Monetary Transmission towards Bank Lending - Its Measurement and Effectiveness Revisited

Dissertation

zur Erlangung des akademischen Grades

doctor rerum politicarum

(Dr. rer. pol.)

vorgelegt dem
Rat der Wirtschaftswissenschaftlichen Fakultät
der Friedrich-Schiller-Universität Jena
am 17.02.2017

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geboren am 26.06.1985 in Erfurt

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Datum der Verteidigung: 23.05.2017

Acknowledgements

This dissertation would not have been possible without the support and assistance of many people around me.

First of all, I would like to thank my first supervisor PD Dr. Markus Pasche for the opportunity to write this doctoral thesis under his supervision. I am deeply grateful for the guidance he provided to me throughout the writing process over the last four years. He was always available whenever I needed help or guidance. I have greatly benefited from his insights, advice, and enlightening thoughts and discussions.

I am also highly indebted to my co-supervisor Prof. Dr. Hans-Walter Lorenz, who provided me with excellent resources of physical nature at his chair, but more importantly with his intellectual insights on numerous topics covered in this thesis.

Moreover, I would also like to express my gratitude to my former colleague Lars Other, whose suggestions, constructive criticism and assistance have greatly improved the quality of this dissertation.

Furthermore, I am grateful to the faculty of Economics and Business Administration at the Friedrich-Schiller-University of Jena, and there specifically the efforts of Prof. Dr. Armin Scholl, Prof. Dr. Bernd Hüfner and Prof. Dr. Andreas Freytag, for employing me, and thus providing me with the financial security to write this thesis.

I have also benefited from comments and discussions from Dr. Sebastian Sienknecht in the early stages of this dissertation, as well as from numerous other PhD students and colleagues at the Friedrich-Schiller-University of Jena and the Central-German Doctoral Programme Economics. These are highly appreciated.

I would also like to thank my family and friends, especially my parents, who raised me to be curious, think independently and be open minded, and by that allowed me to become the person I am today.

But most importantly, I want to thank my fiancée for your loving support, not only during the time of the development of this thesis, but also for the sacrifices you have made over the last nine years. You have pushed and encouraged me when I doubted myself, and believed in me from start to finish. Without you, this thesis would not have been completed.

Stefan Behrendt, February 2017

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List of Abbreviations

2SLS	two-stage least squares
3SLS	three-stage least squares
AB	Arrelano-Bond
AH	Anderson-Hsiao
AIC	Akaike Information Criterium
APP	asset purchase programme
AR	autoregressive
BB	Blundell-Bond
BLS	Bank Lending Survey
C&I	commercial and industrial
CISS	Composite Indicator of Systemic Stress
ECB	European Central Bank
EONIA	Euro OverNight Index Average
ESCB	European System of Central Banks
ESI	Economic Sentiment Index
Fed	Federal Reserve Board
FDIC	Federal Deposit Insurance Corporation
FEIV	fixed effects instrumental variable
FRB	Federal Reserve Board
GDP	gross domestic product
GFC	Global Financial Crisis
GLS	general least squares
GMM	general method of moments
GNI	gross national income
HICP	Harmonised Index of Consumer Prices
IFRS	International Financial Reporting Standards
IFS	International Financial Statistics
IMF	International Monetary Fund

IPI	index of industrial production
IRF	impulse response function
IV	instrumental variable
LIBOR	London Interbank Offered Rate
LSDVC	least squares dummy variable correction
LTRO	Long Term Refinancing Operations
MFI	monetary financial institutions
MIR	Monetary Financial Institution Interest Rate
MRO	Main Refinancing Operations
NBFI	non-bank financial institution
NNI	net national income
NPL	non-performing loans
OECD	Organisation for Economic Co-operation and Development
OLS	ordinary least squares
QE	quantitative easing
SAFE	Survey of Access to Finance of Enterprises
SFC	stock flow consistent
SIC	Schwarz Information Criterium
SPF	Survey of Professional Forecasters
SRTSM	shadow rate term structure model
STBL	Survey of Terms of Business Lending
SVAR	structural vector autoregressive
UMP	unconventional monetary policy
VAR	vector autoregressive
ZLB	zero lower bound

Chapter 1

Introduction

1.1 Motivation

The goal of this dissertation is to develop a better understanding of the transmission of central bank policy in the aftermath of the *Global Financial Crisis* (GFC) of 2007/2008, focussing on the effects on bank lending in particular. As a consequence of the crisis, central banks had to adjust the way they conduct monetary policy considerably, as previous relations between monetary policy, and its influence on inflation and economic activity have been substantially different than what had been observed before the Financial Crisis. Starting with the turmoil on the US subprime market, negative repercussions spread around the world, and presented many central banks with new, unfamiliar and difficult problems.

