrowers' ability to repay due to information asymmetries, their willingness to provide credit at favorable terms declines. This moral hazard issue results in an increase of bank loan interest rates, the external finance premium, and thereby lowers investments by the borrowing firm. Thus, a direct negative relationship between the external finance premium and firm investments exists.

Bernanke and Gertler (1995) state that the credit view operates via two distinct channels: the Balance Sheet Channel (BSC) and the Bank Lending Channel (BLC). Sections 2.2.1 and 2.2.2 focus on the theory behind both transmission channels.

2.2.1 Balance Sheet Channel

The BSC focuses on the impact of a monetary policy shock on a borrowing firms' balance sheet, and thereby its external finance premium. Bernanke and Gertler (1995) argue that − in a world where market imperfections exist − an increase in a firms' net worth results in a reduction of this firms' external finance premium. An increase in a firm's net worth reduces lender-borrower related issues and provides ground for a bank to issue credit at more favorable terms for the borrower. This is the case as borrower net worth links to this borrower's ability to repay the loan, as well as its ability to provide collateral against a loan.

For the BSC to exist, a link between monetary policy and a borrowing firms' net worth thus has to be present. Bernanke and Gertler (1995) provide several links. A contractionary monetary policy shock which directly raises nominal interest rates has an immediate impact on the cash flow of firms via interest payments on outstanding floating rate debt. An increase in interest rates further influences a firms' cash flow if short-term debt reliance (in combination with fixed interest payments) is large. In this case, renewal of short-term liabilities result in an increase in interest expenses and an increase of the external finance premium. Mishkin (1996) states that the cash flow effect impacts the external finance premium via an increase in adverse selection and moral hazard issues. A second link between a monetary policy shock and a firms' net worth runs via changes in asset prices following a monetary policy shock. Bernanke and Gertler (1995) state that rising interest rates are generally associated with declining asset prices. This asset price decline corresponds to the process as shown in the equity price channel and lowers the value of various asset classes. For instance, insofar as borrowers have equities on the asset side of their balance sheet, the fall in equity prices lowers this firms' net worth. This asset price decline lowers the ability of the borrower to provide collateral for a bank loan. This again results in adverse selection and moral hazard issues. Commercial banks respond to the monetary policy induced balance sheet shock by adjusting loan supply, and the interest rate on loans. This corresponds to an increase in the firms' external finance premium. Subsequently, investments and output are affected.

2.2.2 Bank Lending Channel

As opposed to the BSC, the BLC focuses on the impact of a monetary policy shock on the lenderfls balance sheet (instead of the borrower's balance sheet). The change in the bank balance sheet affects bank loan supply (and therefore the interest rate on loans), thereby influencing the external finance premium for borrowers.

Bernanke and Blinder (1988) generate a theoretical model, which gives rise to the BLC. The authors adjust the traditional 'money view' IS-LM model by incorporating a financial market imperfection. Specifically, the authors assume that bank loans and other forms of external finance are imperfect substitutes for firms. Now, an expansionary monetary policy shock results in an increased willingness of commercial banks to sell deposits. As the policy shock increases commercial bank reserves, and the reserve requirement stays on an equal level, the bank is able to increase its level of deposits. Furthermore, Peek and Rosengren (1995) state that the level of commercial bank deposits is inversely related to the Central Bank policy interest rate. This stems from the close relationship between the Central Bank policy interest rate and the interest rate on assets (for instance, government bonds) paying market-related interest rates. Via this mechanism, a decline in the Central Bank policy interest rate (via an increase in OMOs) results in a relative increase in demand for commercial bank deposits vis-à-vis alternative assets. As banks use deposits in order to finance loans, an increase in the amount of deposits results in an increase in loan supply. On the other hand, a contractionary monetary policy shock, lowering reserves and deposits, results in a decline in loan supply. Due to the financial market imperfection, borrowers are unable to replace these bank loans with other types of finance without facing additional costs. For this reason, the borrower's external finance premium rises. This, in turn, results in a decline in the level of investments.

The link between a change in a commercial bank's level of deposits and its loan supply is not straightforward. For this relationship to exist, several assumptions are made in the theoretical model of Bernanke and Blinder (1988). As previously mentioned, the imperfect substitutability condition is required to alter the external finance premium, and thereby investments. If this condition does not hold, firms can replace bank loans with other types of short-term financing without facing additional costs. In this case, a change in the supply of bank loans does not alter a firms' external finance premium and hence does not have a real economic impact. A second condition states that banks do not replace their lost deposits with other sources of funds, such as deposits not subject to reserve requirements. If banks reshuffle the liability side of their balance sheet, they do not have to alter their loan supply on the asset side of the balance sheet. The final condition is concerned with sticky prices. This condition − as in Friedman and Schwarz (1963) − is necessary for any monetary policy to have an impact on the real economy. If prices directly change after a monetary policy shock, the real economy will not respond. Real interest rates will remain equal, and monetary policy is neutral.

Summarizing, for a BLC to exist, the following three conditions must hold (Bernanke & Blinder, 1988):

1. Bank loans and other forms of external financing must not be considered perfect substitutes for at least a subset of firms;

2. By changing the amount of bank reserves, a central bank is able to influence the supply of intermediated loans;

3. Prices do not perfectly adjust to a change in monetary policy.

2.3 Bank Lending Channel Empirics

This section gives an overview of the empirical literature on the BLC, focusing on conditions 1 to 3 as laid down in section 2.2.2. Subsequently, we provide evidence on the BLC by using: borrower heterogeneity (section 2.3.4), lender heterogeneity (section 2.3.5) and country heterogeneity (section 2.3.6). Section 2.3.7 concludes by summarizing the findings, and its impact on our empirical analysis.

2.3.1 Necessary Condition 1: Imperfect Substitution

For a BLC to exist, a subset of firms must consider bank loans and other forms of external finance as imperfect substitutes. That is, bank loans must be considered 'special' compared to alternative debt instruments.

Fama (1985) investigates whether bank loans are special by determining the impact of deposit reserve requirements on the terms of bank loans. Generally, reserve requirements increase the commercial banks' cost of raising debt due to the foregone interest income on reserves held at the Central Bank. These reserves cannot be used in order to provide loans, and therefore interest income is lost for the bank. In the case of Demand Deposits (DDs), the depositor generally bears these additional costs (Black, 1975). These depositors are willing to bear this cost − and abstain from instruments paying market-related interest rates − due to the special transaction service related to DDs. This transaction service refers to the ability to withdraw funds on demand. Certificates of Deposits (CDs) do not provide this service, but were − at the time of writing − also subject to reserve requirements. As CDs do not provide a special service, the interest rate on these instruments must be equal to similar debt instruments. Fama (1985) argues that, in order for CDs to be a viable manner of financing bank loans, the bank borrower has to bear the cost of the 'reserve tax' on CDs. If this is not the case, a bank would not issue CDs as its costs are larger than the revenue it creates. Fama (1985) argues that bank loans can be considered unique due to the willingness of bank borrowers to bear the reserve tax via paying interest rates on loans exceeding the interest rate on alternative debt instruments. In a similar strand of literature, James (1987) measures the impact of reserve requirements on the annual yields of CDs, Commercial Paper and Treasury bills. The author does not find a difference in yields between the financial instruments after a change in the reserve requirement. Strengthening the finding of Fama (1985), this indicates that bank borrowers bear the reserve tax.

In addition to observing the impact of reserve requirements, the uniqueness of bank loans is measured in alternative manners. James (1987) analyzes the impact of bank loan announcements versus announcements of other types of external finance on the stock prices for a subset of firms. The author finds that bank loan announcements have a direct positive impact on the firms' stock price, whereas announcements of other types of finance do not. Furthermore, Hoshi et al. (1991) find that monitoring of borrowing firms by banks results in a decline in information asymmetries and subsequently a fall in the borrower external finance premium. This monitoring occurs prior to a loan agreement. After this monitoring occurs, a certain 'lock-in' between lender and borrower may arise. As the relationship with the bank results in a commitment, it is costly for this borrower to switch between lenders (and debt instruments). This is further established in the theoretical work of Sharphe (1990) and Rajan (1992) and the empirical work of Petersen and Rajan (1994).

2.3.2 Necessary Condition 2: Loan Supply Influence

The second condition states that a Central Bank is able to influence a commercial bank's loan supply after a monetary policy shock via altering the level of commercial bank reserves. When assessing the validity of this condition, an empirical identification issue arises. As shown in the money view, monetary policy has an effect on loan demand via changes in the cost of capital for borrowers. In order to identify a loan supply shift, we thus have to control for changes in loan demand following a monetary policy shock.

To this end, Bernanke and Blinder (1992) measure the impact of the Federal Funds Rate (FFR) on several bank balance sheet variables. The authors claim that this interest rate is a proper exogenous monetary policy measure. This claim is substantiated by observing the information content of the FFR, whether the FFR responds largely to its target rate and determining whether the FFR endogenously responds to movements in the Federal Funds market. The authors find that short-run fluctuations in the FFR represent policy shifts, and are not influenced by non-policy factors. By definition, policy shifts are influenced by past economic conditions. However, Bernanke and Blinder (1992) find that the FFR is insensitive to current (within month) changes in the economy. Subsequently, the authors determine the impact of the FFR on U.S. bank balance sheet data from 1959 until 1978. The authors find that an increase in the FFR results in an immediate decline in deposits. Subsequently, bank securities – such as Treasury bills – fall, which rise again after loans start to decline. The authors state that the delayed impact on loan supply has to do with the different maturities of securities and loans. Securities are generally shorter-lived than loans are. For this reason, banks adjust their balance sheet by first altering the amount of securities, and then loan supply. Bernanke and Blinder (1992) argue that as the bank balance sheet systematically responds to monetary policy shifts, the change in composition cannot be fully assigned to altered loan demand.

Furthermore, Kashyap et al. (1993) identify loan supply shifts by determining the impact of the FFR on a firms' external financing mix. The authors focus on the relative use of commercial paper and bank loans as part of this mix. The authors argue that – for a loan supply shift to exist – a tightening of monetary policy must not lead to a proportional decline in both the use of bank loans and commercial paper. This would provide evidence for the money view of monetary policy transmission, as the overall demand for external funds declines. The authors find that commercial paper issuance rises while bank loans fall after a tightening of monetary policy. This thus provides evidence for a shift in loan supply after a monetary contraction.

The abovementioned findings indicate that a central bank is able to influence the commercial bank's loan supply. However, several factors may influence this process. Romer and Romer (1990) use a theoretical model to show that due to the ability of banks to raise CDs condition 2 does not hold. In case these CDs fully replace the affected DDs after a monetary policy shock, there is no need for a change on the asset side of the bank's balance sheet. Kashyap and Stein (1994) respond to this finding by stating that the CD market is not as simplified as portrayed in Romer and Romer (1990). As the CD market is not federally insured, adverse selection problems between the depositor and the bank occur. This results in an increase in the costs of issuing CDs for banks. This provides further reason to believe that banks are unable to replace their lost DDs by issuing CDs.

Another reason condition 2 might not hold is concerned with the asset side of the bank's balance sheet. Whenever a bank responds to a decline in DDs by cutting down on its amount of securities, its loan supply does not have to be affected. In fact, this would imply perfect substitutability between bank loans and securities. The findings of

James (1987) and Fama (1985) in the previous section indicate that this is not the case. Furthermore, Kashyap and Stein (1994) state that a bank requires liquid securities in case of random depositor withdrawals.

2.3.3 Necessary Condition 3: Price Stickiness

The third condition claims that prices do not perfectly adjust to monetary policy shocks. Such price stickiness is essential not only for the BLC, but for monetary transmission in general. For this reason, studies on price stickiness are available in abundance. Sbordone (2001) provides evidence for price stickiness in the U.S. and Álvarez et al. (2005) provide an overview of empirical studies investigating price stickiness in the Eurozone. The authors conclude that price stickiness is present in the Eurozone, and to a larger extent than in the U.S.

As the BLC operates through changes in a bank's loan supply, the empirical literature often relies on micro-economic data to effectively eliminate any loan demand effects. This literature then relies on heterogeneity across borrowers, lenders and countries to focus on loan supply changes. By relying on conditions 1 and 2, and determining how strong these conditions hold within a group (borrowers, lenders, countries), differences in the Central Bank induced loan supply shift identify the BLC. By assuming that loan demand responds to a monetary policy shock homogeneously across these groups, loan supply changes can be identified. Sections 2.3.4, 2.3.5 and 2.3.6 focus on heterogeneity across borrowers, lenders and countries, respectively.

2.3.4 Borrower Heterogeneity and the BLC

Condition 1 requires borrowers to imperfectly substitute bank loans with other types of external funds. Heterogeneity in this ability to substitute between debt types results in a method of identifying the BLC. Firms with a low ability to access non-bank finance after a monetary policy shock are affected to a larger extent than firms with a high ability to access these external funds. Switching costs and/or larger interest payments for these firms without easy access to external finance results in an increase in the external finance premium, and hence a decline in investments following a monetary policy shock. According to the BLC, more bank-dependent firms thus respond to a monetary policy shock to a larger extent than less bank-dependent firms do.

Gertler and Gilchrist (1994) determine whether cross-sectional heterogeneity in the monetary policy impact exists by discriminating via firm size in the U.S. manufacturing sector. The authors find that, after a monetary contraction, small firms account for a disproportionately large decline in manufacturing sales. As small firms are more likely to be bank-dependent, and thus face difficulties in obtaining funds via other sources, this provides evidence for the BLC. Furthermore, Nilsen (2002) investigates the impact of monetary policy shocks on Trade Credit (TC) issuance for small and large U.S. manufacturing firms. TC is classified as an unattractive and more expensive alternative for bank financing. The results indicate that both small and large firms reduce bank loans and increase TC issuance following a monetary contraction. However, further classifying the sample of large firms, Nilsen (2002) shows that only firms without a credit rating and without collateralizable assets increase TC issuance. Bougheas et al. (2006) find a similar result when observing the impact of a monetary policy shock on a firms' ability to raise external funds. This ability declines disproportionately for small compared to large firms after a monetary tightening.

Besides a firm's ability to substitute between bank and non-bank debt, a firm's level of liquid assets determines the effectiveness of the BLC. This level of liquid assets determines this firm's ability to substitute bank loans via its own funds after a loan supply shock. The BLC should thus be more effective for firms with a low level of liquid assets (Aysun & Hepp, 2013). Aysun and Hepp (2013) further state that the external finance premium is lower for firms with more liquid assets, as lenders are better able to recover a share of the loan in case of default.

2.3.5 Lender Heterogeneity and the BLC

The BLC can further be identified by focusing on a lender's ability to either obtain external funds or to shield its loan supply from monetary shocks by using its own liquid assets.

Kashyap and Stein (1995) employ a cross-sectional analysis, and determine the impact of monetary policy shocks on the loan supply of banks of different sizes. Using quarterly Call Report data for a sample of U.S. banks between 1976 and 1992, the authors find that small banks respond to a monetary policy shock by altering loan supply to a larger extent than large banks do. As small banks have more difficulties in finding external funds after a monetary policy shock than large banks do, this heterogeneity is observed as identification of the BLC.

Focusing on differences in bank capitalization, Gambacorta (2005) finds evidence for a BLC in Italy during the period 1986 to 1998. Using a GMM estimation technique, the results show that less capitalized banks respond to monetary policy more strongly than more capitalized banks do. It is assumed that the heterogeneous responses derive from the different abilities of the banks to obtain external funds. Kishan and Opiela (2000) use both bank size and capitalization and determine that the smallest, most undercapitalized banks respond to monetary policy to the largest extent. Bank size and bank capitalization thus seem to move hand in hand.

Another identification method focuses on bank's ability to shield its loan supply from monetary policy shocks by relying on its own liquid assets. Kashyap and Stein (2000) find that banks with a lower securities-to-assets ratio respond stronger to monetary policy shocks than more liquid banks do. Using a two-step econometric approach, the authors find that a 1 percentage point increase in the FFR results in a level of commercial and industrial loans of the illiquid bank (20.6 percent securities/assets) to be 0.6 percent lower than that of the liquid bank (60.2 percent ratio) after 1 year.

2.3.6 Country Heterogeneity and the BLC

In section 2.3.4, we observed that differences in the strength of the BLC across borrowers is – among other factors – determined by the borrowers' ability to switch between bank and non-bank debt. Furthermore, section 2.3.5 showed that differences in lenders' ability to obtain external funds results in heterogeneity in the BLC. Besides borrower and lender-specific factors, these abilities are influenced by country-specific factors. To this end, this section focuses on the impact of country-specific characteristics on the BLC.

At the onset of creation of the European Monetary Union (EMU), a large share of literature focused on differences in monetary policy transmission between Member States. Due to structural differences between economies, a monetary policy shock would not result in a homogeneous impact across the Member States. To this end, Cecchetti (1999) used country-specific data on the size and concentration of the banking industry, its health, and the relative importance of bank and non-bank finance in several EMU countries to forecast effectiveness of the BLC. In this research, countries with a small and unhealthy banking sector, in combination with undeveloped capital markets are affected by the BLC to the largest extent. Mihov (2001) tests whether the predictions in Cecchetti (1999) hold by employing a VAR analysis on EMU countries. The author finds, in accordance with the BLC theory, that output declines to a larger extent in countries with a small number of banks, low bank health, and little access to alternative finance (more bank-based).

Bank health influences the BLC via a lender's ability to offset liquidity shocks through issuance of non-reservable types of debt. In contrast, access to external finance influences the BLC by determining the ability of borrowers to substitute non-bank debt for bank debt.

Benito (2005) uses this finding, and measures the strength of the BLC in the U.K. and in Spain by focusing on inventory behavior. The author argues that the U.K. has a market-based financial structure, and Spain has a bank-based structure. Nonetheless, in contradiction to the BLC theory, the author finds that the BLC is more potent in the U.K. than in Spain. In a similar study, De Haan and Sterken (2006) investigate the BLC in the EMU and in the U.K. Using a Worldbank measure of bank dependence, the authors state that the EMU is bank-based, and the U.K. is market based. In contradiction with the BLC, the authors find that monetary policy has a smaller impact on the amount of bank loans in a borrowers' portfolio when this borrower is located in a bank-based economy. De Haan and Sterken (2006) argue that a 'relationship lending channel' potentially underlies their results. This channel states that lender-borrower relationships are stronger in bank-based economies than in market-based economies. As a bank is unwilling to forego on a relationship, a monetary policy shock does not result in a large change in loan supply in the bank-based economy. Boot and Thakor (2000) show that investing in this relationship is beneficial for the bank by increasing the firm's profitability. To this end, banks are unwilling to forego on a relationship with a firm by strongly altering loan interest rates. Bharath et al. (2011) confirm this observation by observing the pricing of syndicated loans. The authors show that interest rates on syndicated loans decline after a lending relationship has been established.

2.3.7 Bank Lending Channel Controls

The previous sections focused on borrower, lender and country-specific variables determining the strength of the BLC. This paper focuses on the impact of an economies' financial structure on the BLC, and subsequently the pricing of (syndicated) bank-loan contracts. In order to effectively identify heterogeneity in the BLC as a result of differences in financial structure, we must control for confounding factors influencing the strength of the BLC.