During the *Great Moderation* era from the late 1980s to the early 2000s, a consensus in the macroeconomic literature emerged that the time of deep and long recessions had been overcome. Central banks through their policy actions seemingly had stabilised the economy on a steady and sustainable growth path, with output being near potential. Low and stable inflation rates as well as fewer and weaker recessions seemed to be indicators for this (see for example Bernanke (2004), or Blanchard et al. (2013)).

Since the 1980s, central banks in almost all advanced economies changed their policy objectives to provide the economy with low and stable inflation, primarily through targeting inflation directly. It was widely assumed that this stabilisation alone would be enough to guarantee decent economic growth with fewer fluctuations.

Typically, central banks today steer the economy by manipulating the short-term policy rate, at which depository institutions can refinance themselves at the central bank. These rates act as a guideline for financial market participants, on which they orientate their own interest rates. An increase or a decrease of these policy rates acts as a drag or stimulus for the economy, and thus subsequently affects inflation.

The impact of monetary policy typically visible before the GFC has been put into question due to the changing landscape in light of the turmoil in financial markets (see e.g. Boivin et al. (2010)). Because of policy rates approaching the *zero lower bound* (ZLB), standard policy measures of central banks have not been able to impose their usual effects on the business cycle. Due to this, monetary policy transmission through the interest rate channel could not be ensured to the same extent as before the crisis.

By resorting to measures which are typically not in the toolkit of central banks (at least not in such large dimensions), like the provision of additional liquidity, targeted asset purchases, and/or enhanced communication policies, central banks expected to generate further stimuli on the economy, to counter the negative impacts of the Financial Crisis. The main goal of these *unconventional monetary policies* (UMP) was to stabilise financial markets in the short run, and to set additional impulses in the medium term, to revive bank lending and subsequently economic growth (see e.g. Trichet (2009)).

The dissertation at hand has the objective to provide a better understanding of the effects of central bank policies on the economy, and especially on credit creation of commercial banks, on the background of the broadened measures introduced after the Financial Crisis. The focus is specifically on *why* and *how* the effects of central bank measures in relation to bank lending have changed.

Throughout the thesis, two important improvements to the existing literature are implemented. To answer the first question of *why* central banks had to engage in UMPs, an alternative explanation for the reasons of the secular fall in interest rate levels for the last 40 years throughout advanced economies is given. The existing literature does not adequately consider the rationale that interest has to be earned first, before it can be distributed. But, as the amount of debt-to-GDP has risen during this timespan, the ability to provide interest has receded, which puts a pressure on interest payments, and thus interest rate levels.

To answer the second question of *how* the transmission mechanism towards bank lending has changed, a critique of the use of credit variables in empirical estimations is brought forward. Typical empirical estimations of the effects of monetary policy on bank lending take the outstanding stock of credit as the relevant credit variable. As the change in the stock is not only consisting of new lending, but also of repayments, write-downs, revaluations and securitisation, the impact of monetary policy on credit creation might be over- or underestimated in typical empirical models.

For this analysis, Chapter 1 lays the foundation by giving a short outline of the transmission of monetary policy, focussing particularly on the changing landscape after the Financial Crisis and its effects through the banking system on credit creation. As in the whole thesis, a special emphasis lies on the Euro area and the monetary policy transmission of the European Central Bank (ECB) towards bank lending.

1.2 Monetary Policy Transmission

The monetary transmission mechanism stands in the centre of the analysis of the effects of monetary policy on the economy. Traditionally, monetary transmission has been categorised into two types. First, the classical *money view* assumes that central banks affect short-term nominal market interest rates through manipulations of the policy rate. Given frictionless financial markets, the assumption here is that such changes feed through to a broader range of financial market interest rates, and thus affect aggregate spending directly. The second type, the *credit view*, bases its foundations on the effects due to market imperfections mainly in credit markets. These imperfections are assumed to amplify the effects as postulated in the money view.

1.2.1 The Money View

The money view of monetary policy transmission explains the effects of monetary policy decisions on economic activity through changes in interest rates, which feed through to the real economy through the liability side of bank balance sheets (see Boivin et al. (2010), Mishkin (1996), Woodford (2003) for the following).

Given the monopoly supply of base money, central banks can control the interest rate on its refinancing operations, as the banking system needs to equip itself with enough base money to meet public demand for currency, to meet reserve requirements and to clear interbank balances. By altering the refinancing rate, central banks can thus control the funding costs of liquidity demand for banks, i.e. the level of money market rates. Banks then pass on these costs on to their customers, by changing interest rates demanded on short-term loans and offered on deposits. This channel is broadly known as the *interest rate channel*.

Furthermore, by affecting short-term nominal interest rates through manipulation of the level of interest, central banks can also influence long-term rates to a certain degree, since long-term rates are linked to future short-term rates. Long-term real rates reflect the average of expected future short-term interest rates—the so-called expectation hypothesis of the term structure. Since consumption and investment decisions are interest elastic (albeit to different degrees), changes in the policy rate therefore affect these decisions and subsequently aggregate spending.

Additionally, the money view postulates further channels, through which policy rate decisions affect the economy. By lowering interest rates, returns on domestic assets become relatively more unattractive in relation to foreign assets. As a result, the domestic currency depreciates, which makes domestic goods cheaper and leads to a rise in exports, and consequently aggregate spending. This mechanism is referred to as the *exchange rate channel*.

Despite affecting interest rates, monetary policy can also affect valuations of firms through the so called *Tobin's q* (see Tobin (1969)). This q is defined as the market value of a company divided by its replacement cost of capital. If the q is high, it is attractive to finance investments by issuing new equity, as the replacement cost of capital is relatively cheap. Investment spending will then in turn rise, and thus increase aggregate spending. Such a rise in firm valuations might increase spending by private individuals through higher net worth of the assets. This further *wealth mechanism* has been brought forward by Modigliani (1971).

1.2.2 The Credit View

More important for the scope of this thesis are the effects of monetary policy postulated by the *credit view*. This view has been brought forward by the fact that observed large real economic effects cannot be explained by the relatively small impulses of monetary policy working through the aforementioned channels towards changes in long-term interest rates (see e.g. Bernanke and Gertler (1995), or Mishkin (1995)). These strong effects are seen to be generated by credit market imperfections, like asymmetric information and moral hazard problems (see Gertler and Gilchrist (1993)).[1]

The credit view states that monetary policy has effects on credit supply and demand, by affecting balance sheets of lenders and borrowers, and thus enhancing the traditional interest rate channel. Two distinct bank based channels, which influence the amount of bank lending, have been brought forward in the literature.

The first one is the *balance sheet channel*, which works through the balance sheets of non-financial borrowers (firms and households). Because of information asymmetries between lenders and borrowers, internal funding is an imperfect substitute to external funding. This difference, the *external finance premium*, drives a wedge between the expected return of lenders and costs faced by borrowers (see Bernanke and Gertler (1995)). It furthermore affects the values of assets held by firms and households which can be posted as collateral, and subsequently the net worth of non-financial borrowers. As lending conditions depend on risk and the net worth of borrowers, the ability to obtain credit can thus be affected. According to this view, monetary policy changes the external finance premium in the same direction. A hike in the policy rate thus not only raises risk-free interest rates through the interest rate channel, it also increases the cost of external funds for borrowers (the *financial accelerator*; see Bernanke et al. (1999)). This increase in the relative cost of capital reduces lending and investment, and thus economic activity.

[1] Gertler and Karadi (2015) provide a recent empirical verification of the importance of such credit market frictions towards the transmission of monetary policy shocks.