To this end, table 1 summarizes the findings in sections 2.3.4-2.3.6. This table includes the main borrower, lender and country-specific variables and determines whether these variables increase (+) or decrease (-) the effectiveness of the BLC. 'BLC strength' is measured via the impact of a change in the central bank interest rate on the commercial bank loan rate (i.e. the IRPT). A more effective BLC corresponds to a greater Pass-Through of interest rates. The bank health variable measures the ratio of overhead costs to total assets of the banking sector in an economy. These overhead costs include non-interest expenses, such as wage expenses. A higher value indicates a lower level of banking sector efficiency and banking sector health. This variable influences the IRPT via a lender's ability to find alternative sources of finance after a monetary policy shock. A less healthy bank is unable to easily offset its fall in deposits via raising alternative sources of finance, and therefore has to alter its loan supply. This bank thus increases its interest rates by more compared to healthier banks. A similar mechanism underlies the lender size (measured via the total value of the lender's assets) variable. Larger banks are better able to access alternative funding, and therefore alter loan supply (and loan interest rates) by less compared to smaller banks. Lender liquidity is measured via the total level of liquid assets / total assets and determines the bank' s ability to use its own funds after a monetary policy shock. Due to this ability, more liquid banks are not required to alter loan supply (and bank loan interest rates) to a large extent following a monetary policy shock. Borrower size determines a borrower's ability to switch between bank and non-bank debt following a monetary policy shock. Larger borrowers are better able to switch, and therefore respond to a change in the interest rate on bank loans by relying on alternative sources of funds. Due to this borrower's high interest rate elasticity of demand for bank loans, a commercial bank is not required to alter bank loan interest rates to a large extent in order to accomplish a change in loan supply following a monetary policy shock. For this reason, we observe a smaller pass-through of the Central Bank policy interest rate to bank loan interest rates in case borrowers are large. The borrower liquidity variable is positively related to the interest rate elasticity of demand for bank loans as well. In case the borrower has a large stock of liquid assets, this borrower does not accept a higher interest rate on bank loans due to its ability to rely on its own pool of assets. For this reason, we observe a less strong Pass-Through of the Central Bank policy interest rate to commercial bank loan interest rates for more liquid borrowers.

Table 1: Bank Lending Channel Controls

Variable	BLC Strength	Source
Bank Health	+	Mihov (2001); Dornbusch and Favero (1998)
Borrower Size	-	Gertler and Gilchrist (1994), Nilsen (2002)
Borrower Liquidity	-	Aysun and Hepp (2013)
Lender Size	-	Kashyap and Stein (1995), Kishan (2000)
Lender Liquidity	-	Kashyap and Stein (2000)

Note: 'BLC strength' indicates the Pass-Through of the Central Bank policy interest rate on the commercial bank loan interest rate. A stronger Pass-Through corresponds to a more effective (+) BLC, and vice versa.

2.4 Financial Structure: U.S. versus Eurozone

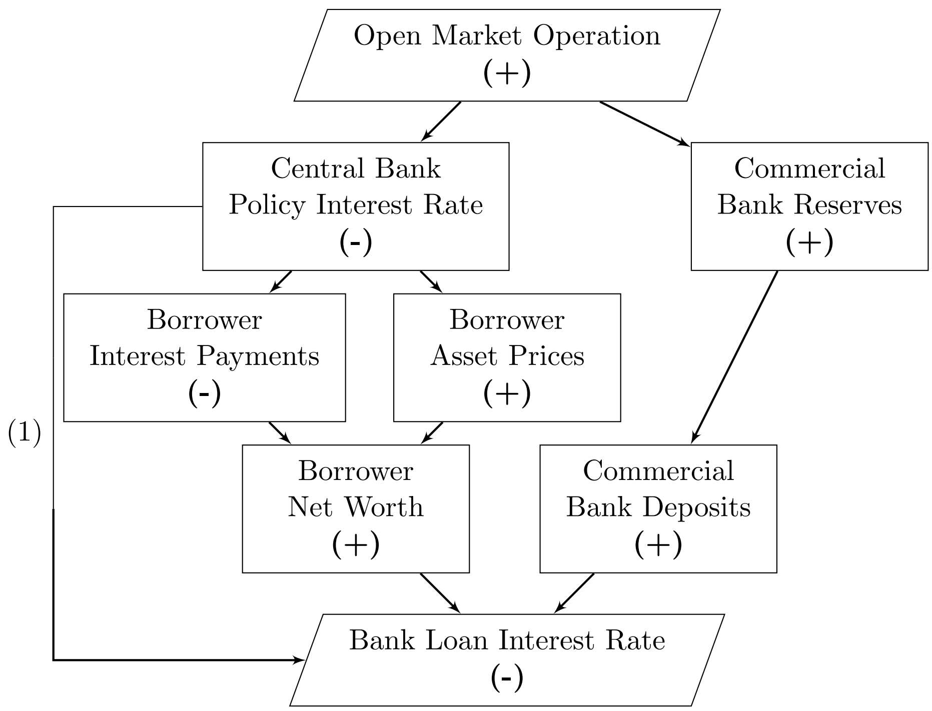
The previous sections showed that borrower, lender and country heterogeneity are used as means of identifying and measuring the strength of the BLC. This paper focuses on cross-country determinants of the BLC. In particular, we determine the impact of differences in the financial structure between the U.S. and the Eurozone on the strength of the BLC. Figure 4 in section A.2.3 indicates a large divergence in the use of bank versus non-bank financing for the non-financial private sector in the U.S. and Eurozone economies. The BLC has a heterogeneous outcome if borrowers in the U.S. and the Eurozone differ in their ability to switch between bank and non-bank debt.

To this end, Fiore and Uhlig (2005) determine the main factors underlying the discrepancy in the use of bank versus non-bank finance in the U.S. and the Eurozone. The authors generate a dynamic general equilibrium model, and determine a firms' financing choice. Specifically, the authors determine the relative use of bank loans and corporate bonds as sources of external financing. Subsequently, the authors use the model for the Eurozone and the U.S. over the period 1997-2003 and determine the factors underlying differences in external financing. The results indicate that the differences in external finance between the U.S. and Eurozone are determined by; a lower availability of public creditworthiness on Eurozone firms and more efficient information gathering on firms by banks in the Eurozone. This finding not only explains the aggregate external finance mixes but also provides insights in the relative costs of switching between bank and non-bank debt. As firms in the Eurozone find it more difficult to enter the money market than U.S. firms do, it is likely that a marginal change in the level of bank debt − for an equal level of bank-dependence − is more costly in the Eurozone than in the U.S. For this reason, the interest rate elasticity of bank loans is higher in the U.S. than in the Eurozone. Dornbusch and Favero (1998) corroborate this intuition, and state that a 100 basis point change in the monetary short-term interest rate results in a larger change in bank loan interest rates in the Eurozone than in the U.S. Whether this finding is caused by differences in financial structure or other factors, is questionable.

2.5 Monetary Transmission and the IRPT

This section provides an overview of the various transmission channels running from OMOs to the interest rate setting on commercial bank loans. As this paper solely focuses on the pass-through of interest rates, we must only consider the monetary transmission channels that rely on this pass-through. By definition, the exchange rate channel and the equity price channel (via Tobin's q) thus do not play a role in our analysis. The exchange rate channel operates through a change in the Central Bank policy interest rate, and the subsequent impact on the exchange rate via foreign investments. The equity price channel focuses on a change in the Central Bank policy interest rate and its subsequent impact on the stock prices of firms and this firms willingness to invest. In both of these transmission channels, commercial bank loan interest rates do not play a distinct role. Figure 1 gives a schematic overview of the transmission channels of interest.

Figure 1: Monetary Transmission Channels



Note: (1) depicts both the interest rate channel and the risk-taking channel. Impact of the Central Bank policy interest rate on the bank loan interest rate is positive for the interest rate channel and negative for the risk taking channel.

This figure portrays the impact of an increase in the Central Bank OMOs (i.e. an increase in liquidity provided via repurchase agreements) on commercial bank loan interest rates.

An increase in liquidity via OMOs directly translates into a lower central bank policy interest rate. The Federal Reserve targets its policy interest rate (the Federal Funds Rate (FFR)) via OMOs. An increase in OMOs then results in a lower FFR. In contrast, the main policy rate of the ECB (the Main Refinancing Rate) is equal to the interest rate on OMOs. A decline in the Central Bank policy interest rate directly lowers bank loan interest rates via the interest rate channel. In contrast, the risk-taking channel predicts a negative relationship between the policy interest rate and the bank loan interest rate. Process (1) thus either shows a positive or a negative relationship. Furthermore, the Central Bank policy interest rate change has an impact on a borrowers' net worth via interest payments and asset price changes. This process corresponds with the BSC, as depicted in section 2.2.1. A decline in interest payments and an increase in asset prices increases the borrower's net worth, and thereby its ability to repay the loan and provide collateral against the loan. The commercial bank responds to this rise in net worth by lowering its interest rate on bank loans. The process on the right hand side shows the BLC. A change in OMOs directly alters the level of commercial bank reserves, and as a result of the reserve requirement and the supply of deposits by the private non-financial sector, an increase in the level of deposits. Subsequently, this increases commercial bank loan supply. This loan supply change is conducted via lowering the interest rate on bank loans. The process shown in figure 1 solely captures an expansionary monetary policy shock. A contractionary monetary policy shock, decreasing the amount of liquidity in circulation would result in opposite signs.

Figure 1 shows that when measuring the impact of the BLC on the IRPT, we must control for alternative MTMs. We must take into account process (1) (showing both the interest rate channel and the risk-taking channel) as well as the BSC. Furthermore, as this paper focuses on the impact of financial structure on the BLC, we must control for other MTMs being influenced by financial structure. As shown in the money view, the interest rate channel is unaffected by financial market imperfections (Friedman & Schwarz, 1963). For this reason, financial structure does not play a role in the interest rate channel. The relationship between the risk-taking channel and financial structure is uncertain. In contrast, the BSC is affected by differences in financial structure. Whenever borrowers in a bank- or market-based financial system differ in their balance sheet composition (i.e. the use of bank versus non-bank debt), heterogeneity in the BSC occurs. The interest expense and asset price responses of these firms may vary across the financial structures. In order to effectively control for the BSC in the empirical analysis, we must thus ensure that these borrower balance sheet items do not play a role in the banks' interest-setting behavior.

On the basis of BLC heterogeneity is the ability of a borrower to switch between bank- and non-bank funds. This interest rate elasticity of demand for bank loans is larger in market-based economies than in bank-based economies. For this reason, in order to alter loan supply after a monetary policy shock, a larger change in interest rates is required in the bank-based economy. To test for heterogeneity in the BLC between financial structures more formally, and to gain further insights into this mechanism, we now turn to the theoretical model in section 3.

3 Theoretical Model

As a starting point, we rely on the model created in Peek and Rosengren (1995). This model analyses the impact of capital requirements on the BLC. Although we do not focus on capital requirements, the model of Peek and Rosengren (1995) remains applicable to our case. We abstract from Peek and Rosengren (1995) by adding another player to their model: the firms. Subsequently, we determine the impact of financial structure heterogeneity on the BLC by observing the heterogeneous impact of a monetary policy shock on bank loan interest rates between firm types.

As in Peek and Rosengren (1995), we focus on a representative commercial bank with on the asset side of its balance sheet: Reserves (R), Securities (S) and Loans (L). The liability side of the balance sheet contains: Capital (K), Transactions Deposits (also referred to as Demand Deposits) (DD) and Nontransaction Deposits or Certificates of Deposits (CD). The balance sheet constraint is thus given by:

$$R + S + L = K + DD + CD \tag{1}$$

Capital is fixed in the short-run. The main difference between DDs and CDs is concerned with the depositor's ability to withdraw its deposits. With DDs, deposits can be withdrawn immediately, whereas CDs must be stalled at the commercial bank for a certain period of time. Transaction deposits are inversely related to the Federal Funds Rate (ECB refinancing rate) r_f. This is the interest rate on the OMOs (MROs) of the FED (ECB). When the Central Bank policy interest rate rises, bank depositors are more inclined to shift their holdings of transaction deposits into assets paying market-related interest rates. These depositors respond to the Central Bank policy interest rate with a magnitude of a_1. Furthermore, a share a_0 of deposits is insensitive to the Central Bank policy interest rate. We thus observe the following:

$$DD = a_0 - a_1 r_f \tag{2}$$

Banks have some market power in the CD market. Banks increase holdings of such deposits by increasing interest rates on these deposits r_D above the mean rate in this market: $\bar{r}_D$. This market is assumed to be competitive. For this reason, the impact of a small change of the deposit interest rate above the market interest rate is large. The coefficient measuring this impact, f_1, is therefore high. As with DDs, a share f_0 of CDs is irresponsive to interest rates.

$$CD = f_0 + f_1(r_D - \bar{r}_D) \tag{3}$$

Importantly, concerning the BLC, transaction deposits are subject to reserve requirements. As explained in section 2, the Central Bank uses these reserve requirements when conducting its policy. Non-transaction deposits are not subject to a reserve requirement. We assume that banks do not hold any excess reserves. The amount of bank reserves is thus shown by:

$$R = \alpha DD \tag{4}$$

Securities are a proportion of DDs. Banks keep these (liquid) securities on the balance sheet as a buffer against large adverse shocks to DDs.

$$S = h_0 + h_1 DD - R \tag{5}$$

The market for bank loans is imperfectly competitive. The loan supply curve of a bank is upward sloping w.r.t. the price of this loan; its interest rate r_L. A bank increases its loan supply by offering a loan rate r_L above the mean rate for bank loans in the market; $\bar{r}_L$. We observe the following relationship:

$$L_S = g_0 + g_1(r_L - \bar{r}_L) \tag{6}$$

In this model, g_1 is considered exogenous. This coefficient determines the sensitivity of loan supply to changes in bank interest rates on loans. This is in contrast with Peek and Rosengren (1995), where the g_1 coefficient was a measure of loan demand. In order to capture loan demand, we add a new player to the model of Peek and Rosengren (1995): *the firm*. These (non-financial) firms require external financing in order to make investments. We assume that this external financing solely originates from bank loans (L) on the one hand and credit obtained via the money market (MM) on the other. We obtain the following formula showing the relationship between loan demand L_D , the interest rate on bank loans r_L and the (exogenous) mean money market interest rate $\bar{r}_{MM}$:

$$L_D = k_0 - k_1(r_L - \bar{r}_{MM}) \tag{7}$$

Now, the exogenous parameter k_1 measures the sensitivity of firm financing to differences between the interest rate on bank loans and the interest rate in the money market. This coefficient is positively linked to a firm's ability to substitute between bank and non-bank debt, and measures the interest rate elasticity of demand for bank loans. When the interest rate on bank loans falls below the mean money market interest rate, loan demand increases by k_1. On the other hand, an increase on the interest rate on bank loans above the mean money market interest rate results in a decline in loan demand by k_1. Taking into account the findings in section 2.4, we assume that this exogenous parameter is larger in the U.S. than in the Eurozone, thus: $k_1 US > k_1 Eurozone$. Due to a larger reliance on money market finance for U.S. firms, an increase in the interest rate of bank loans results in a stronger decline in loan demand for these firms in comparison to Eurozone firms. U.S. firms are thus in a better position to substitute bank loans with other sources of finance and have a higher interest rate elasticity of bank loan demand than Eurozone firms. The impact of the k_1 coefficient on the pass-through of Central Bank policy rates to bank loan interest rates identifies the BLC, and is on the basis of this paper.

Market interest rates on nontransaction deposits and loans are positively related to the Central Bank policy interest rate, by the coefficient ϕ:

$$\bar{r}_D = b_0 + \phi r_f \tag{8}$$

$$\bar{r}_L = c_0 + \phi r_f \tag{9}$$

Banks maximize profits π according to the following formula:

$$\pi = (r_L - \theta)L_S + h_1 S - r_f DD - r_D CD \tag{10}$$

Total profits are the sum of interest income on loans $(r_L L_S)$ net of loan losses (θL_S) , interest received from securities holdings $h_1 S$, minus interest paid on transaction deposits and non-transaction deposits $(r_f DD + r_D CD)$. In order to find the comparative statics, we maximize the profit function, subject to the constraints $L_S = L_D$ and the bank balance sheet constraint $R + S + L = K + DD + CD$. We rewrite this function solely in terms of r_D, r_L and exogenous terms (observe Appendix A.1 for the full derivation). After maximizing this function with respect to the bank's choice variables r_L and r_D, we obtain the equilibrium values $\widetilde{r}_L$ and $\widetilde{r}_D$. Subsequently, we focus on finding the following comparative statics showing the impact of the Central Bank policy interest rate on bank loan and CD interest rates:

$$\frac{\delta \widetilde{r}_L}{\delta r_f}, \frac{\delta \widetilde{r}_D}{\delta r_f} \tag{11}$$

The following equations show the equilibrium values for r_L, r_D, λ and λ_2.

$$\widetilde{r}_L = \frac{g_1(c_0 + \phi r_f) + k_0 + k_1 \bar{r}_{MM} - g_0}{g_1 + k_1} \tag{12}$$

$$\begin{aligned}\widetilde{r}_D = & \frac{h_0 + (h_1 - 1)(a_0 - a_1 r_f) + k_0 - K - f_0 + k_1 \bar{r}_{MM}}{f_1} \\ & - k_1 \left(\frac{g_1(c_0 + \phi r_f) + k_0 + k_1 \bar{r}_{MM} - g_0}{f_1(g_1 + k_1)} \right) + (b_0 + \phi r_f)\end{aligned} \tag{13}$$

$$
\begin{aligned}
\widetilde{\lambda} =& \frac{-k_1(b_0+\phi r_f)+g_1(c_0+\phi r_f)+\theta g_1 - g_0}{g_1+k_1} \\
&- k_1\left(\frac{2h_0+2(h_1-1)(a_0-a_1r_f)+2k_0-2K-f_0+2k_1\bar{r}_{MM}}{f_1(g_1+k_1)}\right) \\
&+ \frac{2(k_1^2-g_1)(g_1(c_0+\phi r_f)+k_0+k_1\bar{r}_{MM}-g_0)}{(g_1+k_1)^2}
\end{aligned}
\tag{14}
$$

$$
\begin{aligned}
\widetilde{\lambda}_2 =& -\left(\frac{2h_0+2(h_1-1)(a_0-a_1r_f)+2k_0-2K+2k_1\bar{r}_{MM}-f_0}{f_1}\right. \\
&\left. + 2k_1\left(\frac{g_1(c_0+\phi r_f)+k_0+k_1\bar{r}_{MM}-g_0}{g_1+k_1}\right) - (b_0+\phi r_f)\right)
\end{aligned}
\tag{15}
$$

The comparative statics are given by:

$$
\frac{\delta\widetilde{r}_D}{\delta r_f} = \frac{-a_1(h_1-1)(g_1+k_1)+f_1(g_1+k_1)\phi-k_1g_1\phi}{f_1(g_1+k_1)} > 0 \tag{16}
$$

$$
\frac{\delta\widetilde{r}_L}{\delta r_f} = \frac{g_1\phi}{(g_1+k_1)} > 0 \tag{17}
$$

The comparative static in 16 shows that an increase in the Central Bank policy interest rate results in an increase in the interest rate a bank charges on non-transaction deposits. As h_1 represents the fraction of DD's held as securities on the bank's balance sheet, $h_1 < 1$ and the first term is larger than zero; $-a_1(h_1-1)(g_1+k_1) > 0$. Furthermore, the $f_1(g_1+k_1)\phi$ term is positive. The only negative value originates from the $k_1g_1\phi$ term. The required condition for $\frac{\delta\widetilde{r}_D}{\delta r_f} > 0$ is thus: $-a_1(h_1-1)(g_1+k_1)+f_1(g_1+k_1)\phi > k_1g_1\phi$. The second term on the Left Hand Side (LHS) of this condition $f_1(g_1+k_1)\phi$ consists of all of the terms on the Right Hand Side (RHS) of the condition. In absence of the f_1 coefficient, this term would be larger than the RHS term by definition. However, the f_1 coefficient represents the impact of a change of the non-transaction deposits interest rate w.r.t. the mean market rate on the amount of non-transaction deposits. Due to the competitiveness of this market, we assume f_1 is large. Making use of this observation, and the fact that the first term on the LHS is positive, we determine that the condition $-a_1(h_1-1)(g_1+k_1)+f_1(g_1+k_1)\phi > k_1g_1\phi$ holds. To understand the mechanism underlying this finding, consider a contractionary monetary policy shock; lowering the amount of commercial bank reserves and raising the Central Bank policy interest rate. Via both the reserve requirement and the supply of deposits, the amount of DDs will fall. In order to keep loan supply unaffected by this change in DDs, the commercial bank will increase its level of CDs. As shown in equation 3, an increase in the interest rate on these non-transaction deposits results in an increase of the amount of deposits by f_1.

Furthermore, equations 3 and 8 show that the refinancing rate has a direct impact on the level of non-transaction deposits via $\bar{r}_D$. An increase in the refinancing rate lowers the amount of CDs with ϕf_1 via this path. In order to offset this negative impact on the level of loanable funds for the bank, the bank increases its interest rate on CDs. Concerning the BLC theory, this finding is important. We find that a bank offsets the impact of changes in the amount of reserves and DDs, by issuing CDs. In order to determine whether this change in CDs is potent enough to leave loan supply unaltered, we focus on the second comparative static.

Equation 17 shows the impact of a contractionary monetary policy shock on the interest rate charged on bank loans. The comparative static indicates that an increase in the Central Bank policy interest rate results in an increase in the interest rate on loans. This finding is intuitive, and holds with the interest rate channel. In order to identify the BLC, we focus on the k_1 coefficient. As noted, this coefficient measures the interest rate elasticity of demand for bank loans and is determined by the borrower's ability to switch between debt types. In equation 17, we observe that a large value of k_1 results in a lower impact of r_f on $\widetilde{r}_L$. This corresponds with the high interest rate elasticity attached to a high value of k_1. After an increase in r_f, commercial banks subject to borrowers with a high interest rate elasticity of demand do not have to alter the interest rate on bank loans by much in order to accomplish a shift in loan supply. We assumed that $k_1US > k_1Eurozone$. Using this information, we formulate our hypothesis as:

Via financial structure heterogeneity, OMOs have a larger impact on interest rates of loan contracts in the Eurozone in comparison to the U.S.

Section 4 introduces the data and empirical methodology used in order to answer this hypothesis.

4 Data and Methodology

Having established the hypothesis, we are in the position to proceed to the empirical analysis. Section 4.1 focuses on the data used in this paper and section 4.2 provides the descriptive statistics. Section 4.3 presents the empirical methodology.

4.1 Data Description

In our empirical analysis, we rely on micro-economic data on syndicated loan arrangements, originating from the Thomson Reuters Dealscan database. Section 4.1.1 introduces this loan data. Section 4.1.2 provides the monetary policy variables used in our analysis. The independent variable measures an economies' financial structure, and is shown in section 4.1.3. Furthermore, as shown in section 2, we must control for certain variables influencing the strength of the BLC. Sections 4.1.4:4.1.6 focus on these control variables.

4.1.1 Loan Data

Dealscan provides loan data from commercial banks towards the non-financial private sector. This loan data includes the amount involved, the maturity, and several measures related to the interest rate on the loan. We only include loan contracts where the lender and borrower are located in the same economy (U.S - U.S. and Eurozone-Eurozone). The majority of loan facilities within the Dealscan database focus on syndicated loan deals. The loan amount in these deals is generally large, and multiple lenders are involved. Using syndicated loan data to measure the transmission of monetary policy is useful as Dealscan provides information on both the lender and borrower in a loan deal. To this end, syndicated loan data has been used to analyze the BLC (Aysun & Hepp, 2013) and monetary transmission in general (Delis et al., 2011).

Our dependent variable is denoted by the 'All In Drawn' variable in Dealscan. This variable depicts the interest rate on a loan contract. The variable is measured by the number of basis points a borrower pays over LIBOR (EURIBOR for Eurozone loan facilities) for each Dollar/Euro borrowed. This measure includes any annual fees paid to the group of lenders. We gather information on this interest rate for a subset of loans during the period: 1999Q1:2016Q4.

In addition to the dependent variable, we include several loan-specific control variables. We include these variables as they are possibly linked to both the monetary policy indicator and the dependent variable. In order to effectively measure the sole impact of a monetary policy shock on interest rates, we must thus control for these loan-specific factors. A monetary policy shock may induce commercial banks to alter the non-price terms of loans. Hence, we include the logarithm of the *Maturity* and the *Amount* of every loan. The *Maturity* variable is denoted in months, and states how long the loan will be active from signing date to expiry date. The *Amount* variable measures the size of the loan, and is depicted in millions of Dollars/Euros. Mahanti et al. (2008) and Bao et al. (2011) argue that the amount of a loan is positively related to the liquidity (i.e.

ability to resell the loan in the secondary market) of this loan. A higher ability to resell the loan lowers the risks involved in issuing the loan, and therefore lowers the interest rate on the loan. We thus expect a negative impact of the *Amount* variable on the dependent variable. Eichengreen and Mody (2000) and Aysun and Hepp (2013) argue that the risk of a loan increases with the maturity of this loan. Lenders tend to value the liquidity of a short-term loan, and its corresponding ability to discipline borrowers. To this end, we expect a positive impact of the *Maturity* variable on the loan interest rate. Section A.2.4 of the Appendix provides an overview of the distribution of Loan Types and Purposes for both the U.S. and Eurozone samples. We observe that both the loan type and its purpose do not show large discrepancies between the U.S. and the Eurozone. Thus, we do not take these variables into account in our empirical analysis.

4.1.2 Monetary Policy Data

In order to effectively measure the impact of a monetary policy shock, we have to find a proper monetary policy indicator. We follow the common methodology in related literature, and use the ECB Refinancing Rate and the FFR as indicators of monetary policy in the Eurozone and U.S., respectively (Bernanke & Blinder, 1992). These interest rates operate as proxies for the OMOs, and are inversely related to these operations. We obtain the data from the ECB Statistical Data Warehouse and the St. Louis Federal Reserve Bank Database. The effective FFR is given on a monthly basis. We calculate the quarterly value by averaging this interest rate value over 3-month periods. In contrast, changes in the ECB Refinancing Rate occur on specific dates. We calculate quarterly monetary policy values by taking into account the number of days an interest rate prevailed. For instance, in case the interest rate in a specific quarter changes once, the monetary policy (*MP*) variable is calculated in the following manner:

$$MP_t = \frac{\#\ Days\ old\ rate * Old\ Policy\ Rate + \#\ Days\ new\ rate * New\ Policy\ Rate}{Total\ \#\ of\ days\ in\ quarter\ t} \tag{18}$$

As monetary policy responds to current economic conditions, the monetary policy indicator is endogenous by definition. For instance, in our analysis the *MP* variable may respond to the interest rate on syndicated bank loans in order to steer aggregate demand in the economy. However, we solely focus on the movement of bank loan interest rates following a monetary policy shock. In order to limit this endogeneity issue, we measure the monetary policy value one quarter prior to the loan deal. Section A.2.2 in the Appendix shows the movements of both monetary policy measures over the period 1999Q1:2016Q4. As the time period taken into consideration includes the low-interest years, we must take into account the possibility of a risk-taking channel in our data. To this end, we expect either a positive (according to the interest rate channel) or a negative impact of the MP variable on our dependent variable.

4.1.3 Financial Structure Data

As shown in sections 2 and 3, a firms' ability to switch between bank and non-bank debt determines the strength of the BLC. As explained in section 2, the relative use of bank versus non-bank credit of the non-financial private sector gives insights in a firms' ability to switch between external fund sources. As the U.S. and the Eurozone differ strongly in this financial structure measure, differences in the strength of the BLC between both economies may exist via this path. Fiore and Uhlig (2005) further show that these factors explain differences in the ability to switch for firms in the U.S. and in the Eurozone.

To this end, we employ a similar measure as in De Haan and Sterken (2006). These authors use a measure of bank-basedness in an economy by dividing the total level of credit from commercial banks to the private sector by the aggregate value of stock market and bond market capitalization. The data is retrieved from the Worldbank Financial Structure database, and is measured on a yearly basis. We refer to this variable as *Financial Structure*. The variable is calculated as:

$$Financial\ Structure_{ht} = 100 * \frac{PC_{ht}}{ST_{ht} + PC_{ht} + PRB_{ht} + PUB_{ht}} \tag{19}$$

Where PC_{ht} represents the total level of credit from commercial banks to the private sector, ST_{ht} = stock market capitalization, PRB_{ht} = Private bond market capitalization and PUB_{ht} = Public bond market capitalization. The manner of calculation of this variable is the same as in De Haan and Sterken (2006), and measures the financial structure of country h in year t. This is a percentage, and thus moves between 0 - 100%. A higher value indicates a more bank-based economy and gives insights in the ability of the private non-financial sector to rely on non-bank sources of funds. As in De Haan and Sterken (2006) we expect a positive sign of this variable on our dependent variable. A borrower in a bank-based economy − corresponding to a high *Financial Structure* value − is less able to find non-bank sources of finance. The borrower thus has less bargaining power when negotiating the terms of the loan contract with the lender. This results in a higher interest rate on the loan for the borrower. Table 2 shows the average value of this measure for our sample of countries over the period 1999:2016.

Table 2: Financial Structure Variable

Country	Mean	Observations
Austria	57.71	20
Belgium	36.52	50
Finland	38.41	37
France	38.23	428
Germany	51.26	344
Greece	53.79	20
Ireland	50.75	29
Italy	41.97	171
Luxembourg	31.77	16
The Netherlands	41.95	115
Portugal	58.65	35
Spain	52.67	314
USA	**15.22**	**5,934**
Eurozone	**45.63**	**1,579**

Note: Values calculated as: $100 * \frac{PC_{ht}}{ST_{ht}+PC_{ht}+PRB_{ht}+PUB_{ht}}$. PC_{ht} = Private Credit deposit money banks, ST_{ht} = Stock market capitalization, PRB_{ht} = Private bond market capitalization and PUB_{ht} = Public bond market capitalization in country h and year t. Mean values calculated over period 1999Q1:2016Q4.

Table 2 shows a large divergence in the use of bank credit between the U.S. and the Eurozone. Furthermore, the table indicates that differences within the Eurozone exist as well. We take this into account in our regression analyses by including the *Financial Structure* variable as a control variable.

4.1.4 Borrower Controls

We use the 'facility start date' variable in Dealscan in order to match the loan data to the balance sheet data of both lenders and borrowers. We obtain the balance sheet data by relying on the Compustat database. To this end, we use a link file generated in Chava and Roberts (2008). This file links the borrower/lender ID from the Dealscan database to its ID in the Compustat database. As this file does not provide links for a large share of lenders and borrowers, we lose a large subset of observations. In order to minimize this loss of observations, we manually link the Dealscan and Compustat databases, filtering on the location of the headquarters and the company name. Section A.2.6 provides further details of this matching procedure. By matching in this manner, we obtain an additional 2,000 observations.

As observed in section 2.3.8, we have to include several relevant borrower balance sheet variables potentially influencing the strength of the BLC. To this end, we include the borrower's liquid-to-total asset ratio and the market value of its total assets. We refer to these variables as *Borrower Liquidity* and *Borrower Size*. The liquidity variable is measured in percentages, and thus moves between 0 and 100%. The total assets variable is denominated in millions (Euro's for the Eurozone sample and U.S. Dollars for the U.S. sample). This variable is equal to the market value of the firm's equity and the book value of its debt. We alter this variable by taking its logarithm. We expect a negative coefficient on the *Borrower Liquidity* and *Borrower Size* variables. Larger and more liquid firms have a better bargaining position when discussing the interest rate on the bank loan. These firms are considered less risky due to their ability to repay the loan (Aysun & Hepp, 2013). Additionally, we create a variable measuring firm-specific bank-dependence in the following manner:

$$Borrower\ Finance\ Mix_{it} = \frac{Total\ Loan\ Amount_{it}}{Total\ Assets_{it}} \tag{20}$$

This variable approximates the level of bank-dependency for firm i in quarter t. As with the *Financial Structure* variable, the *Borrower Finance Mix* variable influences the strength of the BLC via a firm's ability to substitute non-bank for bank funds. A high value for this variable indicates a larger dependence on bank loans. This larger bank-dependence indicates a lower ability to switch to non-bank funds, and provides less bargaining power for the borrower. Therefore, we expect a positive impact of this variable on our dependent variable. Furthermore, the *Borrower Finance Mix* variable is a measure of leverage. As in Hubbard et al. (2002), an increase in the leverage ratio increases risk for the lender due to an increased probability of default on the loan. Thus, this also indicates a positive impact of *Borrower Finance Mix* on the interest rate of the bank loan.

Furthermore, we must control for borrower-specific variables determining interest-rate setting on bank loans via the BSC. As shown in section 2, the BSC predominantly operates through changes in borrower's interest expenses and changes in borrower asset prices. For this reason, we include the interest expense - to total asset ratio in our analysis. The interest expenses include payments on both short- and long-term debt, and exclude interest related income. We refer to this variable as *Borrower Interest Expense*. These interest expenses are mechanically related to the dependent variable. For this reason – in order to account for reverse causality – we include these expenses with a lag. The expected sign on this variable is positive due to the relationship between borrower interest expenses and the net worth of the firm (Mishkin, 1996). An increase in interest expenses lowers the firm's net worth, due to a decline in cash flow. Lenders re-assess the terms of the loan and increase the interest rate thereon. We further control for changes in borrower asset prices – underlying the BSC – by means of the *Borrower Size* variable. This variable measures the total value of the borrower's assets and takes into account changes in asset prices after a monetary policy shock.

4.1.5 Lender Controls

As the loans gathered from the Dealscan database are syndicated, we observe that a single loan is often linked to multiple lenders. Ideally, we link each loan facility with a single lender. To this end, we make use of the method as in Ivashina (2009) and solely focus on the lead bank. Ivashina (2009) states that the lead bank generally belongs to the 'Administrative Agent' category in Dealscan. If a syndicate does not have an administrative agent, Ivashina (2009) states that the following categories are applicable as functioning as lead bank: book runner, lead arranger, lead bank, lead manager, agent or arranger.

By filtering on these lender categories, we remain with a sample of 5,934 U.S. loan facilities and 1,579 Eurozone loan facilities. The discrepancy between U.S. and Eurozone data exists due to a larger availability of U.S. loan data in the Dealscan database. The 5,934 U.S. loans originate from 296 individual commercial banks and the 1,579 Eurozone loans originate from 146 banks. We solely focus on the holding company of the bank, and do not take into account its subsidiaries. This exercise is similar to the one performed in Kashyap and Stein (2000), who do not observe large differences in their results when making use of holding company or individual company data.

To control for differences in the strength of the BLC across lenders, we decide to include variables indicating the size and liquidity positions of our banks. The size variable is defined as the logarithm of the total market value of assets (in millions) of a bank in a particular quarter. Liquidity is measured by observing the amount of cash and short term investments as a percentage of total assets. We refer to these variables as; *Lender Size* and *Lender Liquidity.* Delis et al. (2011) state that the impact of lender size on bank loan interest rates is ambiguous. Larger banks may invest in more risky assets (higher bank loan interest rate) due to better-developed diversification methods. However, these banks are more tightly supervised and therefore obliged to take on less risk. The coefficient on the *Lender Size* variable is thus either positive or negative. Furthermore, Santos (2011) argues that lender liquidity is a measure of the bank's cost of funds. In case a lender has a large stock of liquid assets, this lender is able to provide loans without raising additional debt. As funding loans from its own pool of liquid assets is associated with low costs of capital, we thus expected a negative impact of the *Lender Liquidity* variable on our dependent variable.

4.1.6 Additional Controls and Data Overview

Besides the mentioned variables, we rely on several additional control variables. Specifically, we control for whether the borrowing economy taken into consideration has been in a recession. As we investigate the time period 1999:2016, we take into account the start of the Global Financial Crisis. These years are depicted by a large contraction in aggregate demand, in combination with sharp monetary measures. In order to effectively measure the impact of a monetary policy shock − irrespective of whether the borrowing economy was in a recession or not − we must control for cross-country differences in the decline in aggregate demand for bank loans. We do this by relying on yearly data from the NBER, determining whether an economy is in a recession or not. We obtain a dummy variable for each economy (including Eurozone economies) in every year, where a 1 indicates an economy being in a recession and a 0 indicates that an economy is not in a recession. We refer to this variable as *Recession.* Chui et al. (2010) argue that interest rates on syndicates loan contracts increased drastically following the Global Financial Crisis. We thus expect a positive coefficient on the *Recession* dummy.

As indicated in section 2.3.6, we have to control for several country-specific variables impacting the BLC. As Cecchetti (1999) argues, the health of the banking sector affects the strength of the BLC. To this end, we create a *Bank Health* variable, originating from the Worldbank database. This variable measures the overhead costs as a percentage of total assets for the entire banking sector, per country per year. These overhead expenses include non-interest expenses, and predominantly consist of wage expenses. Efficient and healthy banks are expected to have lower ratios of overhead costs. A high level of overhead costs thus indicates a low level of bank health. Kunt and Huizinga (1999) argue that overhead costs may be passed on to financial customers via higher bank loan interest rates or lower deposit interest rates. This indicates a positive impact of the *Bank Health* variable on our dependent variable. On the other hand, (Altunbas et al., 2007) links banking efficiency (i.e. bank health) to bank risk-taking. The authors find that inefficient banks hold more capital and take on less risk. This thus corresponds with a negative coefficient on the *Bank Health.* We therefore expect either a positive or negative impact of the *Bank Health* variable on our dependent variable.

Furthermore, as shown in section 2.3.6, De Haan and Sterken (2006) indicate that the relationship-lending channel works in the opposite direction of the BLC, and is linked to the Worldbank financial structure measure. A relationship between lender and borrower is more likely to be present in a bank- than in a market-based economy. Due to this relationship, a monetary policy shock has a smaller impact on bank loan interest rates in the bank-based economy. To control for this relationship-lending channel, we create the *Relationship* variable, using a similar measure as in Bharath et al. (2011). We rely on the following formula:

$$Relationship_{ijt} = \frac{Total\ Loan\ Amount\ Bank\ j\ to\ firm\ i\ quarter\ t}{Total\ Loan\ Amount\ firm\ i\ quarter\ t} * 100 \qquad (21)$$

The *Relationship* variable is thus created for every lender-borrower relationship in a specific quarter. The variable runs from 0 to 100%, where a low value indicates a weak lender-borrower relationship and a high value indicates a strong relationship. A strong relationship indicates a high ability of the lender to assess the borrower's risk. As in Hoshi et al. (1991) we expect a negative impact of this variable on bank loan interest rates.

Table 3 summarizes the impact of the control variables on our dependent variable.

Table 3: Control Variables

Variable	Expected Sign	Source
Loan Maturity	+	Aysun and Hepp (2013)
Loan Amount	-	Bao et al. (2011); Mahanti et al. (2008)
Borrower Finance Mix	+	Hubbard et al. (2002)
Borrower Size	-	Aysun and Hepp (2013)
Borrower Liquidity	-	Aysun and Hepp (2013)
Borrower Interest Expense	+	Mishkin (1996)
Lender Size	(+/-)	Delis et al. (2011)
Lender Liquidity	-	Santos (2011)
Recession	+	Chui et al. (2010)
Bank Health	(+/-)	Kunt and Huizinga (1999); Altunbas et al. (2007)
Relationship	-	Hoshi et al. (1991)

Note: The expected sign indicates the expected impact of the variable on the interest rate on syndicated bank loans (the dependent variable).

Table 14 in section A.2.1 provides the description and the source of the dependent, independent and control variables used in this paper.

4.2 Descriptive Statistics

Before turning to the regressions, this section gives an overview of our variables of interest. Table 4 and 5 provides the number of observations, the unit of observation, the mean, standard deviation, minimum and maximum value for our dependent, independent and control variables for the U.S. and Eurozone samples. Furthermore, table 6 shows the number of lender and borrower observations in every Eurozone country and table 7 gives an overview of the development of the number of observations over time in the Eurozone and in the U.S.