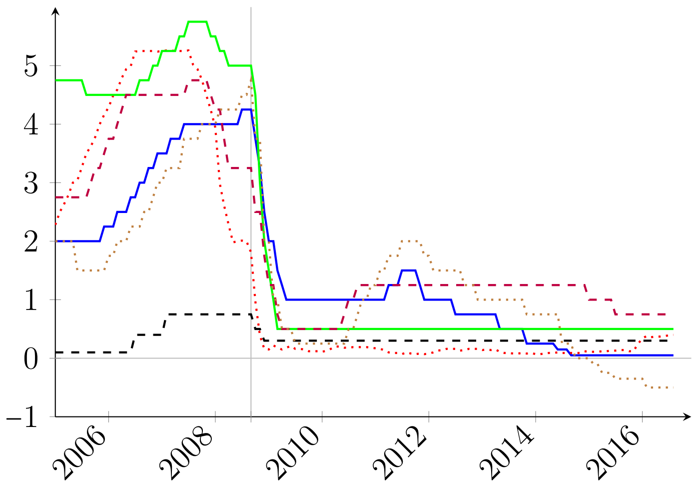
The second credit channel is the *bank lending channel*. By influencing short-term interest rates, loan supply of depository institutions is also shifted, through the external finance premium of these lenders (see Bernanke (2007), or Bernanke and Gertler (1995)). Moreover, an increase in the policy rate worsens the terms under which banks can refinance themselves with central bank reserves, thus leading banks to create fewer reservable deposits, which have to be replaced by either shrinking their assets or raising non-reservable liabilities. A reduction in quantity or rise in the price of reserves thus impairs the ability of banks to provide loans. This impacts aggregate spending, if potential borrowers are not able to replace bank loans with other sources of financing.

1.3 Transmission Mechanisms after the Global Financial Crisis

The Financial Crisis led to a rethinking about the workings of these monetary transmission mechanisms. Since the crisis began, previous regularities about the relation between monetary policy and the real economy have been put into question. While on the one hand inflation did not fall as much as would be expected by the severity of the crisis, monetary policy on the other hand was also not able to stimulate the economy to a large extent (see Blanchard et al. (2013)).

To counter the negative repercussions of the Lehman crash and the subsequent GFC, central banks around the world cut their interest rates aggressively (see Figure 1.1). This had the effect that policy rates quickly approached the ZLB. Thus, further stimuli through interest rate policy could not be accomplished. As an answer to the main policy tool not being available anymore, central banks broadened their policy measures and engaged in operations which are typically not in their toolkit. These unconventional monetary policies were aimed at stabilising financial markets and to provide further monetary policy accommodation. Most notably, central banks engaged in broadened communication policies, provided emergency liquidity to financial institutions and conducted purchases of financial assets (see e.g. Borio and Disyatat (2009) for a classification of UMPs). Although a more in depth discussion about the specific transmission of UMPs will be given in Chapter 5, the effects of these policies are discussed here briefly.

Figure 1.1: Central bank policy rates

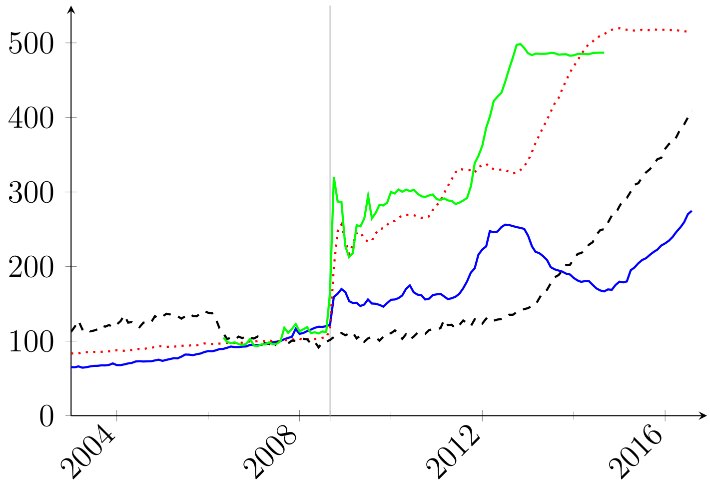


Note: Main refinancing rates for the ECB (——), Bank of England (——), Bank of Japan (⋯⋯) Bank of Canada (- - -), Riksbank (⋯⋯), and the Effective Federal Funds rate for the Fed (⋯⋯). The vertical line indicates the time of the Lehman crash in 9/2008. Sources: ECB, BoE, BoJ, BoC, Riksbank, Fred.

In response to the breakdown of well functioning interbank money markets, central banks provided commercial banks with further liquidity in the form of an over-allotment with central bank reserves. These emergency liquidity provisions were intended to reduce market stress and enable a smooth functioning of money markets (see e.g. Trichet (2009)).