Table 4: Descriptive Statistics US

Variable	Unit of Obs.	Obs.	Mean	Std. Dev.	Min	Max
All-in Drawn	Basis Points, *L*	5,934	226.74	141.50	12	1,300
MP	Percentage, *Q*	5,934	2.46	2.16	.07	6.52
Financial Structure	Percentage, *Y*	5,934	15.22	0.98	13.31	17.46
Bank Health	Percentage, *Y*	5,934	3.20	0.61	2.41	5.03
Relationship	Percentage, *Q*	5,934	95.62	17.61	2.61	100
Borrower Finance Mix	Percentage, *Q*	5,934	27.63	23.37	0.003	99.79
Borrower Size	Millions USD, *Q*	5,934	12,533	82,608	6,406	2,181,449
Borrower Liquidity	Percentage, *Q*	5,934	6.11	8.28	.00001	98.42
Borrower Interest	Percentage, *Q*	5,934	2.12	2.73	0.003	65.83
Lender Size	Millions USD, *Q*	5,934	1,025,120	747,780	254,603	3,879,172
Lender Liquidity	Percentage, *Q*	5,934	7.30	6.58	0.36	43.39
Loan Amount	Millions USD, *L*	5,934	385.67	656.24	0.18	13,500
Loan Maturity	Months, *L*	5,755	48.54	22.25	1	204

Note: L,Q and Y refer to units of measurement. L: Loan-specific, Q:Quarterly and Y:Yearly

Table 5: Descriptive Statistics Eurozone

Variable	Unit of Obs.	Obs.	Mean	Std. Dev.	Min	Max
All-in Drawn	Basis Points, L	1,602	169.72	150.25	5	1,450
MP	Percentage, Q	1,602	1.80	1.29	0	4.74
Financial Structure	Percentage, Y	1,579	45.63	13.48	18.43	88.72
Bank Health	Percentage, Y	1,602	1.43	0.68	0.05	7.15
Relationship	Percentage, Q	1,602	78.16	34.40	1.82	100
Borrower Finance Mix	Percentage, Q	1,602	23.76	24.27	0.007	98.38
Borrower Size	Millions Euros, Q	1,602	41,390	167,942	26.86	1,998,158
Borrower Liquidity	Percentage, Q	1,602	8.34	7.32	0.001	82.72
Borrower Interest	Percentage, Q	1,602	1.43	3.23	0.006	82.37
Lender Size	Millions Euros, Q	1,602	473,590	495,844	62,128	2,241,174
Lender Liquidity	Percentage, Q	1,602	6.28	7.16	0.009	79.48
Loan Amount	Millions Euros, L	1,602	1,166	2,394	1.42	36,309
Loan Maturity	Months, L	1,597	63.85	45.48	2	372

Note: L,Q and Y refer to units of measurement. L: Loan-specific, Q:Quarterly and Y:Yearly

Table 6: Observations Per Country

Country	Borrower	Percentage	Lender	Percentage
Austria	20	1.25	38	2.37
Belgium	50	3.12	46	2.87
Finland	44	2.75	9	0.56
France	432	26.97	354	22.10
Germany	344	21.47	463	28.90
Greece	20	1.25	15	0.94
Ireland	29	1.81	34	2.12
Italy	183	11.42	256	15.98
Luxembourg	16	1.00	3	0.19
The Netherlands	115	7.18	116	7.24
Portugal	35	2.18	55	3.43
Spain	314	19.60	213	13.30
Total	1,602	100.00	1,602	100.00

Note: borrower-lender couples are not country-specific. Example: not every Austrian lender (38 observations) provides loans to Austrian borrowers (20 observations).

Table 7: Observations Over Time

Economy / Period	1999:2001	2002:2004	2005:2007	**2008:2010**	2011:2013	2014:2016
U.S.	1,295	1,399	1,274	**608**	922	436
Eurozone	27	165	440	**317**	384	269

Note: Global Financial Crisis years denoted in **bold**.

Tables 4 and 5 show that the mean *All in Drawn* value for the U.S. is around 0.5%

higher than for the Eurozone sample. This may be the result of the larger *Loan Amount* in the Eurozone sample. Furthermore, we observe that the mean *Borrower Size* value is significantly larger in the Eurozone than in the U.S, whereas the mean *Lender Size* is larger in the U.S. When conducting our empirical analysis, it is important to control for these factors.

Turning to table 6, we observe that the majority of our borrower and lender observations (i.e. the number of times a borrower or lender from country A is in the data-set) originate from a subset of countries. France, Germany, Italy, The Netherlands and Spain account for approximately 90% of the data-set. Furthermore, we limit our Eurozone analysis to 12 economies. We do not include the remaining Eurozone countries due to a lack of loan observations in these economies. Furthermore, table 6 shows that borrower-lender relationships are not necessarily one-on-one country couples in the Eurozone. A bank in a Eurozone economy may thus lend towards borrowers outside of its own economy. When measuring our country-specific control variables, we must thus effectively discriminate between the borrowing and lending economy. The *Bank Health* variable measures the lender economy and the *Financial Structure* and *Recession* variables measure the borrower economies. This is not required in the U.S. sample, as both borrowers and lenders originate from the same economy. Table 7 shows that both the level of U.S. and Eurozone observations decline after the outbreak of the GFC. This decline is largest in the U.S. sample. Figure 5 in Appendix A.2.7 shows the movements of the level of observations in more detail. This relative abundance of pre-crisis observations in the U.S. sample further explains the differences in the mean values for the *All-in Drawn* and *MP* variables between the U.S. and the Eurozone. As shown in section 4.1.6, we control for the impact of the GFC on bank loan interest rates by including the *Recession* variable.

4.3 Methodology

We aim to answer the hypothesis formulated in section 3. We determine the effectiveness of OMOs by observing − via the BLC − its impact on the pricing of bank loans. In terms of the theoretical model in section 3, we thus focus on $\frac{\delta \tilde{r}_L}{\delta r_f}$. Before turning to the regression analyses, we perform several tests on our data. We focus on detecting multicollinearity between our independent and control variables, and among our control variables, and the manner of distribution of our dependent variables. Sections A.3.1 and A.3.2 show the results of these tests. We omit variables with a high ($> |0.5|$) level of correlation, section A.3.1 provides insights into these variables. Section A.3.2 shows that both the U.S. and Eurozone dependent variables do not follow a normal distribution. Our dependent variable measures the number of basis points above LIBOR or EURIBOR, and is restricted to observations larger than zero. For this reason, our sample of observations is 'truncated' (Verbeek, 2008). In case the dependent variable is continuous, but its range is restricted, estimation occurs via the Tobit-model (Tobin, 1958). Heckman (1979) states that not accounting for the distribution of the dependent variable (i.e. via estimating an OLS regression) results in selection bias. As we only select observations by observing the value of our dependent variable, we cannot state that the error term is uncorrelated with our independent variables. That is, unobserved factors determining the interest rate on a bank loan correspond to factors contained in our independent variables. This violates the second Gauss-Markov condition, and results in biased OLS estimates (Verbeek, 2008). Where the values of the dependent variable are unknown in the Tobit model and the values of the independent variables are known, the 'truncated regression model' states that observations are missing if the dependent variable is equal to or below zero. (Verbeek, 2008). As we only include observations where the dependent variable is larger than zero, we do not take into account information on the independent variables in case the dependent variable is equal to or smaller than zero. For this reason, we rely on the truncated regression model and do not make use of the Tobit-model. The truncated regression is estimated via Maximum Likelihood, and truncation occurs at the lower limit of 0. The regression model is given by (Verbeek, 2008):

$$\begin{aligned} y_i^* &= x_i'\beta + \varepsilon_i, \quad i = 1, 2, ..., N, \\ y_i &= y_i^* \quad if\ y_i^* > 0 \\ (y_i, x_i)\ & not\ observed\ if\ y_i^* \leq 0 \end{aligned} \tag{22}$$

In equation 22, the y_i^* observations represent the observations used in our regression (thus, with a value larger than zero). The y_i variable takes into account the entire data-set and thus includes values equal and lower than zero. Equation 22 shows that we solely take into account x_i (the independent variables), in case $y_i^* > 0$. Relying on this methodology, we estimate the following regression:

$$\begin{aligned} AllinDrawn_{hijkt} = {} & constant + \alpha_1 MP_{ht-1} + \alpha_2 Financial\ Structure_{ht-1} + \\ & \alpha_3 MP_{ht-1} * Financial\ Structure_{ht-1} + \alpha_4 bc_{it-1} + \alpha_5 lc_{jt-1} \\ & + \alpha_6 fc_{kt} + \alpha_7 cc_{ht-1} + \varepsilon_{hijkt} \end{aligned} \tag{23}$$

In equation 23, the subscripts *h,i,j,k* and *t* denote country *h*, firm *i*, bank *j*, loan facility *k*, and time quarter *t* linked to every single loan facility. The *Financial Structure* variable is our main independent variable. *MP* represents the monetary policy variable. The variables *bc, lc, fc and cc* represent the borrower, lender, loan facility and country-specific control variables as explained in section 4.1. *bc* consists of: Borrower Size, Borrower Liquidity and Borrower Interest Expenses. *lc* consists of: Lender Size, Lender Liquidity and the Relationship indicator. *fc* consists of: Loan Amount and Loan Maturity. Finally, the *cc* control is limited to the Bank Health variable. The coefficients in the truncated regression are interpreted in a similar manner as OLS regression coefficients (Amemiya, 1973). That is, a one unit increase in the independent variable results in an increase of the dependent variable by the estimated coefficient. We rely on clustered standard errors to take into account heteroskedasticity. We believe that industry-specific shocks (such as shocks to aggregate demand or supply) are able to steer the dependent variable.

Therefore, we cluster on the borrower industry level (via two-digit SIC-codes), and thereby take into account differences in the variance of the error term across industry groups. We estimate equation 23 for both the U.S. and the Eurozone sample. As monetary policy responds to current economic conditions, we include the *MP* variable one quarter prior to the loan deal. This ensures that the dependent variable reacts to the *MP* variable, and lowers endogeneity issues. Furthermore, as in Aysun and Hepp (2013), we take into account the firm and bank-specific variables a quarter prior to the loan deal. This exercise lowers the risk of reverse causality in our regressions. In other words, we limit the risk of finding an effect running from the interest rate on loan facilities to bank and borrower balance sheets. For this reason, we also include the country-specific variables with a lag. Furthermore, we account for omitted variable bias (originating from differences in institutions or the rule of law between economies) by including country fixed effects in section 6. The α_3 coefficient identifies the BLC. In case the BLC exists via financial structure heterogeneity, we observe a positive value for α_3, the monetary policy shock has a larger impact on bank loan interest rates in case the economy is more bank-based. In case we identify a BLC via financial structure heterogeneity in both economies, we are able to answer our main hypothesis. As the *Financial Structure* measure is larger in the Eurozone than in the U.S., a monetary policy shock has a larger impact on bank loan interest rates in the Eurozone via this path. Furthermore, by comparing the values of the α_3 coefficients we are able to identify differences in the marginal impact of a monetary policy shock between the U.S. and the Eurozone. Based on equation 17 in the theoretical model, we believe that the α_3 coefficient must be larger in the Eurozone regression than in the U.S. regression.

In addition to equation 23, we estimate the regression by making use of a fixed effects approach. The fixed effects approach differs from equation 23 by including borrower and lender-specific dummies. The purpose of the fixed effects approach is to take into account unobserved time-invariant heterogeneity between borrowers and lenders, correlated with our main independent variable (*MP * Financial Structure*). Not accounting for these unobserved differences between borrowers and lenders results in omitted variable bias, and hence a biased estimate of α_3. We alter equation 23 in the following manner:

$$\begin{aligned} AllinDrawn_{hijkt} = {} & constant + \mu_{ij} + \alpha_1 MP_{ht-1} + \alpha_2 Financial\ Structure_{ht-1} + \\ & \alpha_3 MP_{ht-1} * Financial\ Structure_{ht-1} + \alpha_4 bc_{it-1} + \alpha_5 lc_{jt-1} \\ & + \alpha_6 fc_{kt} + \alpha_7 cc_{ht-1} + \varepsilon_{hijkt} \end{aligned} \tag{24}$$

The μ_{ij} terms in regression 24 represents the borrower i and lender j intercepts. We estimate this regression in three manners: using either borrower or lender fixed effects, and using both borrower and lender fixed effects. Important to note is that we do not include time-invariant borrower or lender controls in these fixed effects regressions. These controls are not required, because the intercept term takes into account all of the relevant time-invariant factors. The borrower and lender balance sheet data spans a large time period, and values move over time. To this end, we include these variables as controls in the fixed effects regressions. Neyman and Scott (1948) state that estimating a truncated regression with fixed effects may result in a bias of the Maximum Likelihood estimator. However, this 'incidental parameters' problem solely results in bias whenever the number of time periods is low (smaller than 10). As our sample includes data for 72 quarters, this issue is limited in our analysis. Furthermore, Greene (2005) relies on a Monte Carlo simulation and finds that the incidental parameter bias is negligible in a Tobit/Truncated regression. For this reason, we do not further alter regression 24. Greene (2005) also indicates that a more practical issue arises when estimating a truncated regression including fixed effects. In case the number of parameters are larger than the number of clusters, the Wald-statistic cannot be computed. We resolve this issue by relying on an alternative R-squared measure, calculating the squared value of the correlation between the predicted and actual dependent variable.

Table 8 shows the expected signs of the variables, and the origins from these expected signs.

Table 8: Independent Variables

Variable	Expected Sign	Reference
Monetary Policy	(+/-)	Theoretical Model / Risk-Taking Channel
Financial Structure	+	Haan and Sterken (2006)
MP * Fin. Structure	+	Theoretical Model, equation 17

Note: The expected sign indicates the expected impact of the variable on the interest rate on syndicated bank loans (the dependent variable).

We expect that the coefficients on the interaction term (the main variable of interest) is positive. Equation 17 in section 3 shows that the k_1 coefficient lowers the impact of an increase in r_f on r_L. We argue that the *Financial Structure* measure is a proxy for k_1, and is negatively related to this coefficient. For this reason, the impact of an increase in the monetary policy rate for higher values of *Financial Structure* (lower values of k_1) is positive. Table 8 further shows that the monetary policy variable either carries a positive or negative sign. This relates to the general interest rate channel of monetary transmission as shown in the theoretical model, as well as the risk-taking channel. To this end, the impact of the MP variable on the bank loan interest rate is ambiguous. The proxy for financial structure is positively related to the loan interest rate. An increase in bank-dependence, gives commercial banks the opportunity to increase the interest rate on loans. This theory is based on the findings in De Haan and Sterken (2006).

5 Results

This section focuses on estimation of equations 23 and 24, for both the U.S. and Eurozone samples. In both the U.S. and Eurozone regressions, specification (1) refers to equation 23 and specifications (2:4) subsequently include lender, borrower and both lender and borrower fixed effects. Due to multicollinearity (observe section A.3.1), both the U.S. and

Eurozone regressions exclude the *Borrower Finance Mix* and *Loan Amount* variables. Furthermore, in the U.S. regression the *Bank Health* variable is omitted. Table 9 presents the outcome of the U.S. regression and table 10 shows the results of the Eurozone regressions.

Table 9: Truncated Regression U.S.

Dependent Variable: Basis points over LIBOR					
Independent Variables	Exp. Sign	(1)	(2)	(3)	(4)
MP	+/-	246.5***	250.0***	153.5***	182.1***
		(44.56)	(28.70)	(22.83)	(26.20)
Financial Structure	+	46.22***	47.82***	33.04***	37.02***
		(7.996)	(5.249)	(4.305)	(4.362)
MP * Financial Structure	+	-17.82***	-17.65***	-11.54***	-13.07***
		(3.092)	(1.972)	(1.503)	(1.701)
Relationship	-	-0.970***	-0.901***	-0.637***	-0.613***
		(0.224)	(0.199)	(0.178)	(0.173)
Borrower Size	-	-38.38***	-36.20***	-5.185	-19.44***
		(8.868)	(6.851)	(8.060)	(7.265)
Borrower Liquidity	-	0.768	0.196	-0.0699	-0.172
		(1.181)	(0.992)	(0.519)	(0.551)
Borrower Interest Expense	+	0.364	0.885	-0.846	-0.617
		(0.885)	(0.804)	(0.695)	(0.657)
Lender Size	+/-	16.14***	46.49***	12.79***	63.66***
		(4.198)	(11.83)	(3.478)	(10.73)
Lender Liquidity	-	4.588***	2.702***	2.989***	1.538**
		(0.482)	(1.012)	(0.480)	(0.775)
Loan Maturity	+	39.82***	25.03***	-4.061	-8.889**
		(13.20)	(9.196)	(5.140)	(4.416)
Recession	+	58.07***	50.44***	53.49***	49.67***
		(10.37)	(8.912)	(7.608)	(9.044)
Constant		-488.5***	-744.4***	-241.9***	-752.2***
		(158.2)	(99.19)	(84.61)	(117.6)
Observations		5,747	5,747	5,747	5,747
Lender FE		NO	YES	NO	YES
Borrower FE		NO	NO	YES	YES
AIC		70,812	70,164	65,787	65,328
Wald Statistic		309.2	-	-	-
R-Squared		0.212	0.308	0.623	0.662

Notes: Standard errors (in parantheses) are clustered at the borrower industry (SIC) level. *** p <0.01, ** p<0.05, * p<0.1. AIC = Aikaike Information Criterion. R-Squared calculated as: (*corr* $\widehat{y}_i$ *and* y_i)^2. Wald-Statistic unavailable for (2:4) due to *# parameters > # clusters*. Stata code: truncreg *dependent variable indep. variables i.Lender/Borrower*, lower limit (0) vce (cluster SIC).

Table 10: Truncated Regression Eurozone

Dependent Variable: Basis points over EURIBOR					
Variables	Exp. Sign	(1)	(2)	(3)	(4)
MP	+/-	-74.76	-57.05	-40.55	-30.29
		(63.95)	(53.65)	(26.32)	(28.70)
Financial Structure	+	4.518*	3.359	1.312	1.211
		(2.574)	(2.167)	(0.884)	(0.934)
MP * Financial Structure	+	-0.788	-0.519	0.0337	-0.145
		(1.435)	(1.232)	(0.701)	(0.761)
Bank Health	+/-	-77.43**	-106.9***	-32.61***	-51.68***
		(30.54)	(35.07)	(11.37)	(17.87)
Relationship	-	-2.187***	-1.885***	-0.249	-0.163
		(0.625)	(0.406)	(0.192)	(0.190)
Borrower Size	-	-60.60***	-49.18***	49.17	23.86
		(13.85)	(11.32)	(36.26)	(37.96)
Borrower Liquidity	-	1.861	1.465	-1.249	-1.079
		(2.066)	(1.775)	(2.119)	(1.789)
Borrower Interest Expense	+	7.528*	7.225**	8.095	7.738
		(4.333)	(3.503)	(7.244)	(8.507)
Lender Size	+/-	2.639	77.93**	-1.382	29.87***
		(11.01)	(34.94)	(4.014)	(10.80)
Lender Liquidity	-	-0.668	-2.629	-0.635	-3.087**
		(2.027)	(3.003)	(0.887)	(1.536)
Loan Maturity	+	92.65***	91.42***	11.19	8.972
		(34.07)	(26.56)	(11.35)	(10.34)
Recession	+	236.0***	178.3***	99.80***	84.79***
		(60.69)	(45.87)	(22.16)	(21.08)
Constant		238.6	-702.0	-509.6	-503.2
		(307.5)	(477.5)	(441.3)	(484.1)
Observations		1,574	1,574	1,574	1,574
Lender FE		NO	YES	NO	YES
Borrower FE		NO	NO	YES	YES
AIC		18,956	18,824	17,351	17,233
Wald Statistic		34.82	-	-	-
R-Squared		0.201	0.214	0.610	0.648

Notes: Standard errors (in parantheses) are clustered at the borrower industry (SIC) level. *** p <0.01, ** p<0.05, * p<0.1. AIC = Aikaike Information Criterion. R-Squared calculated as: (*corr* $\widehat{y}_i$ *and* y_i)^2. Wald-Statistic unavailable for (2:4) due to # *parameters* > # *clusters*. Stata code: truncreg *dependent variable indep. variables i.Lender/Borrower*, lower limit (0) vce (cluster SIC).

The regression results in the U.S. sample do not change much throughout specifications (1:4). In all of the specifications, the MP * Financial Structure coefficient is negative and significant. This indicates that a monetary tightening (an increase in *MP*) has a smaller impact on bank loan interest rates in case the *Financial Structure* variable is larger. That is, the monetary policy shock has a smaller impact in case the economy is more bank-based. This result does not hold with the BLC theory, nor with the theoretical model. The result indicates that no BLC is present in the U.S. via heterogeneity in financial structure. In contrast, an increase in the level of bank-dependence results in a smaller monetary policy impact. As argued in De Haan and Sterken (2006), this result corresponds with the relationship lending channel. Our *Relationship* variable solely focuses on the borrower-lender relationship by taking into account the loan amount involved. The *MP * Financial Structure* coefficient is thus driven by factors other than the loan amount determining the lender-borrower relationship. The relationship lending channel as formulated in De Haan and Sterken (2006) states that the channel is predominantly active in bank-based economies, due to strong lender-borrower relationships in these economies. As the U.S. is a market-based economy, the negative coefficient on the *MP * Financial Structure* variable is counter-intuitive. A potential explanation is concerned with the U.S. lender's costs involved in monitoring the ability of U.S. borrowers to repay a bank loan. As shown in Fiore and Uhlig (2005), U.S. banks are less efficient in gathering information (i.e. monitoring) on firms' ability to repay a loan than Eurozone banks are. This inefficiency results in high monitoring costs when providing bank loans to borrowers. An increase in this non-financial private sector's use of bank-finance thus corresponds with large monitoring costs for the U.S. bank. The positive and significant *Financial Structure* coefficient indicates that these monitoring costs are translated into bank loan interest rates. After making these monitoring expenses, the bank is unwilling to forego on the lender-borrower relationship in case of a monetary contraction. This results in a negative and significant coefficient on the *MP * Financial Structure* variable. As a result of an investment into the borrower-lender relationship (via monitoring expenses), the lender is unwilling to raise interest rates on bank loans and thereby potentially lose its relationship. The coefficients on the *MP* variables are positive and significant, which holds with the interest rate channel. The *Borrower Liquidity* and *Borrower Interest Expense* variables show insignificant coefficients, indicating that these variables do not have a large impact on our dependent variable. The *Lender Liquidity* variable has the opposite sign and is significant. The regression states that an increase in this variable results in higher interest rates charged on bank loans. Potentially, a link between commercial bank liquidity and risk-taking thus exists in the U.S. sample. The AIC indicates that specification (4) has the best fit. Furthermore, the R-squared measure increases after including fixed effects.

Turning to the Eurozone regression, we observe that the *MP* and *MP * Financial Structure* coefficients are insignificant in all specifications. Furthermore, the *Financial Structure* variable only shows a significant positive sign in specification (1). These results indicate that monetary policy shocks did not have an impact on syndicated loan interest rates in the Eurozone during 1999Q1:2016Q4 via either an interest rate channel or a risk taking channel. We also do not find a BLC via financial structure heterogeneity. Furthermore, the coefficients on our control variables are similar to the U.S. regression. The *Bank Health* variable is significant and negative, and thus corresponds to the findings in Altunbas et al. (2007).

From the regression output in tables 9 and 10, we do not observe the existence of a BLC via financial structure heterogeneity in the U.S. or the Eurozone. As shown in section A.3.1, we exclude the *Borrower Finance Mix* and *Loan Amount* variables in both regressions due to multicollinearity. Appendix A.4 shows the result of the regressions including these variables. We obtain similar regression coefficients and similar results for the goodness-of-fit. Due to the strong theoretical relevance of the *Borrower Size* variable, we decide to focus on the results found in tables 9 and 10. Based on these results, we cannot confirm that monetary policy has a stronger impact on syndicated bank loans in the Eurozone than in the U.S. due to differences in financial structure. Identification of the BLC via financial structure heterogeneity does not occur in both regressions. In order to further determine whether this result holds across alternative specifications, we alter our regressions in section 6.

6 Robustness

As our Eurozone sample exists of multiple (heterogeneous) countries, we estimate the Eurozone regression and include country fixed effects. This ensures that time-invariant country-specific factors do not bias our estimates. Table 23 in Appendix A.4 shows the result of this regression. The estimates do not differ from the results found in table 10 in section 5.

Furthermore, in order to use the full width of our data, we now perform regressions 23 and 24 by combining the U.S. and Eurozone samples. As a robustness check to the results found in section 5, we rely on an alternative monetary policy measure. We use the 3-month interbank Money Market Rate (MMR) for the U.S. and the Eurozone. This interbank interest rate measures the interest rate banks pay when lending interbank funds. As commercial banks obtain funds from the Central Bank against the Central Bank interest rate, the interest rate charged between banks is higher than this Central Bank policy interest rate. Commercial banks in need of additional liquidity (for instance, in order to meet the reserve requirement), are able to borrow at a premium in this interbank market. The interbank MMR is often used as a proxy for monetary policy, due to its close relationship with the Central Bank policy interest rate (De Haan & Sterken, 2006; Mojon, 2000; Borio & Fritz, 1995). Figure 3 in section A.2.2 of the Appendix shows the movements of this rate for the U.S. and Eurozone economies. Comparing figure 3 with figure 2 in A.2.2, we immediately observe similar movements in these interest rates. After taking into account multicollinearity (we omit the *Loan Amount*, *Bank Health* and *Finance Mix* variables from our regressions) we estimate equations 23 and 24. By focusing on the α_3 coefficient, we again observe the existence of a BLC via financial structure heterogeneity. Furthermore, table 11 shows the mean values of our independent variables for the U.S. and the Eurozone.

Table 11: Mean Values Independent Variables

Economy / Variable	MP	Financial Structure	MP * Financial Structure
U.S.	2.64	15.22	40.18
Eurozone	1.89	45.63	86.24

Note: The MP variable measures the average 3-month Money Market Rate.
Mean values calculated over period 1999Q1:2016Q4.

As seen in table 7 in section 4.2, the U.S. sample has relatively more pre-crisis observations than the Eurozone sample. As the 3-month MMR was higher in this period, we observe a larger mean MP value in the U.S. than in the Eurozone. Furthermore, table 11 shows that, as a result of a large *Financial Structure* value in the Eurozone, the *MP * Financial Structure* variable is significantly larger in the Eurozone than in the U.S. As a result, we can interpret the α_3 coefficient as measuring not only heterogeneity of a monetary policy shock between financial structures but also as measuring differences in the strength of the BLC between the U.S. and the Eurozone. In order to further discriminate between the U.S. and the Eurozone, we add a *U.S.* dummy variable which is equal to 1 in case the country of the borrower is the U.S. and 0 otherwise. Furthermore, we interact this dummy variable with the *MP*, *Financial Structure* and *MP*Financial Structure* variables. In this manner, we obtain immediate insights into differences in monetary policy transmission between the U.S. and the Eurozone. Specifications (5) and (6) provide the results of this regression (alternative fixed effects are included in table 24 in section A.4). Table 12 provides the regression results.

Table 12: Truncated Regression Robustness

Dependent Variable: Basis points over EURIBOR/LIBOR							
Variables	Sign	(1)	(2)	(3)	(4)	(5)	(6)
MP	+/-	4.594	-6.406	-17.05***	-12.19***	-35.11	-16.63
		(4.083)	(6.089)	(4.409)	(4.605)	(34.55)	(23.24)
Financial Structure	+	1.384*	3.260***	1.981***	1.724***	2.909**	0.893
		(0.724)	(1.040)	(0.593)	(0.577)	(1.356)	(0.662)
MP * Financial Structure	+	-1.696***	-0.771**	-0.265	-0.395*	-0.280	-0.298
		(0.264)	(0.354)	(0.227)	(0.229)	(0.697)	(0.579)
U.S.						-599.2***	-595.6***
						(167.0)	(92.10)
U.S. * MP						256.5***	180.5***
						(61.19)	(38.53)
U.S. * Financial Structure						46.12***	34.87***
						(9.129)	(4.986)
U.S. * Fin. Struc. * MP						-15.94***	-11.60***
						(3.413)	(2.005)
Relationship	-	0.0111	-0.0164	0.0218	0.00442	0.0516	0.0154
		(0.132)	(0.0960)	(0.0805)	(0.0688)	(0.127)	(0.0676)
Borrower Size	-	-45.82***	-41.72***	-4.449	-18.40**	-41.88***	-11.56
		(9.336)	(7.202)	(8.034)	(9.325)	(8.865)	(8.503)
Borrower Liquidity	-	0.842	0.288	0.121	0.115	0.919	-0.0222
		(1.318)	(1.029)	(0.595)	(0.499)	(1.261)	(0.497)
Borrower Interest Expense	+	0.135	0.150	7.722***	7.013***	0.163	6.263***
		(0.175)	(0.151)	(2.257)	(2.253)	(0.163)	(1.989)
Lender Size	+/-	14.31***	39.96***	5.622***	50.01***	15.58***	67.19***
		(3.453)	(12.55)	(2.044)	(9.586)	(3.979)	(10.45)
Lender Liquidity	-	3.600***	-0.113	1.820***	-0.856	4.154***	0.140
		(0.438)	(0.971)	(0.449)	(0.803)	(0.492)	(0.835)
Loan Maturity	+	36.30***	23.64***	-5.583	-10.52***	43.22***	-7.495*
		(12.28)	(8.862)	(4.443)	(4.018)	(13.18)	(3.861)
Recession	+	98.25***	80.07***	69.81***	64.75***	92.20***	63.47***
		(16.52)	(12.60)	(6.974)	(8.623)	(15.90)	(8.511)
Constant		176.4***	-234.2	79.45	-348.2***	-16.32	-593.8***
		(56.34)	(185.5)	(65.83)	(101.7)	(94.12)	(113.4)
Observations		7,355	7,355	7,355	7,355	7,355	7,355
Lender FE		NO	YES	NO	YES	NO	YES
Borrower FE		NO	NO	YES	YES	NO	YES
Wald Statistic		297.2	-	-	-	272.6	-
AIC		90,643	89,769	83,836	83,193	90,473	83,023
R-Squared		0.183	0.254	0.604	0.642	0.204	0.653

Note: Standard errors (in parantheses) are clustered at the borrower industry (SIC) level. *** p<0.01, ** p<0.05, * p<0.1. AIC = Aikaike Information Criterion. R-Squared calculated as: $(corr\ \hat{y}_i\ and\ y_i)^2$. Wald-Statistic unavailable for (2:4) due to $\#\ parameters > \#\ clusters$. Stata code: truncreg *dependent variable indep. variables i.Lender/Borrower*, lower limit (0) vce (cluster SIC). Values are denominated in U.S. dollars.

The results in specifications (1:4) shown in table 12 hold with the findings in section 5. We observe a positive and significant impact of the *Financial Structure* variable and a negative and significant impact of the *MP * Financial Structure* variable throughout nearly every specification. Again, we thus do not find a BLC via heterogeneity in financial structure. We observe that a monetary policy shock has a smaller impact on bank loan interest rates in case the economy is more bank-based. This thus also suggests a smaller (albeit, relatively small) impact of a monetary policy shock on bank loan interest rates in the Eurozone than in the U.S. Again, (time-varying) factors related to the lender-borrower relationship not taken into account in the *Relationship* measure are potentially on the basis of this finding. Interestingly, the *MP* variable shows a significantly negative coefficient in specifications (3) and (4). This may be an indication of the risk-taking channel. Furthermore, the *Relationship* and *Borrower Liquidity* variables are insignificant. As in the U.S. regression, we observe (in specifications 1 and 3) a positive and significant coefficient on the *Lender Liquidity* variable. This may again be an indicator of the link between lender liquidity and bank risk-taking. The AIC again indicates that specification (4) has the best fit. Furthermore, the R-squared measure steadily increases when adding fixed effects.

In order to further determine the differences in monetary transmission between the U.S. and the Eurozone, we turn to specifications (5) and (6). We observe that the U.S. dummy carries a significant negative coefficient. This thus indicates that, keeping the remaining variables constant, the interest rate on a U.S. bank loan is significantly lower than the interest rate on a Eurozone bank loan. In order to interpret the remaining coefficients, we turn to table 13. This table provides the results of the regressions in section 5 as well as in section 6. We focus on specifications (4) in section 5 and specification (6) in table 12, including both lender and borrower fixed effects.

Table 13: Summary of Results

Economy / Variable	Section	MP	Financial Structure	MP * Financial Structure
Eurozone	5	-30.29	1.211	-0.145
U.S.	5	182.1***	37.02***	-13.07***
Eurozone	6	-16.63	0.89	-0.30
U.S.	6	163.87***	35.76***	-11.90***

Notes: *** p<0.01, ** p<0.05, * p<0.1. Values represent the coefficients as found in sections 5 (specification 4) and section 6 (specification 6).

Turning to the results in section 6, we observe that (as in section 5), the *MP* coefficient is positive and significant for the U.S. and insignificant for the Eurozone. This indicates that the interest rate channel is operative in the U.S. but not in the Eurozone. The relative abundance of post-crisis observations in the Eurozone sample (shown in figure 5 in Appendix A.2.7) may drive this finding. As the MMR remained relatively flat during the post-crisis period, we are unable to find a clear impact of this variable on bank loan interest rates. The discrepancy in the amount of observations between the U.S. and the Eurozone may further drive this finding. Furthermore, the *Financial Structure* coefficient is positive and significant in the U.S., yet insignificant in the Eurozone. This indicates that a significantly positive impact of a change in the *Financial Structure* variable on the bank loan interest rate can only be found in the U.S. This holds with the findings in section 5. As shown in Fiore and Uhlig (2005), U.S. banks are less efficient in gathering information on firms compared to Eurozone banks. As the *Financial Structure* variable is a proxy for the use of bank credit by the non-financial private sector, an increase in this variable is thus associated with rising monitoring costs by the lender. These costs are assumed to be larger in the U.S. than in the Eurozone (Fiore & Uhlig, 2005). The U.S. lender passes these monitoring expenses on to the bank loan interest rate to a larger extent than the Eurozone lender does. This results in a significantly positive coefficient on the *Financial Structure* variable in the U.S. and an insignificant coefficient in the Eurozone. Finally, the coefficients on the *MP * Financial Structure* variable are insignificant in the Eurozone and negative and significant in the U.S. Again, this holds with the findings in section 5. As a result of costly monitoring, a U.S. lender is unwilling to forego on a lender-borrower relationship following a monetary policy shock. Therefore, for higher levels of the *Financial Structure* variable (related with higher monitoring expenses), the lender reduces the bank loan interest rate in relative terms following a monetary policy shock to maintain the lender-borrower relationship. This alternative relationship lending channel potentially drives the negative coefficient on the *MP * Financial Structure* variable in the U.S. The results found in specification (6) hold when accounting for individual lender and borrower fixed effects (observe table 24 in Appendix A.4).

All-in-all, observing the results in table 13, we do not find evidence for the existence of a BLC via financial structure heterogeneity in the U.S. or the Eurozone. We thus reject the hypothesis formulated in section 3. OMOs did not − via financial structure heterogeneity − result in a larger impact on bank loan interest rates in the Eurozone than in the U.S during the period 1999Q1:2016Q4

7 Concluding Remarks

Identifying in what manner a monetary policy shock influences the real economy is vital for monetary policymakers. An important factor in this transmission is concerned with the impact of the Central Bank policy interest rate on interest rates on commercial bank loans. Where the money view of monetary policy transmission hinges on the perfect financial market assumption, the credit view exists in case financial market imperfections arise. As a result of financial market imperfections, an economies' financial structure (i.e. the relative use of bank versus non-bank finance by the non-financial private sector) has an impact on the strength of the transmission channels within the credit view. In particular, financial structure determines the ease of substituting bank for non-bank debt for the private sector and thereby may influence the BLC of monetary policy transmission. Due to a lower interest rate elasticity of demand for bank loans, a monetary policy shock should have a stronger impact on bank loan rates in bank-based versus market-based economies.

By relying on both a theoretical model and an empirical analysis, this paper determines the impact of financial structure heterogeneity − via the BLC − on the pricing of syndicated bank loans. To this end, we focus on two economies with historical differences in financial structure: the U.S. and the Eurozone. Our theoretical model, based on Peek and Rosengren (1995), finds that an increase in the Central Bank policy interest rate results in a larger change in the interest rate of Eurozone bank loans vis-à-vis U.S. bank loans as a result of differences in financial structure between these economies. This financial structure heterogeneity translates into differences in the interest rate elasticity of bank loan demand for the non-financial private sector between the U.S. and the Eurozone. Via this interest rate elasticity, the BLC has a larger impact on Eurozone bank loan interest rates than on U.S. bank loan interest rates. We determine whether this hypothesis holds empirically by focusing on U.S. and Eurozone syndicated bank loan data during the period 1999Q1:2016Q4. Furthermore, we use lender and borrower balance sheet data, originating from the Compustat database. The variable capturing an economies' ease of substituting between debt types originates from the Worldbank database and measures the relative use of bank versus non-bank financing by the private sector in an economy. This variable determines whether an economy is bank- or market-based and measures − via a borrower's ability to replace bank funds by non-bank funds − the interest rate elasticity of demand for bank loans. Our empirical analysis relies on a truncated regression model. This paper adds to the current literature by assessing whether the BLC is operative via an economies' financial structure. Related literature commonly identifies the BLC via observing heterogeneity across lenders and borrowers. An exception is De Haan and Sterken (2006), who focus on the impact of financial structure heterogeneity on the BLC by observing the amount of loans in a borrower's portfolio. We abstract from this paper by focusing on the pricing of syndicated bank loan interest rates. Thereby, we also determine the role of financial structure heterogeneity in the IRPT.

We do not find evidence for the existence of a BLC via financial structure heterogeneity in either the U.S. or in the Eurozone. Our results indicate that financial structure heterogeneity between the U.S. and the Eurozone does not result in differences in the strength of the BLC between both economies. In contrast, our results indicate that a relative increase in the use of bank financing in the U.S. results in a smaller impact of a monetary policy shock on bank loan interest rates. As shown in Fiore and Uhlig (2005), U.S. banks are less efficient in monitoring borrowers than Eurozone banks are. Due to the associated higher costs of monitoring borrowers, U.S. lenders are unwilling to forego on a relationship with the borrower after a monetary policy shock occurs. For this reason, the U.S. banks potentially respond to a monetary policy shock by lowering bank loan interest rates in case the use of bank credit by the private sector increases. This result corresponds with the relationship lending channel, but differs from the finding in De Haan and Sterken (2006). These authors state that the relationship lending channel is more potent in the bank-based economy (Eurozone) than in the market-based economy (U.S). However, we believe that differences in the cost of monitoring borrowers, as shown in Fiore and Uhlig (2005), potentially drive our results. We have attempted to control for the relationship lending channel by including a variable measuring the borrower-lender relationship by focusing on the amount of loans obtained from a specific bank in quarter t divided by the total amount of loans used by the firm in quarter t. However, other time-varying factors (such as monitoring practices) capturing the borrower-lender relationship are potentially on the basis of our results.

The inexistence of a BLC in the syndicated loan market holds with the findings in related literature (Aysun & Hepp, 2013). The inability to identify a BLC in the syndicated loan market may be the result of several factors. Firstly, the syndicated loan market is depicted by large borrowers. Due to the size of these borrowers, they may not be hampered in their ability to switch between bank and non-bank debt. Corresponding with necessary condition 1, this results in an inexistence of the BLC. Secondly, lenders active in the syndicated loans market are generally large and liquid. For this reason, these lenders do not have to adjust loan supply after a monetary policy shock. Finally, the long maturity of syndicated bank loans may hamper the existence of a BLC. De Haan and Sterken (2006) find evidence for a BLC via borrowers' short-term bank debt rather than its long-term bank debt.

Several shortcomings must be taken into account when assessing the empirical results. Our sample of U.S. observations is larger than the sample of Eurozone observations. When assessing the results in section 5, we must acknowledge this observation mismatch. Another caveat in our empirical analysis concerns the use of the Worldbank variable as a measure of firms' ability to switch between bank and non-bank debt. This variable measures the relative use of bank versus non-bank debt by the non-financial private sector. Porta et al. (1997) and Qian and Strahan (2007) argue that it is the underlying rule of law that determines the level of financial sector development. Specifically, the level of creditor protection is of particular importance. To this end, future research may focus on the impact of creditor rights on the BLC of monetary policy transmission. Furthermore, future research may also focus on differences in relationship lending in the syndicated loan market between the U.S. and the Eurozone.

A Appendix

A.1 Theoretical Model Derivations

This section focuses on the full derivations underlying the theoretical model. To this end, section A.1.1 focuses on substitution of terms, section A.1.2 focuses on the Profit Function, section A.1.3 analyses maximization issues, section A.1.4 focuses on the equilibrium values and section A.1.5 concludes by providing the derivations of the Comparative Statics.

A.1.1 Substitution of Terms

In order to find the Lagrangian, we substitute the L_S, S, DD and CD terms from the profit function in terms of exogenous variables. The DD and CD terms are substituted following equations 2 and 3 in section 3, this section focuses on substitution of S and L_S.