By purchasing financial assets, central banks aimed to revive nominal spending through the injection of money into the private sector, which is supposed to increase spending. Since purchases directly from banks only increase base money, these operations have been intended to purchase securities from private non-banks. But as only depository institutions are able to engage directly in transactions with the central bank, these purchases have to be funnelled through the banking system. This in turn increases base money and broad money at the same time. The increase in broad money should then lead to an increase in asset prices as well as spending, and thus ultimately raise inflation (see e.g. Benford et al. (2009)). By providing liquidity through enhanced refinancing operations and engaging in final purchases of securities, central banks expanded their balance sheets significantly after the crisis (see Figure 1.2).

Figure 1.2: Central bank total assets



Note: Data for the ECB (——), Fed (⋯⋯), Bank of England (——), Bank of Japan (⋯⋯). The vertical line indicates the time of the Lehman crash in 9/2008. Data has been normalised to 100 in 8/2007. Sources: ECB, Fred, BoE, BoJ.

There is a broad literature pointing out that asset purchases and liquidity provisions by the central banks were able to lower not only short-term market rates, but also longer-term interest rates (see e.g. Borio and Zabai (2016), or Williams (2014) for an overview). But, evidence of these policies also increasing economic activity and inflation is somewhat inconclusive. While most studies show an increase in output and inflation in response to UMPs, the magnitudes and significances differ greatly and are quite uncertain (see also Borio and Zabai (2016) for an overview). Important for the scope of this thesis are the effects of

UMPs towards bank lending. In this regard, the results are even more uncertain and inconclusive. Some studies show an increase in bank lending in response to UMP shocks, others do not find a significant impact (see Chapter 5 for a further discussion).

Furthermore, through enhanced communication policies, central banks aimed at lowering not only short-term rates, but also longer-term rates. With these *forward guidance* policies after the crisis, central banks promised to keep interest rates lower for a longer period of time, even if policy rules would recommend otherwise (see e.g. Filardo and Hofmann (2014)). Through lower expected future interest rates, spending was supposed to be boosted immediately.

1.4 Policies by the European Central Bank after the Global Financial Crisis

As the focus of this thesis lies primarily on the effectiveness of monetary policy transmission of the ECB, this subsection gives a short overview of the general toolkit of the ECB and its additional policy measures after the Financial Crisis.

The European Central Bank aims to affect the level of short-term money market interest rates to keep inflation below, but close to two percent in the medium term (see ECB (2011c) for the following discussion). Typically, this is done by restricting the price and/or quantity of refinancing operations, in which depository institutions can refinance themselves with central bank reserves. Banks need those reserves to meet public demand for currency, reserve requirements and to clear interbank balances. For this, the ECB uses either open market operations or standing facilities, to manage liquidity conditions in the banking sector. By setting the rate for the standing facilities (these are the marginal lending and the deposit facility), the ECB sets a corridor within which the overnight money market rate can fluctuate. Typically, the ECB will manage the liquidity in a way that the money market rate will be close to the main refinancing rate, which is typically in the middle of the two standing facility rates.

Starting on the 15th October 2008, the ECB changed its conduct from variable rate tenders with a pre-announced minimum bid rate to fixed rate tenders with full allotment, to counteract the negative effects that dysfunctional money markets were exerting on the banking system. This had the consequence that the ECB provided unlimited reserves at a pre-defined interest rate to the counterparties. As a result, more reserves than needed for reserve requirements were allotted to the counterparties and the overnight money market rate dropped down almost to the deposit facility rate, because of the excess liquidity in the interbank market, thus providing further stimulus without shifting the main refinancing rate. Additionally, the collateral requirements for these refinancing operations were lowered, resulting in an expansion of the range of eligible securities.

Furthermore, the ECB conducted several unconventional measures, for which they coined the term *enhanced credit support*. These policies specifically laid its focus on commercial banks, as they are the primary source of credit in the Euro area (see ECB (2009b)). These bank based measures were intended to enhance bank lending above and beyond what would be achievable by interest rate policy alone (see Trichet (2009)).

The first operations were a lengthening of the maturities of the ECB's longer-term refinancing operations (LTRO), in addition to the main refinancing operations (MRO), which have a maturity of one week. These operations typically have a maturity of three months. They were prolonged first to six months and then even up to one and three years (see e.g. Rogers et al. (2014) for an overview of the liquidity operations of the ECB since the crisis). This provision of longer-term liquidity to the banking system was aimed to meet banks' increasing demand for liquidity, and thus resolve mismatches of their funding and investment sides of their balance sheets.