Securities

$$\begin{aligned} S &= h_0 + h_1 DD - R \\ &= h_0 + h_1(a_0 - a_1 r_f) - \alpha(a_0 - a_1 r_f) \\ &= h_0 + (h_1 - \alpha)(a_0 - a_1 r_f) \end{aligned} \tag{25}$$

Loan Supply

$$\begin{aligned} L_S &= g_0 + g_1(r_L - \bar{r}_L) \\ &= g_0 + g_1 r_L - g_1(c_0 + \phi r_F) \end{aligned} \tag{26}$$

A.1.2 Profit Function

After substituting the terms from the profit function with the results found in Appendix A.1.1, we are in the position to create the desired profit function. To this end, we alter the profit function, and create a subset of constraints. We focus on the constraint concerning the loan market and the constraint concerning a bank's balance sheet. Specifically, we state that $L_S = L_D$ and $R + S + L = K + DD + CD$. These constraints are given by the Lagrange multipliers λ and λ_2.

After substituting the terms from the profit function, we obtain the following:

$$\begin{aligned} \pi =& (r_L - \theta)(g_0 + g_1(r_L - \bar{r}_L)) + h_1(h_0 + (h_1 - \alpha)(a_0 - a_1 r_f)) \\ & - r_f(a_0 - a_1 r_f) - r_D(f_0 + f_1(r_D - \bar{r}_D)) \end{aligned} \tag{27}$$

Subject to the following constraints, rewritten by making use of substitution in a similar fashion as for the profit function:

$$\lambda[g_0 + g_1(r_L - \bar{r}_L) - k_0 + k_1(r_L - \bar{r}_{MM})] \tag{28}$$

$$\lambda_2[h_0 + (h_1 - 1)(a_0 - a_1 r_f) + k_0 - k_1(r_L - \bar{r}_{MM}) - K - f_0 - f_1(r_D - \bar{r}_D)] \tag{29}$$

A.1.3 Maximization

In the following step, we determine the FOC's for the profit function with respect to the endogenous variables r_D and r_L as well as the Lagrangian multipliers λ and λ_2. The four FOCs are given by:

$$\frac{\delta \mathcal{L}}{\delta r_D} = 0 \tag{30}$$
$$- f_0 - f_1(r_D - \bar{r}_D) - f_1 r_D - \lambda_2 f_1 = 0$$

$$\frac{\delta \mathcal{L}}{\delta r_L} = 0 \tag{31}$$
$$g_0 + g_1(r_L - \bar{r}_L) + g_1(r_L - \theta) + \lambda g_1 + \lambda k_1 - \lambda_2 k_1 = 0$$

$$\frac{\delta \mathcal{L}}{\delta \lambda} = 0 \tag{32}$$
$$g_0 + g_1(r_L - \bar{r}_L) - k_0 + k_1(r_L - \bar{r}_{MM}) = 0$$

$$\frac{\delta \mathcal{L}}{\delta \lambda_2} = 0 \tag{33}$$
$$h_0 + (h_1 - 1)(a_0 - a_1 r_f) + k_0 - k_1(r_L - \bar{r}_{MM}) - K - f_0 - f_1(r_D - \bar{r}_D) = 0$$

A.1.4 Equilibrium Values

After finding the FOCs, we remain with four equations including four unknown values: r_L, r_D, λ and λ_2. We aim to find the equilibrium terms of r_L and r_D, solely expressed in exogenous values. From these equilibrium values, we find the comparative statics required for our main hypothesis.

As a starting point, we make use of the FOC shown in equation 32. We rewrite this FOC, and express r_L in exogenous terms. A tilde $\tilde{r}$ denotes the final equilibrium value in exogenous terms. We obtain the following:

$$\begin{aligned}
&g_0 + g_1(r_L - \bar{r}_L) - k_0 + k_1(r_L - \bar{r}_{MM}) = 0 \\
&g_0 + g_1 r_L - g_1 \bar{r}_L - k_0 + k_1 r_L - k_1 \bar{r}_{MM} = 0 \\
&r_L(g_1 + k_1) = g_1 \bar{r}_L + k_0 + k_1 \bar{r}_{MM} - g_0 \\
&r_L = \frac{g_1 \bar{r}_L + k_0 + k_1 \bar{r}_{MM} - g_0}{g_1 + k_1} \\
&\widetilde{r}_L = \frac{g_1(c_0 + \phi r_f) + k_0 + k_1 \bar{r}_{MM} - g_0}{g_1 + k_1}
\end{aligned} \tag{34}$$

Now, in order to find a similar value in exogenous terms for r_D, we substitute the r_L value in the FOC found in equation 33. This results in the following:

$$
\begin{aligned}
&h_0 + (h_1 - 1)(a_0 - a_1 r_f) + k_0 - k_1(r_L - \bar{r}_{MM}) - K - f_0 - f_1(r_D - \bar{r}_D) = 0\\
&h_0 + (h_1 - 1)(a_0 - a_1 r_f) + k_0 - k_1(\frac{g_1\bar{r}_L + k_0 + k_1\bar{r}_{MM} - g_0}{g_1 + k_1} - \bar{r}_{MM}) - K - f_0 - f_1(r_D - \bar{r}_D) = 0\\
&f_1 r_D = h_0 + (h_1 - 1)(a_0 - a_1 r_f) + k_0 - k_1(\frac{g_1\bar{r}_L + k_0 + k_1\bar{r}_{MM} - g_0}{g_1 + k_1} - \bar{r}_{MM}) - K - f_0 + f_1\bar{r}_D\\
&r_D = \frac{h_0 + (h_1 - 1)(a_0 - a_1 r_f) + k_0 - K - f_0 + k_1\bar{r}_{MM}}{f_1} - k_1\left(\frac{g_1\bar{r}_L + k_0 + k_1\bar{r}_{MM} - g_0}{f_1(g_1 + k_1)}\right) + \bar{r}_D\\
&\widetilde{r}_D = \frac{h_0 + (h_1 - 1)(a_0 - a_1 r_f) + k_0 - K - f_0 + k_1\bar{r}_{MM}}{f_1} - k_1\left(\frac{g_1(c_0 + \phi r_f) + k_0 + k_1\bar{r}_{MM} - g_0}{f_1(g_1 + k_1)}\right)\\
&\; + (b_0 + \phi r_f)
\end{aligned}
\tag{35}
$$

After finding these expressions for $\widetilde{r}_L$ and $\widetilde{r}_D$ in terms of exogenous variables, we are in the position to determine the equilibrium values for λ and λ_2. To this end, we substitute the $\widetilde{r}_L$ and $\widetilde{r}_D$ terms in the FOCs in 30 and 31.

We start off by substituting for $\widetilde{r}_D$ in the FOC in equation 30, and thereby obtain an expression for λ_2 in exogenous terms:

$$
\begin{aligned}
&-f_0 - f_1(r_D - \bar{r}_D) - f_1 r_D - \lambda_2 f_1 = 0\\
&-f_0 - 2f_1 r_D + f_1\bar{r}_D - \lambda_2 f_1 = 0
\end{aligned}
$$

After substituting for r_D we find:

$$
\begin{aligned}
&-f_0 + f_1\bar{r}_D - \lambda_2 f_1 - 2f_1\left(\frac{h_0 + (h_1 - 1)(a_0 - a_1 r_f) + k_0 - K - f_0 + k_1\bar{r}_{MM}}{f_1}\right)\\
&+ 2k_1\left(\frac{g_1\bar{r}_L + k_0 + k_1\bar{r}_{MM} - g_0}{g_1 + k_1}\right) - 2f_1\bar{r}_D = 0\\
\rightarrow &-f_0 - f_1\bar{r}_D - \lambda_2 f_1 - 2h_0 - 2(h_1 - 1)(a_0 - a_1 r_f) - 2k_0 + 2K + 2f_0 - 2k_1\bar{r}_{MM}\\
&+ 2k_1\left(\frac{g_1\bar{r}_L + k_0 + k_1\bar{r}_{MM} - g_0}{g_1 + k_1}\right) = 0\\
\rightarrow &\lambda_2 f_1 = -f_1\bar{r}_D + f_0 - 2h_0 - 2(h_1 - 1)(a_0 - a_1 r_f) - 2k_0 + 2K - 2k_1\bar{r}_{MM}\\
&+ 2k_1\left(\frac{g_1\bar{r}_L + k_0 + k_1\bar{r}_{MM} - g_0}{g_1 + k_1}\right)\\
\rightarrow &\lambda_2 = -\left(\frac{2h_0 + 2(h_1 - 1)(a_0 - a_1 r_f) + 2k_0 - 2K + 2k_1\bar{r}_{MM} - f_0}{f_1}\right)\\
&+ 2k_1\left(\frac{g_1\bar{r}_L + k_0 + k_1\bar{r}_{MM} - g_0}{g_1 + k_1}\right) - \bar{r}_D
\end{aligned}
$$

Rewriting this results in the equilibrium value $\widetilde{\lambda}_2$:

$$\begin{aligned}\widetilde{\lambda}_2 = &-\left(\frac{2h_0 + 2(h_1 - 1)(a_0 - a_1 r_f) + 2k_0 - 2K + 2k_1\bar{r}_{MM} - f_0}{f_1}\right) \\ &+ 2k_1\left(\frac{g_1(c_0 + \phi r_f) + k_0 + k_1\bar{r}_{MM} - g_0}{g_1 + k_1}\right) - (b_0 + \phi r_f)\end{aligned} \tag{36}$$

In order to find the value for λ in exogenous terms, we substitute the values of r_L and λ_2 in the FOC found in 31. Doing this results in the following:

$$\begin{aligned}&g_0 + g_1(r_L - \bar{r}_L) + g_1(r_L - \theta) + \lambda g_1 + \lambda k_1 - \lambda_2 k_1 = 0 \\ &g_0 + 2g_1 r_L - g_1\bar{r}_L - \theta g_1 + \lambda g_1 + \lambda k_1 - \lambda_2 k_1 = 0 \\ &\lambda(g_1 + k_1) = \lambda_2 k_1 + g_1\bar{r}_L + \theta g_1 - g_0 - 2g_1 r_L\end{aligned}$$

After substitution we find:

$$\begin{aligned}&\lambda(g_1 + k_1) = -k_1\left(\frac{2h_0 + 2(h_1 - 1)(a_0 - a_1 r_f) + 2k_0 - 2K - f_0 + 2k_1\bar{r}_{MM}}{f_1}\right) - k_1\bar{r}_D \\ &+ 2k_1^2\left(\frac{g_1\bar{r}_L + k_0 + k_1\bar{r}_{MM} - g_0}{g_1 + k_1}\right) + g_1\bar{r}_L + \theta g_1 - g_0 - 2g_1\left(\frac{g_1\bar{r}_L + k_0 + k_1\bar{r}_{MM} - g_0}{g_1 + k_1}\right) \\ &\rightarrow \lambda = \frac{-k_1\bar{r}_D + g_1\bar{r}_L + \theta g_1 - g_0}{g_1 + k_1} - k_1\left(\frac{2h_0 + 2(h_1 - 1)(a_0 - a_1 r_f) + 2k_0 - 2K - f_0 + 2k_1\bar{r}_{MM}}{f_1(g_1 + k_1)}\right) \\ &+ 2k_1^2\left(\frac{g_1\bar{r}_L + k_0 + k_1\bar{r}_{MM} - g_0}{(g_1 + k_1)^2}\right) - 2g_1\left(\frac{g_1\bar{r}_L + k_0 + k_1\bar{r}_{MM} - g_0}{(g_1 + k_1)^2}\right) \\ &\rightarrow \lambda = \frac{-k_1\bar{r}_D + g_1\bar{r}_L + \theta g_1 - g_0}{g_1 + k_1} - k_1\left(\frac{2h_0 + 2(h_1 - 1)(a_0 - a_1 r_f) + 2k_0 - 2K - f_0 + 2k_1\bar{r}_{MM}}{f_1(g_1 + k_1)}\right) \\ &+ \frac{2(k_1^2 - g_1)(g_1\bar{r}_L + k_0 + k_1\bar{r}_{MM} - g_0)}{(g_1 + k_1)^2}\end{aligned}$$

This results in the equilibrium value $\widetilde{\lambda}$:

$$\begin{aligned}\widetilde{\lambda} = &\frac{-k_1(b_0 + \phi r_f) + g_1(c_0 + \phi r_f) + \theta g_1 - g_0}{g_1 + k_1} \\ &- k_1\left(\frac{2h_0 + 2(h_1 - 1)(a_0 - a_1 r_f) + 2k_0 - 2K - f_0 + 2k_1\bar{r}_{MM}}{f_1(g_1 + k_1)}\right) \\ &+ \frac{2(k_1^2 - g_1)(g_1(c_0 + \phi r_f) + k_0 + k_1\bar{r}_{MM} - g_0)}{(g_1 + k_1)^2}\end{aligned} \tag{37}$$

After finding λ and λ_2 in exogenous terms, we again substitute these terms in equations 30 and 31, and thereby find the equilibrium values $\widetilde{r}_D$ and $\widetilde{r}_L$ again. This exercise is performed solely to ensure our equilibrium values hold. Firstly, we substitute $\widetilde{\lambda}_2$ in equation 31:

$$
\begin{aligned}
&- f_0 - 2f_1 r_D + f_1 \bar{r}_D - \lambda_2 f_1 = 0\\
&- f_0 - 2f_1 r_D + 2f_1 \bar{r}_D + f_1 \left(\frac{2h_0 + 2(h_1 - 1)(a_0 - a_1 r_f) + 2k_0 - 2K - f_0 + 2k_1 \bar{r}_{MM}}{f_1} \right)\\
&- 2k_1 f_1 \left(\frac{g_1 \bar{r}_L + k_0 + k_1 \bar{r}_{MM} - g_0}{g_1 + k_1} \right) = 0\\
\rightarrow & 2f_1 r_D = f_1 \left(\frac{2h_0 + 2(h_1 - 1)(a_0 - a_1 r_f) + 2k_0 - 2K - f_0 + 2k_1 \bar{r}_{MM}}{f_1} \right)\\
&- 2k_1 f_1 \left(\frac{g_1 \bar{r}_L + k_0 + k_1 \bar{r}_{MM} - g_0}{g_1 + k_1} \right) - f_0 + 2f_1 \bar{r}_D\\
\rightarrow & 2f_1 r_D = 2h_0 + 2(h_1 - 1)(a_0 - a_1 r_f) + 2k_0 - 2K + 2k_1 \bar{r}_{MM} - 2k_1 f_1 \left(\frac{g_1 \bar{r}_L + k_0 + k_1 \bar{r}_{MM} - g_0}{g_1 + k_1} \right)\\
&- 2f_0 + 2f_1 \bar{r}_D\\
\rightarrow & r_D = \left(\frac{h_0 + (h_1 - 1)(a_0 - a_1 r_f) + k_0 - K + k_1 \bar{r}_{MM} - f_0}{f_1} \right) - k_1 \left(\frac{g_1 \bar{r}_L + k_0 + k_1 \bar{r}_{MM} - g_0}{g_1 + k_1} \right) + \bar{r}_D
\end{aligned}
\tag{38}
$$

Furthermore, we substitute both λ and λ_2 in equation 2 to find the equilibrium value for r_L. This results in the following:

$$
\begin{aligned}
\rightarrow & g_0 + 2g_1 r_L - g_1 \bar{r}_L - \theta g_1 + (g_1 + k_1) \left(\frac{-k_1 \bar{r}_D + g_1 \bar{r}_L + \theta g_1 - g_0}{g_1 + k_1} \right)\\
&+ (g_1 + k_1)(-k_1) \left(\frac{2h_0 + 2(h_1 - 1)(a_0 - a_1 r_f) + 2k_0 - 2K - f_0 + 2k_1 \bar{r}_{MM}}{f_1 (g_1 + k_1)} \right)\\
&+ (g_1 + k_1) \left(\frac{2(k_1^2 - g_1)(g_1 \bar{r}_L + k_0 + k_1 \bar{r}_{MM} - g_0)}{(g_1 + k_1)^2} \right) +\\
&k_1 \left(\frac{2h_0 + 2(h_1 - 1)(a_0 - a_1 r_f) + 2k_0 - 2K - f_0 + 2k_1 \bar{r}_{MM}}{f_1} \right)\\
&- 2k_1^2 \left(\frac{g_1 \bar{r}_L + k_0 + k_1 \bar{r}_{MM} - g_0}{g_1 + k_1} \right) + k_1 \bar{r}_D = 0
\end{aligned}
$$

$$
\begin{aligned}
\rightarrow & g_0 + 2g_1 r_L - g_1\bar{r}_L - k_1\bar{r}_D + g_1\bar{r}_L + \theta g_1 - g_0 \\
& - k_1\left(\frac{2h_0 + 2(h_1-1)(a_0 - a_1 r_f) + 2k_0 - 2K - f_0 + 2k_1\bar{r}_{MM}}{f_1}\right) \\
& + (2k_1^2 - 2g_1)\left(\frac{g_1\bar{r}_L + k_0 + k_1\bar{r}_{MM} - g_0}{g_1 + k_1}\right) \\
& + k_1\left(\frac{2h_0 + 2(h_1-1)(a_0 - a_1 r_f) + 2k_0 - 2K - f_0 + 2k_1\bar{r}_{MM}}{f_1}\right) \\
& - 2k_1^2\left(\frac{g_1\bar{r}_L + k_0 + k_1\bar{r}_{MM} - g_0}{g_1 + k_1}\right) + k_1\bar{r}_D = 0 \\
\rightarrow & r_L = \frac{g_1\bar{r}_L + k_0 + k_1\bar{r}_{MM} - g_0}{(g_1 + k_1)}
\end{aligned}
$$

A.1.5 Comparative Statics

After finding the equilibrium values for $\widetilde{r}_D$ and $\widetilde{r}_L$, we are in the position to generate the comparative statics. We focus on the impact of the monetary policy variable r_f on both of the bank's choice variables.

Firstly, we determine the impact of r_f on $\widetilde{r}_D$. To this end, we take the first derivative of the equilibrium value of $\widetilde{r}_D$ with respect to r_f.

$$
\begin{aligned}
\widetilde{r}_D = & \frac{h_0 + (h_1-1)(a_0 - a_1 r_f) + k_0 - K - f_0 + k_1\bar{r}_{MM}}{f_1} \\
& - k_1\left(\frac{g_1(c_0 + \phi r_f) + k_0 + k_1\bar{r}_{MM} - g_0}{f_1(g_1 + k_1)}\right) + (b_0 + \phi r_f)
\end{aligned} \tag{39}
$$

The first derivative of the equilibrium value of r_D with respect to r_f is shown by:

$$
\frac{\delta\widetilde{r}_D}{\delta r_f} = \frac{-a_1(h_1-1)}{f_1} + \phi - k_1 g_1 \frac{\phi}{f_1(g_1 + k_1)} > 0 \tag{40}
$$

We rewrite this result into one fraction by multiplying the first term by $\frac{(g_1+k_1)}{(g_1+k_1)}$ and the second term by $\frac{f_1(g_1+k_1)}{f_1(g_1+k_1)}$. This exercise gives further insights in the required condition for $\frac{\delta\widetilde{r}_D}{\delta r_f} > 0$. We obtain the following:

$$
\frac{\delta\widetilde{r}_D}{\delta r_f} = \frac{-a_1(h_1-1)(g_1+k_1) + f_1(g_1+k_1)\phi - k_1 g_1\phi}{f_1(g_1+k_1)} > 0 \tag{41}
$$

We perform the same exercise for r_L.

$$
\widetilde{r}_L = \frac{g_1(c_0 + \phi r_f) + k_0 + k_1\bar{r}_{MM} - g_0}{g_1 + k_1} \tag{42}
$$

The first derivative of this equilibrium value w.r.t. the monetary policy variable is then:

$$\frac{\delta \widetilde{r}_L}{\delta r_f} = \frac{g_1 \phi}{(g_1 + k_1)} > 0 \tag{43}$$

A.2 Data

This section provides insights into the data used in this paper. Section A.2.1 provides an overview of the variables used in our analysis. Sections A.2.2 and A.2.3 show the movements of the monetary policy data and the financial structure data. Subsequently, section A.2.4 gives an overview of the Loan data used. Sections A.2.5 and A.2.6 provide insights in the data-gathering process.

A.2.1 Data Descriptions

Table 14 shows the variables used in our empirical analysis, including the description and its source.

Table 14: Data Descriptions

Variable	Description	Source
A. Dependent Variable		
All-in Drawn spread	Measures the amount the borrower pays in basis points (100 b.p. is 1 percentage point) over LIBOR/EURIBOR for each dollar/euro drawn down. This measure includes annual fees paid to the banking group.	Dealscan
B. Independent Variables		
Federal Funds Rate	Effective nominal Federal Funds Rate. Provided on a monthly basis. Quarterly values created by averaging over 3-monthly period.	Federal Reserve Bank Database
ECB Refinancing Rate	Interest rate on ECB Main Refinancing Operations. Quarterly values generated by observing days of change of this interest rate, and determining the number of days an interest rate prevailed.	ECB Statistical Data Warehouse
Money Market Rate	3-month Interbank U.S. and Eurozone Money Market Rate.	Federal Reserve
Financial Structure	Measure of financial structure of an economy. Calculated as shown in section 4.1.3, and determined per country per year.	Worldbank Financial Structure Database
C. Control Variables		
a) Loan-level		
Maturity	A calculation of how long (in months) the facility will be active from signing date to expiration date.	Dealscan
Amount	Indicates the loan amount commited by the facility's lender pool, in millions of Dollars/Euros.	Dealscan
Type	Type of facility.	Dealscan
Purpose	Primary purpose of the facility	Dealscan
b) Lender-level		
Size	Measures of the size of the lender, measures by taking the log of the market value of assets (in millions).	Compustat
Liquidity	Liquidity-to-assets ratio. Calculated as: (Cash and Short Term Investments / Total Assets * 100).	Compustat
c) Borrower-level		
Size	Similar to Lender-level variable.	Compustat
Liquidity	Similar to Lender-level variable.	Compustat
Interest Expense	Total interest expenses on short and long-term debt. Net of interest income. Ratio over Total Assets.	Compustat
Finance Mix	Calculation of firm-specific bank-dependence. Calculated as: (Loan amount quarter t / total assets quarter t).	Dealscan / Compustat
SIC	Two-digit variable indicating the borrower companies' industry.	Compustat
d) Country-specific		
Bank Health	Measure of health of the banking sector. Calculated per country per year. Calculation: (overhead costs as percentage of total bank assets).	Worldbank Financial Structure Database

A.2.2 Monetary Policy Data

Figures 2 and 3 show the movement of the *MP* variables used in the regressions in section 5 and 6, respectively.

Figure 2: Monetary Policy Rates

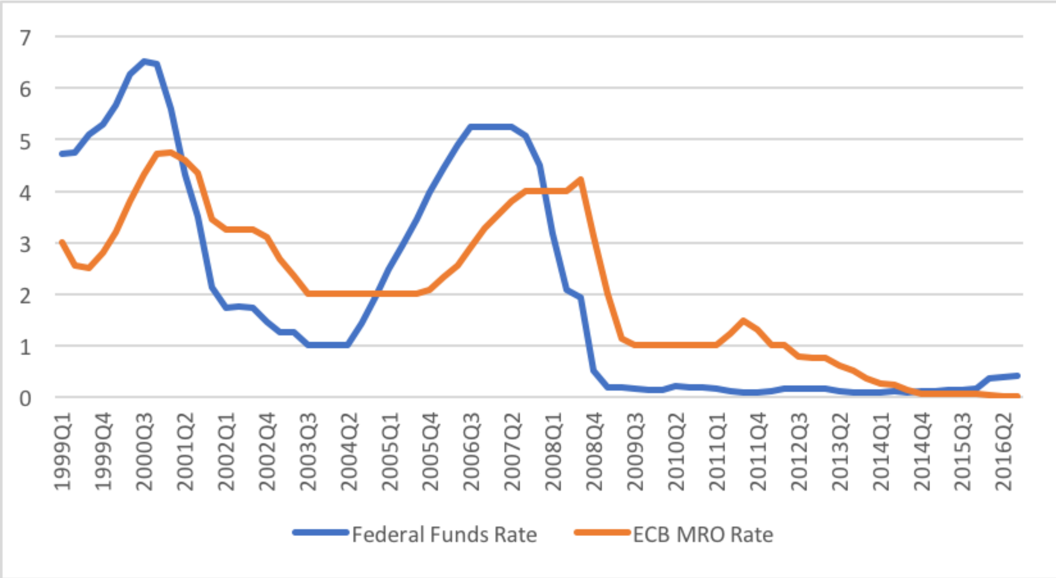
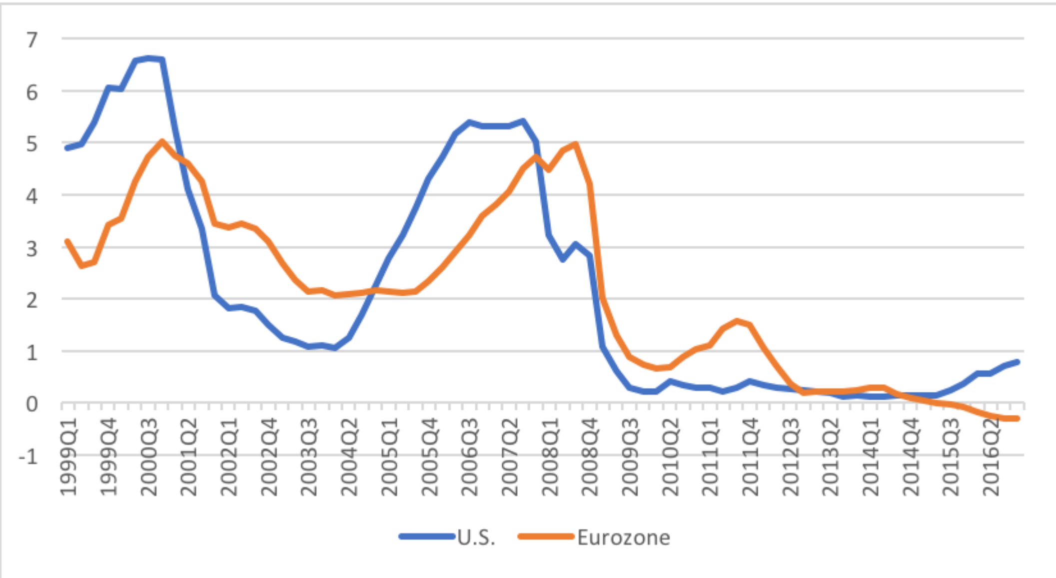


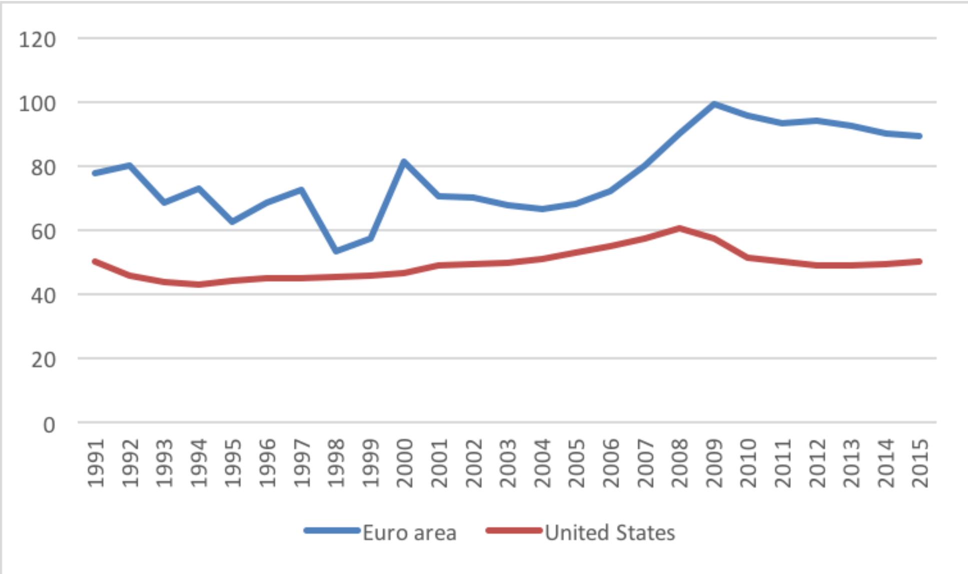
Figure 3: 3-month Interbank Rates



A.2.3 Financial Structure Data

Figure 4 shows the relative use of private credit obtained from commercial banks in the Eurozone and in the U.S during the period 1991:2015. We observe a large and steady discrepancy between both economies. Data is obtained from the WorldBank database on financial structure and economic development.

Figure 4: Financial Structure U.S. and Eurozone



A.2.4 Loan Data

The following two tables give insights into the distribution of loan purposes and loan types for the U.S. and Eurozone samples.

Table 15: Loan Purpose

Loan Purpose	U.S.	Percentage	Eurozone	Percentage
Acquisition Line	260	4.38	79	4.93
Aircraft Finance	-	-	2	0.12
CP Backup	393	6.62	8	0.50
Capital Expenditures	26	0.44	6	0.37
Corporate Purposes	2,618	44.12	759	47.38
Debt Repayment	587	9.89	265	16.54
Debtor-in-possession	88	1.48	-	-
Dividend Recapitalization	51	0.86	6	0.37
Distribution to Shareholder	1	0.02	-	-
ESOP	2	0.03	-	-
Equipment Purchase	13	0.22	-	-
Gaurantee	-	-	-	-
Exit Financing	36	0.61	-	-
IPO Related Finance	14	0.24	14	0.87
LBO	221	3.72	115	7.18
MBO	4	0.07	-	-
Merger	9	0.15	2	0.12
Other	34	0.57	-	-
Project Finance	20	0.34	103	6.43
Real Estate	9	0.15	8	0.50
Rec. Prog.	3	0.05	-	-
Recapitalization	16	0.27	30	1.87
Restructuring	-	-	21	1.31
SBO	6	0.10	17	1.06
Securities Purchase	3	0.05	-	-
Ship Finance	-	-	2	0.12
Spinoff	35	0.59	3	0.19
Stock Buyback	24	0.40	2	0.12
Takeover	425	7.16	137	8.55
Telcom Buildout	10	0.17	4	0.25
Trade Finance	-	-	1	0.06
Working Capital	1,026	17.29	18	1.12
Total	5,934	100.00	1,602	100.00

Table 16: Loan Type

Loan Type	U.S.	Percentage	Eurozone	Percentage
364-Day Facility	539	9.08	56	3.50
Acquisition Facility	11	0.19	11	0.69
Bridge Loan	84	1.42	28	1.75
CAPEX Facility	1	0.02	14	0.87
Delay Draw Term Loan	93	1.57	-	-
Demand Loan	1	0.02	-	-
Floating Rate Bond	3	0.05	-	
Gaurantee	-	-	9	0.56
Leagues/Other	2	0.03	-	-
Lease	2	0.03	1	0.06
Mezzanine Tranche	-	-	2	0.12
Other Loan	32	0.54	25	1.56
Revolver/Line < 1 Yr.	138	2.33	4	0.25
Revolver/Line >= 1 Yr.	3,187	53.71	746	46.57
Revolver/Term Loan	11	0.19	4	0.25
Schuldschein	-	-	75	4.68
Standby Letter of Credit	2	0.03	2	0.12
Synthetic Lease	22	0.37	-	-
Term Loan	514	8.66	437	27.28
Term Loan A	366	6.17	59	3.68
Term Loan B	816	13.75	80	4.99
Term Loan C	76	1.28	26	1.62
Term Loan D	16	0.27	6	0.37
Term Loan E	8	0.13	5	0.31
Term Loan F	4	0.07	-	-
Term Loan G	1	0.02	1	0.06
Term Loan H	2	0.03	1	0.06
Term Loan I	2	0.03	1	0.06
Term Loan J	1	0.02	-	-
Undisclosed	-	-	1	0.06
VAT	-	-	8	0.50
Total	5,934	100.00	1,602	100.00

A.2.5 Lender Data

In our analysis, we solely focus on lead banks. To this end, we use the lead bank definition as in Ivashina (2009). This exercise provides us with a data-set of 86,085 unique loans. However, we observe that multiple lenders exist for the majority of loans. The majority of these duplicates consist of book-runners (8,000/11,000 duplicate loans), we decide to exclude these loans altogether. We remain with a sample of 75,065 loans, each loan belonging to only one 'lead bank'. This sample originates from 1,443 lenders. As the BLC works through monetary policy changes of central banks, we should only incorporate loans from banks subject to ECB and Federal Reserve monetary policy. Thus, we only make use of banks located within the Eurozone and the U.S. This reduces our sample of banks from 1,443 to 1,177. Subsequently, we lose a share of loan data and remain with a sample of 67,038 loan facilities. We lose borrowers with a primary SIC code of 6 = financials. Thereby we lose an additional 11,255 facilities. These loans belong to a sample of 1,053 lenders.

These 1,053 lenders are not necessarily fit for measuring the bank lending channel of monetary policy. The Dealscan database contains several 'Institution Types'. We decide to solely focus on the following categories: 'Eastern European Bank', 'Foreign Bank', 'US Bank' and 'Western European Bank'. We thus remove categories such as 'Corporation' and 'Finance Company', as these institutions' balance sheets do not adhere to the BLC theory. As the transmission channel goes through a banks' deposits, this requirement is binding. We end up with a sample of +- 450 lenders.

In linking the facility IDs to lender data (size and liquidity), we take into account the balance sheet data of the parent ID. In linking the lenders identified in Dealscan with the Compustat balance sheet data, we observe whether the banks identified belong to the same parent bank by looking at the ParentID and UltimateparentID indicators in Dealscan.

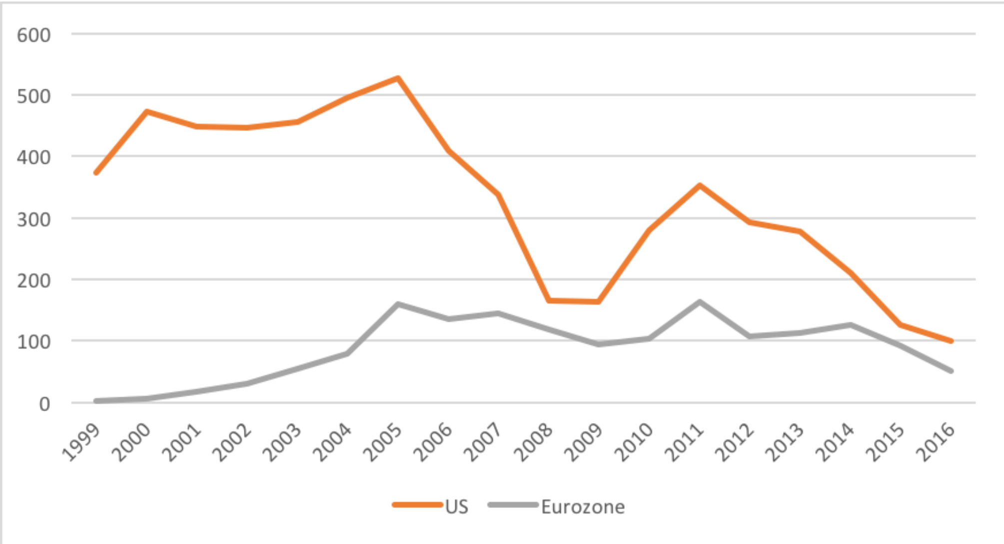
A.2.6 Matching Dealscan-Compustat

In order to find the correct balance sheet variables in our sample, we have to link the Dealscan database with the Compustat database. We do so via the linking-file from Chava and Roberts (2008). However, using this linking file results in a large loss of observations. For this reason, we resort to manually linking both databases. This manual link is made by downloading the entire Compustat (North-America) and (Global) databases. Subsequently, we obtain lender and borrower data from Dealscan (company name, postal code, city) and link both databases via these variables. Furthermore, we use the search engine in Compustat and link companies (both lenders and borrowers) via the company name. Both of these manual linking methods provide us with an additional 2,000 observations. Our final full database consists of 5,934 U.S. observations and 1,602 Eurozone observations.

A.2.7 Observations

Figure 5 gives a graphical overview of the movement of the number of loan observations over the period 1999:2016 for the U.S. and the Eurozone samples.

Figure 5: Observations Over Time



A.3 Specification Tests

This section focuses on the specification tests used for the empirical analysis. The following sections focus on: Multicollinearity and Normality.

A.3.1 Multicollinearity

This section shows the manner of correlation between our explanatory variables and control variables, and among the control variables. Table 17 shows the U.S. correlation matrix, table 18 shows the Eurozone correlation matrix and table 19 shows the correlation matrix for the merged sample. We denote variables with a high correlation value ($> |0.5|$) in **bold**. Several correlation terms are high by definition (for instance between the monetary policy stance and its interaction term), we do not alter our regressions for these values. In all of the correlation matrices, we observe a large correlation between the *Loan Amount* and *Borrower Size* variables. We respond to this finding by removing the *Loan Amount* variable from our regressions. The *Bank Health* variable also shows a high correlation value in the U.S. and Merged correlation matrices. For this reason, we omit the *Bank Health* variable from these regressions. Furthermore, every correlation matrix shows a large correlation between the *Borrower Size* and *Finance Mix* variables. For this reason, we remove the *Finance Mix* variable. Finally, both the Eurozone and Merged correlation matrices show a high correlation coefficient between the *MP* and *Fi-*

nancial Structure variables. As these variables are of utmost importance for this paper, we do not remove these variables.