Additionally to conducting refinancing operations, the ECB also engaged in outright purchases of eligible assets through structural operations. Through several asset purchase programmes (APPs), the ECB bought private and public sector securities, to provide the economy with an additional stimulus and thus bringing inflation closer to its target rate.

The transmission mechanisms through which these additional operations are supposed to affect the economy are discussed in more detail in Chapter 5, in which the effects of these on bank lending in the Euro area are estimated.

1.5 Structure of the Thesis

This thesis contains five chapters that give an overview of the effects of monetary policies on bank lending after the Global Financial Crisis of 2007/2008. While Chapter 1 already built the theoretical foundation of the transmission process of monetary policy towards bank lending, the following chapters estimate how bank lending was affected by the GFC and its subsequent monetary policy responses.

Thereby, Chapter 2 attempts to give an explanation as to why we have seen a secular decline in the general level of interest rates in the majority of advanced economies over the last 40 years. Only because of this long-lasting decline, which restricted the central banks' abilities to lower policy rates distinctly after the GFC, central banks were forced to resort to policies which have not been used widely before the crisis. The insights of this chapter have been previously published in Behrendt (2017a).

There are several explanations in the literature as to why the general level of interest rates exhibited a secular falling trend, even before the Financial Crisis. Rachel and Smith (2015), Bean et al. (2015) and the IMF (2014), among others, provide numerous explanations of the reasons of this decline. However, previous studies have left out the outstanding amount of credit in an economy, and the resulting lower ability to distribute interest as a potential explanation. This gap is closed within Chapter 2.

The main hypothesis of this chapter is the insight that interest payments have to be earned (supplied) first, before they can be distributed among the different stakeholders. In the long-run, interest payments can only be sustainably guaranteed out of the per-period added value. Because of the higher indebtedness in most economies around the globe in the last four decades, the capacity to make interest payments out of the generated value has markedly receded. Due to the fact that income for the other factor income groups—namely profits and dividends out of economic activity and labour income—have not receded as much as would be needed to compensate the growing amount of interest claims, the average interest payment per debt contract, i.e. the average interest rate, must consequently diminish. This has the implication that as long as economic agents do not live off their substance, nor redeem interest payments by issuing new debt, and/or the debt amount in relation to economic output does not shrink, the average paid out interest per debt contract cannot rise, without the need that other stakeholders would need to cut back on their claims in the production process. Central banks are therefore confronted with a certain restriction in their ability to raise interest rates, without potentially causing new, unwanted negative side effects.

These theoretical insights of Chapter 2 are taken up in the second part of the dissertation, to answer the question, if and how central banks were able to stabilise the economy and provide impulses towards bank lending through their expanded operations after the Global Financial Crisis. The focus here is on the influence of monetary policies on lending activity by commercial banks in the Euro area.

Thereby, a special interest is on the usage of credit variables in empirical estimations of the monetary transmission mechanism through the banking system. The overwhelming majority of the empirical literature analysing questions about the influence of central bank policies on bank lending applies the outstanding amount of credit as the relevant variable. But this variable is only appropriate with limitations to answer such questions, because the change of the outstanding stock does not indicate the true amount of newly issued credit. Apart from incorporating new lending activity, the change in the stock contains several other factors, namely maturing loans, revaluations, securitisation, and write-offs. But, in the assessment of central bank policies towards credit creation, it is of primary interest how current and future lending evolves, and not how the amount of previously issued credit changes.

This part of the thesis gives a critical review of the measurement of bank lending in the econometric literature; first from a theoretical point of view in Chapter 3 and then in two separate empirical estimations. The research questions there deal with determinants of bank lending supply and demand in Chapter 4, and the effects of the UMPs on bank lending in Chapter 5.

Chapter 3 picks up the above mentioned insight from a theoretical perspective. It is based on a previously published paper (Behrendt (2016b)). The specific factors contained in the change of the outstanding stock of credit are analysed as to which extent central banks can influence these. The main conclusion there is that the other factors, except for newly issued credits, are to a large extent out of the sphere of influence of the central bank.

Further, from an empirical point of view there occurs the problem that the other factors are only partly correlated with newly issued credits. Thus, empirical estimations would over- or underestimate the effect of monetary policy shocks on bank lending, if the outstanding stock is applied as the relevant credit variable.

A look at the stylised facts supports the theoretical argumentation. The correlation between newly issued credits and the change in the outstanding stock of commercial and industrial loans in the USA for the period between 1998 and 2015 is only 0.30. This implies, that 70% of the change in the stock cannot be explained by new lending. For the Euro area, the correlation for bank lending to non-financial corporations is 0.46 for the period 2003-2015. This loose relation is becoming even less binding in times of high economic volatility.

There are also problems regarding the timing. Central banks might come to different conclusions on their policy decisions while looking at the change in the stock of credit. The ECB (2011b) stated in their Monthly Bulletin of June 2011: "The annual growth rate of MFI loans to the private sector ... [increased] to 2.6% in April". Even though the stock grew, new lending to the private sector decreased at an annual rate of 11.2% in April 2011. This difference stems from a slowdown of the fall in new lending, and potentially in lower write-downs and higher upward revaluations. The focus on the credit stock might, among others, be a reason that the ECB raised its interest rates in July 2011, as they assessed that there might be price pressures due to the continued growth in bank lending (see ECB (2011a)). If the ECB would have looked at the underlying credit creation instead of the change in the stock, it might have come up with a different decision.

Chapter 4 picks up the insights of Chapter 3. An empirical investigation about determinants of credit creation is conducted there., while revealing differences between empirical estimations applying the outstanding stock of credit and new lending. The goal of this chapter is to measure the impacts of different determining variables on credit supply and demand. This chapter has been previously published as Behrendt (2016a).

Different empirical time series models, similar to the existing literature, are therefore considered. The overwhelming majority of the existing literature in this field applies the outstanding amount of credit as the dependent variable (see e.g. Bernanke and Blinder (1992), Kashyap and Stein (2000), or Kishan und Opiela (2000)). The empirical estimation on the basis of a simultaneous equations panel model with instrumental variables (IV) for eight Euro area countries, similar in their set-up to Carpenter et al. (2014) and Calani et al. (2010), reveals that there are partly considerable differences between the determinants in the supply as well as the demand equation, while applying the two credit variables. This has far reaching consequences for the determination of credit creation as well as the assessment of the transmission of central bank policies through the banking system. However, the specifications with the new lending variable can better represent the underlying theory.

Following on these results, an assessment of the effectiveness of the unconventional monetary policies of the ECB on credit creation by non-financial corporations on the basis of a structural vector autoregressive model (SVAR) is performed in Chapter 5. Peersman (2011) und Gambacorta et al. (2014)) show that the UMPs of the ECB have a significant positive impact on bank lending. However, these studies apply the outstanding stock of credit. As shown in Chapter 3, this variable can only reveal the true amount of new lending to a certain degree, what can lead to imprecise results on the question at hand. This is confirmed in the empirical estimation while using the new lending variable. It can be shown that there is only a significant positive reaction of lending to an unconventional monetary policy shock in the short-run, which dies out fast. The results of this chapter have been previously published as Behrendt (2017b).

The first main insight of this thesis is that in regard to bank lending, central bank policies since the Global Financial Crisis do not exert the same effects as before the crisis. A major reason for that is seen in high debt-to-GDP ratios, which might be to a certain extent responsible for the low interest rate environment. It is argued that through higher indebtedness the ability to distribute interest has receded, and similarily interest rates, as other stakeholders did not abide from their share in the production process to compensate claimants on interest payments sufficiently.

The second main insight of this thesis is that it is appropriate to use the amount of newly extended loans instead of the change in the outstanding stock as the relevant credit variable to explain the influence of monetary policy on bank lending. If the outstanding stock (or the change thereof) is applied for specific questions, estimations could be prone to imprecise results, as the change in the stock is comprised not only of newly issued credits, but also incorporates repayments, revaluations, write-offs and securitisation activity.

While this dissertation specifically lays its focus on the impact of monetary policy in the aftermath of the Global Financial Crisis and the specific policy responses in their impact towards bank lending, it deliberately leaves out a discussion about potential side effects of the additional measures central banks engaged in since the GFC, like possible consequences for central bank independence, asset price inflation, distributional consequences, or problems of potential exit strategies from these unconventional policy measures. Such considerations would go beyond the scope of this dissertation, as the purpose is specifically to empirically analyse the effects of monetary policy on new credit creation.