Table 17: U.S. Correlation Matrix

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
Monetary Policy (1)	1.0													
Financial Structure (2)	-0.1205	1.0												
Monetary Policy * Financial Structure (3)	**0.9964**	-0.0621	1.0											
Bank Health (4)	**0.5265**	-0.2510	0.4800	1.0										
Relationship (5)	0.0458	-0.0337	0.0428	0.0539	1.0									
Borrower Finance Mix (6)	0.1184	-0.0434	0.1166	0.1203	-0.1255	1.0								
Borrower Size (7)	-0.1784	-0.0441	-0.1732	-0.2161	-0.0624	**-0.5095**	1.0							
Borrower Liquidity (8)	-0.0641	0.0471	-0.0589	-0.0919	0.0089	-0.0004	-0.0212	1.0						
Borrower Interest Expense (9)	0.0455	0.0768	0.0462	0.0550	-0.0226	-0.0088	-0.0190	-0.0171	1.0					
Lender Size (10)	-0.2788	-0.0117	-0.2672	-0.3516	-0.0377	-0.0257	0.2624	0.0366	-0.0262	1.0				
Lender Liquidity (11)	-0.1184	-0.1782	-0.1206	-0.1116	-0.0441	-0.0090	0.1557	0.0437	-0.0234	0.1296	1.0			
Loan Amount (12)	-0.1417	-0.0825	-0.1366	-0.1907	-0.0465	-0.1075	**0.6888**	-0.0342	-0.0431	0.2931	0.1375	1.0		
Loan Maturity (13)	-0.1207	-0.0824	-0.1149	-0.1607	-0.0114	0.2359	-0.0526	0.0635	-0.0431	0.1500	0.0814	0.0654	1.0	
Recession (14)	0.0162	0.2546	0.0284	-0.0219	-0.0032	-0.0396	-0.0542	0.0028	0.0573	-0.0689	-0.1116	-0.0930	-0.1752	1.0

Table 18: Eurozone Correlation Matrix

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
Monetary Policy (1)	1.0													
Financial Structure (2)	**-0.5909**	1.0												
Monetary Policy * Financial Structure (3)	**0.9240**	-0.3281	1.0											
Bank Health (4)	-0.1026	0.0361	-0.1264	1.0										
Relationship (5)	0.0918	-0.0536	0.1081	0.0136	1.0									
Borrower Finance Mix (6)	0.1022	-0.0982	0.0578	0.0287	-0.1399	1.0								
Borrower Size (7)	-0.0063	0.0203	0.0162	-0.0187	0.0477	**-0.5642**	1.0							
Borrower Liquidity (8)	-0.0499	-0.0097	-0.0653	0.0434	0.0433	0.0254	-0.0508	1.0						
Borrower Interest Expense (9)	0.0313	-0.0159	0.0256	0.0176	0.0445	-0.0396	0.0601	-0.0653	1.0					
Lender Size (10)	-0.0892	0.0503	-0.0910	-0.2246	-0.0340	-0.0246	0.0189	-0.0017	0.0115	1.0				
Lender Liquidity (11)	-0.1168	0.0729	-0.1133	-0.0657	-0.0244	-0.0243	0.0015	-0.0120	-0.0077	0.1625	1.0			
Loan Amount (12)	-0.0614	-0.0348	-0.0885	-0.0235	0.1535	-0.0651	**0.5372**	-0.0221	-0.0484	-0.0064	0.0025	1.0		
Loan Maturity (13)	0.0438	0.0015	0.0557	0.0698	-0.0294	0.0007	-0.0502	0.0304	-0.0003	-0.0539	-0.0283	-0.1609	1.0	
Recession (14)	0.4269	-0.1332	0.4610	-0.1415	0.0346	-0.0106	0.0154	-0.0565	0.0257	-0.0365	-0.1041	-0.0703	-0.0574	1.0

Table 19: Robustness Correlation Matrix

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
Monetary Policy (1)	1.0													
Financial Structure (2)	-0.2368	1.0												
Monetary Policy * Financial Structure (3)	**0.7565**	0.2078	1.0											
Bank Health (4)	0.3501	**-0.6840**	-0.1544	1.0										
Relationship (5)	-0.1316	0.0474	-0.0976	-0.0642	1.0									
Borrower Finance Mix (6)	0.1197	-0.0870	0.0547	0.1190	-0.0072	1.0								
Borrower Size (7)	-0.1973	0.3267	0.0499	-0.3743	0.0290	**-0.5094**	1.0							
Borrower Liquidity (8)	-0.0866	0.1224	-0.0005	-0.1437	0.0259	-0.0028	0.0356	1.0						
Borrower Interest Expense (9)	0.0418	-0.0008	0.0548	-0.0065	0.0059	0.0117	-0.0421	-0.0144	1.0					
Lender Size (10)	-0.2141	-0.2052	-0.2619	-0.0188	0.0475	-0.0072	0.0995	0.0051	0.0064	1.0				
Lender Liquidity (11)	-0.1418	-0.0518	-0.1466	-0.0142	0.0353	-0.0021	0.0790	0.0318	0.0144	0.1479	1.0			
Loan Amount (12)	-0.1732	0.2402	0.0059	-0.3003	0.0325	-0.1168	**0.6961**	0.0307	-0.0363	0.1297	0.0789	1.0		
Loan Maturity (13)	-0.1505	0.1369	-0.0068	-0.1860	0.0369	0.1732	-0.0030	0.0814	0.0056	0.0590	0.0472	0.0520	1.0	
Recession (14)	0.1821	0.0114	0.2154	-0.0564	-0.0616	-0.0313	-0.0211	-0.0108	-0.0016	-0.0693	-0.1133	-0.0715	-0.1423	1.0

A.3.2 Normality

This section provides several graphical and numerical methods to test for normality of the dependent variable. The graphical method refers to a histogram, including the kdensity plot, as well as a Q-Q and P-P plot. All of the figures show that some non-normality is present. In order to test for normality of the dependent variable more formally, we provide a numerical method for testing for normality. We rely on the Skewness/Kurtosis test in Stata, where the null hypothesis indicates the variable is normally distributed. Table 20 indicates that null hypothesis of a normal distribution is rejected in all cases. We further observe that the dependent variable is truncated. We resolve this by relying on truncated regressions, where the lower limit is set to 0.

Figure 6: U.S. Normality Tests

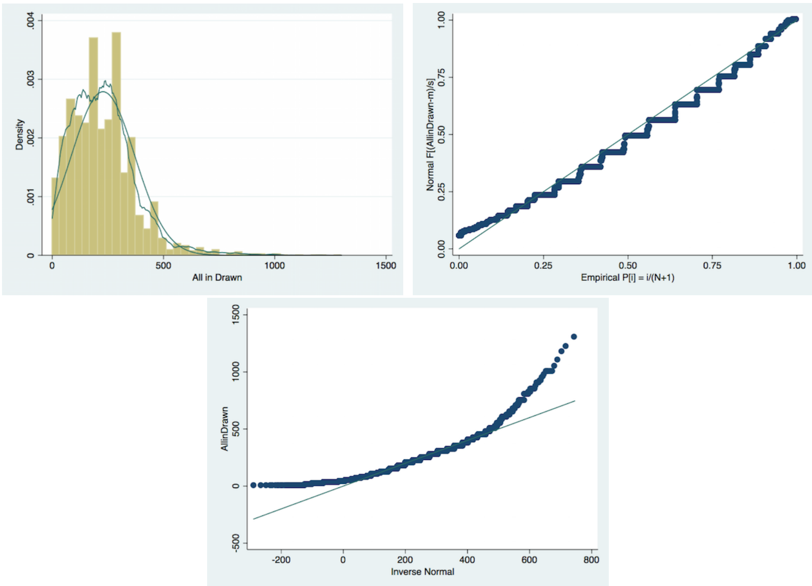


Figure 7: Eurozone Normality Tests

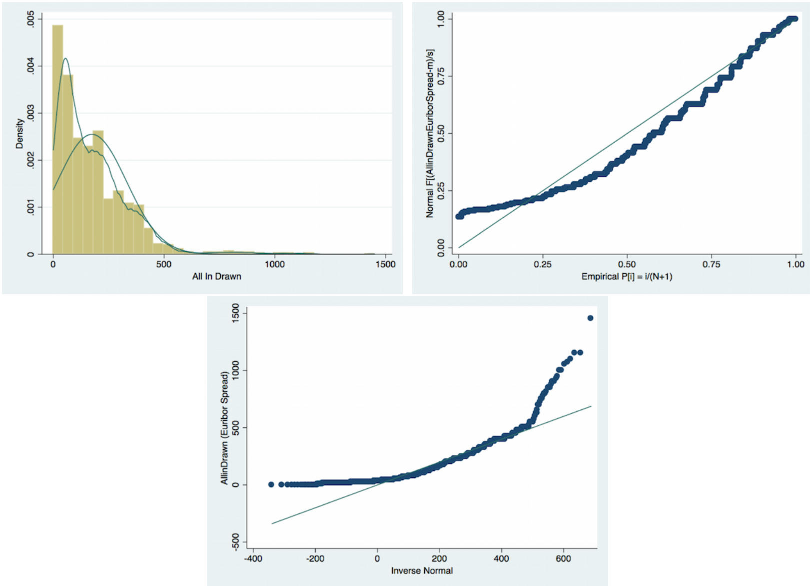


Figure 8: Robustness Normality Tests

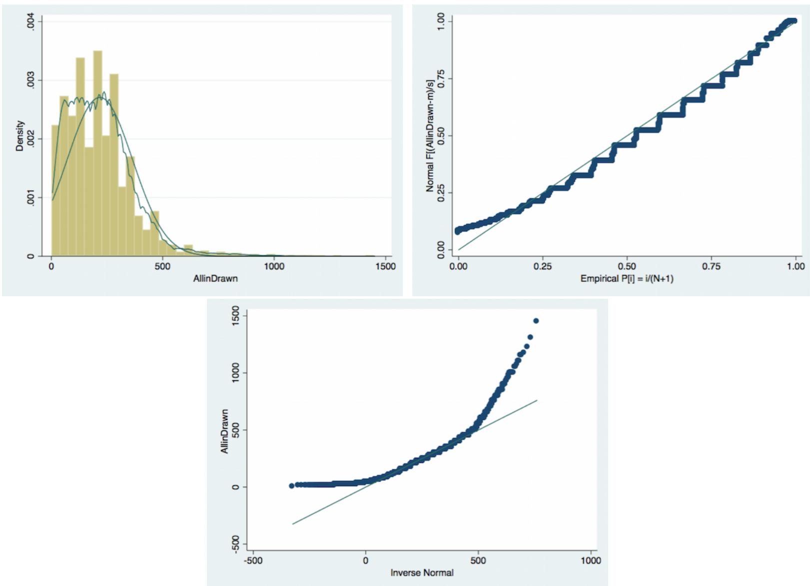


Table 20: Skewness / Kurtosis Test

Variable	Observations	Pr(Skewness)	Pr(Kurtosis)	adj Chi2 (2)	Prob¿Chi2
U.S.	6,625	0.000	0.000	.	.
Eurozone	1,926	0.000	0.000	.	0.000
Merged	8,552	0.000	0.000	.	.

A.4 Regressions

This section provides several additional regression estimates. Tables 21 and 22 show similar regressions as in section 5, but omit the *Borrower Size* variable and include the *Borrower Finance Mix* and *Loan Amount* variables. Table 23 estimates the Eurozone regression as in section 5, but includes country fixed effects. Table 24 provides the results of the regression as in section 6, and includes borrower and lender fixed effects.

Table 21: Truncated Regression U.S. 2

Dependent Variable: Basis points over LIBOR					
Variables	Exp. Sign	(1)	(2)	(3)	(4)
MP	+/-	227.3***	238.0***	147.7***	186.8***
		(37.60)	(25.69)	(20.06)	(25.15)
Financial Structure	+	43.21***	45.74***	32.31***	38.12***
		(7.120)	(5.053)	(4.164)	(4.551)
MP * Financial Structure	+	-16.60***	-16.91***	-11.21***	-13.39***
		(2.620)	(1.759)	(1.318)	(1.622)
Relationship	-	-0.559***	-0.522***	-0.510***	-0.481***
		(0.200)	(0.198)	(0.182)	(0.173)
Borrower Finance Mix	+	1.830***	1.708***	0.585***	0.709***
		(0.502)	(0.392)	(0.145)	(0.141)
Borrower Liquidity	-	0.740	0.200	-0.199	-0.172
		(1.100)	(0.950)	(0.522)	(0.553)
Borrower Interest Expense	+	0.101	0.774	-0.843	-0.587
		(0.836)	(0.761)	(0.700)	(0.670)
Lender Size	+/-	16.40***	48.52***	13.68***	62.42***
		(3.428)	(10.52)	(3.453)	(10.17)
Lender Liquidity	-	4.194***	2.611***	2.955***	1.637**
		(0.452)	(0.946)	(0.491)	(0.804)
Loan Amount	-	-41.59***	-39.05***	-11.74***	-12.92***
		(5.248)	(3.919)	(3.392)	(3.105)
Loan Maturity	+	32.94***	19.68**	-3.856	-9.195**
		(11.03)	(7.995)	(5.091)	(4.343)
Recession	+	54.96***	48.03***	52.24***	48.64***
		(10.36)	(8.865)	(7.312)	(8.807)
Constant		-576.4***	-862.3***	-266.0***	-845.3***
		(170.3)	(90.90)	(83.68)	(123.4)
Observations		5,747	5,747	5,747	5,747
Lender FE		NO	YES	NO	YES
Borrower FE		NO	NO	YES	YES
AIC		70,459	69,839	65,722	65,263
Wald Statistic		429.3	-	-	-
R-Squared		0.263	0.350	0.627	0.666

Notes: Standard errors (in parantheses) are clustered at the borrower industry (SIC) level. *** p <0.01, ** p<0.05, * p<0.1. AIC = Aikaike Information Criterion. R-Squared calculated as: ($corr\ \widehat{y}_i\ and\ y_i)^2$. Wald-Statistic unavailable for (2:4) due to $\#\ parameters > \#\ clusters$. Stata code: truncreg *dependent variable indep. variables i.Lender/Borrower*, lower limit (0) vce (cluster SIC).

Table 22: Truncated Regression Eurozone 2

Dependent Variable: Basis points over EURIBOR					
Variables	Exp. Sign	(1)	(2)	(3)	(4)
MP	+/-	-48.22	-50.69	-41.07	-30.22
		(48.04)	(42.19)	(25.46)	(27.71)
Financial Structure	+	4.080**	2.974	1.613*	1.381
		(2.060)	(1.847)	(0.897)	(0.955)
MP * Financial Structure	+	-1.264	-0.647	-0.0443	-0.175
		(1.219)	(1.026)	(0.700)	(0.745)
Bank Health	+/-	-74.15***	-95.61***	-36.16***	-54.17***
		(20.79)	(25.95)	(11.27)	(18.46)
Relationship	-	-1.002**	-0.931***	-0.170	-0.117
		(0.402)	(0.299)	(0.196)	(0.184)
Borrower Finance Mix	+	3.307***	2.844***	0.270	0.0709
		(0.683)	(0.540)	(0.472)	(0.504)
Borrower Liquidity	-	1.245	1.086	-1.446	-1.096
		(1.500)	(1.368)	(2.083)	(1.763)
Borrower Interest Expense	+	3.688	4.147	7.048	6.866
		(4.384)	(3.576)	(7.501)	(8.635)
Lender Size	+/-	0.662	64.57**	-1.974	29.63***
		(9.067)	(30.86)	(3.928)	(10.25)
Lender Liquidity	-	-0.520	-2.086	-0.608	-3.008*
		(1.720)	(2.654)	(0.877)	(1.590)
Loan Amount	-	-69.49***	-60.80***	-18.11***	-14.49***
		(10.81)	(8.836)	(4.566)	(5.458)
Loan Maturity	+	56.64**	61.00***	11.58	9.738
		(23.82)	(20.08)	(10.91)	(10.11)
Recession	+	179.7***	147.1***	104.7***	87.38***
		(41.47)	(36.32)	(24.05)	(22.53)
Constant		201.4	-566.0	101.8	-179.3
		(192.6)	(408.2)	(124.2)	(159.1)
Observations		1,574	1,574	1,574	1,574
Lender FE		NO	YES	NO	YES
Borrower FE		NO	NO	YES	YES
AIC		18,804	18,680	17,346	17,223
Wald Statistic		89.83	-	-	-
R-Squared		0.281	0.282	0.615	0.652

Notes: Standard errors (in parantheses) are clustered at the borrower industry (SIC) level. *** p <0.01, ** p<0.05, * p<0.1. AIC = Aikaike Information Criterion. R-Squared calculated as: $(corr\ \widehat{y}_i\ and\ y_i)^2$. Wald-Statistic unavailable for (2:4) due to # *parameters* > # *clusters*. Stata code: truncreg *dependent variable indep. variables i.Lender/Borrower*, lower limit (0) vce (cluster SIC).

Table 23: Truncated Regression Eurozone Country FE

Dependent Variable: Basis points over EURIBOR					
Variables	Exp. Sign	(1)	(2)	(3)	(4)
MP	+/-	-94.96	-76.56	-40.55	-30.29
		(65.48)	(56.42)	(26.32)	(28.70)
Financial Structure	+	4.889**	3.766*	1.312	1.211
		(2.315)	(2.092)	(0.884)	(0.934)
MP * Financial Structure	+	0.228	0.317	0.0337	-0.145
		(1.552)	(1.328)	(0.701)	(0.761)
Bank Health	+/-	-80.91***	-98.68***	-32.61***	-51.68***
		(28.28)	(31.85)	(11.37)	(17.87)
Relationship	-	-2.003***	-1.740***	-0.249	-0.163
		(0.590)	(0.385)	(0.192)	(0.190)
Borrower Size	-	-52.70***	-42.82***	49.17	23.86
		(13.43)	(11.37)	(36.26)	(37.96)
Borrower Liquidity	-	1.630	1.506	-1.249	-1.079
		(2.112)	(1.865)	(2.119)	(1.789)
Borrower Interest Expense	+	6.832*	6.346**	8.095	7.738
		(3.906)	(3.154)	(7.244)	(8.507)
Lender Size	+/-	-1.858	66.29*	-1.382	29.87***
		(10.20)	(34.10)	(4.014)	(10.80)
Lender Liquidity	-	-0.739	-3.043	-0.635	-3.087**
		(1.869)	(2.788)	(0.887)	(1.536)
Loan Maturity	+	100.7***	99.49***	11.19	8.972
		(34.14)	(27.60)	(11.35)	(10.34)
Recession	+	190.2***	145.9***	99.80***	84.79***
		(56.54)	(40.88)	(22.16)	(21.08)
Constant		-284.6	-1,058**	-509.6	-503.2
		(438.2)	(445.6)	(441.3)	(484.1)
Observations		1,574	1,574	1,574	1,574
Country FE		YES	YES	YES	YES
Lender FE		NO	YES	NO	YES
Borrower FE		NO	NO	YES	YES
AIC		18,923	18,766	17,353	17,233
Wald Statistic		314.6	-	-	-
R-Squared		0.228	0.241	0.610	0.648

Notes: Standard errors (in parantheses) are clustered at the borrower industry (SIC) level. *** p <0.01, ** p<0.05, * p<0.1. AIC = Aikaike Information Criterion. R-Squared calculated as: $(corr\ \widehat{y}_i\ and\ y_i)^2$. Wald-Statistic unavailable for (2:4) due to # *parameters* > # *clusters*. Stata code: truncreg *dependent variable indep. variables i.Lender/Borrower*, lower limit (0) vce (cluster SIC).

Table 24: Truncated Regression Robustness 2

Dependent Variable: Basis points over EURIBOR/LIBOR					
Variable	Sign	(1)	(2)	(3)	(4)
MP	+/-	-35.11	-45.23	-24.92	-16.63
		(34.55)	(28.57)	(21.74)	(23.24)
Financial Structure	+	2.909**	1.750	1.287**	0.893
		(1.356)	(1.161)	(0.654)	(0.662)
MP * Financial Structure	+	-0.280	0.125	-0.0734	-0.298
		(0.697)	(0.635)	(0.554)	(0.579)
U.S.		-599.2***	-1,011***	-485.5***	-595.6***
		(167.0)	(136.5)	(84.71)	(92.10)
U.S. * MP		256.5***	310.3***	147.3***	180.5***
		(61.19)	(43.14)	(29.95)	(38.53)
U.S. * Financial Structure		46.12***	53.48***	29.48***	34.87***
		(9.129)	(6.465)	(4.646)	(4.986)
U.S. * Fin. Struc. * MP		-15.94***	-18.72***	-9.408***	-11.60***
		(3.413)	(2.342)	(1.543)	(2.005)
Relationship	-	0.0516	-0.0132	0.0389	0.0154
		(0.127)	(0.0916)	(0.0806)	(0.0676)
Borrower Size	-	-41.88***	-39.96***	5.514	-11.56
		(8.865)	(6.838)	(8.561)	(8.503)
Borrower Liquidity	-	0.919	0.149	0.123	-0.0222
		(1.261)	(1.010)	(0.570)	(0.497)
Borrower Interest Expense	+	0.163	0.188	7.313***	6.263***
		(0.163)	(0.141)	(2.073)	(1.989)
Lender Size	+/-	15.58***	69.99***	7.054***	67.19***
		(3.979)	(10.73)	(2.079)	(10.45)
Lender Liquidity	-	4.154***	1.319	2.307***	0.140
		(0.492)	(0.952)	(0.447)	(0.835)
Loan Maturity	+	43.22***	27.57***	-1.565	-7.495*
		(13.18)	(8.921)	(4.472)	(3.861)
Recession	+	92.20***	81.04***	67.83***	63.47***
		(15.90)	(11.55)	(6.735)	(8.511)
Constant		-16.32	-584.5***	-3.906	-593.8***
		(94.12)	(154.4)	(70.38)	(113.4)
Observations		7,355	7,355	7,355	7,355
Lender FE		NO	YES	NO	YES
Borrower FE		NO	NO	YES	YES
AIC		90,473	89,598	83,727	83,023
Wald Statistic		272.6	-	-	-
R-Squared		0.204	0.274	0.613	0.653

Note: Standard errors (in parantheses) are clustered at the borrower industry (SIC) level. *** p<0.01, ** p<0.05, * p<0.1. AIC = Aikaike Information Criterion. R-Squared calculated as: $(corr\ \widehat{y}_i\ and\ y_i)^2$. Wald-Statistic unavailable for (2:4) due to $\#\ parameters > \#\ clusters$. Stata code: truncreg *dependent variable indep. variables i.Lender/Borrower*, lower limit (0) vce (cluster SIC).

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