Chapter 2

Low Long-Term Interest Rates - An Alternative View

The fall in risk free interest rates since the 1980s has mostly been described as being induced by factors that push down interest rates from the demand side. This chapter contributes to the literature by adding a view of the supply side, namely that interest has to be earned first, before it can be distributed. Consequently, interest can only sustainably be distributed from the added value in a given period. But through higher debt ratios today, a smaller amount of added value can be used to fund interest payments than in the past. In such an environment, average interest rates can only be held stable, if the nominal amount of interest paid out is rising, which would then lead to lower income for labour and/or a lower reward for entrepreneurs in the form of corporate profits and dividends. But labour and entrepreneurial income did not fall as much as would be needed to compensate for the much higher amount of interest bearing assets since the 1980s. The only logical consequence then is a fall in average interest rates. This chapter is based on insights previously published as Behrendt (2017a).

2.1 Introduction

For the last four decades the world experienced a substantial decline in risk free interest rates. Many theories on this secular decline circulate in the literature and the policy debate. Standard theories about the fall in interest rates explain it by a drop in the natural risk free interest rate, the so called *Wicksellian* rate, which is in line with an economy operating without any inflationary or deflationary pressures, i.e. when demand for capital is equalling its supply (Wicksell (1898)). There are proponents who ascribe this decline to an overhang of savings relative to investments, the so called *Global Savings Glut* hypothesis (see Bernanke (2005)), to a lower investment-demand schedule (see Gordon (2010)), a higher demand for safe instead for risky assets (see Caballero and Farhi (2013)), reduced growth and inflation outlooks potentially leading towards *Secular Stagnation* (see Summers (2014)), lower term premia (see Adrian et al. (2015)), a central bank driven fall in interest rates, a shift in demographics (see Favero et al. (2013)), or rising inequality (see Rachel and Smith (2015)). Bean et al. (2015) and the IMF (2014) give overviews about these numerous explanations.

Most of these theories look onto the demand side of interest rates, but leave out the supply side, namely that interest has to be earned (supplied) first, before it can be distributed to the specific stakeholders. Based on this premise, the following chapter aims to contribute to these mentioned plentiful theories about the secular decline of interest rates by adding the additional viewpoint, that interest can sustainably only be distributed from the added value in the economy in the long-run.

Due to this constraint, there is a boundary on the amount of interest that can be distributed. If all added value flows towards interest payments, which would imply that other stakeholders (labour and company owners) do not receive any payments for their contribution in the production process, the maximum amount of interest to be distributed is given by the added value divided by the amount of outstanding debt—the GDP-to-debt ratio. But the ability to distribute interest has receded in the last forty years, since higher debt levels in the economy have lead to more interest bearing assets in relation to added value. However, this chapter is not giving a causal interpretation as of how interest rates evolve over time in such a higher indebted world, but only shows the limits of interest payments from the above mentioned constraint.

There would be no pressure on interest rates, if the nominal amount of interest paid out in an economy would grow proportionally with the growth of financial claims. But since the added value has to be distributed among the different stakeholders, namely to creditors in the form of interest, to labour in the form of wage payments, to land owners in the form of rents, and to company owners and entrepreneurs in the form of profits and dividends, there is no guarantee that interest remains proportionally the same in a higher financialised world.

The constraint to distribute interest is binding on a first stage for entities which generate economic value, as they can make interest payments without sacrificing current or future payments. These are predominantly non-financial corporations, as their share of added value is above 70% for most advanced economies. Due to the increasing proportion of debt to the underlying added value, from which the different stakeholders have to be paid out, there needs to be a fall in either the proportion going to labour, a decline in amounts available to company owners, lower income from land ownership, lower average interest rates distributed to the creditors, or a combination of all of these. This puts a ceiling on how much these corporations are sustainably able to pay for taking out loans, without running the risk of not being able to pay the creditors in full. This notion is based on the assumption that these corporations are not living off of the substance and/or are not engaging in some kind of *Ponzi*-financing.

On a second stage, financial intermediaries face a constraint to pass on interest by the amounts they receive in income (interest and non-interest) from the value adding sector. They are subject to the same trade-off as non-financial corporations, as they also need to channel their surpluses towards labour, profits, rents and interest. But due to higher financialisation, the funds which are flowing to the financial sector have to be distributed to a larger number of debt obligations originated within the financial sector itself.

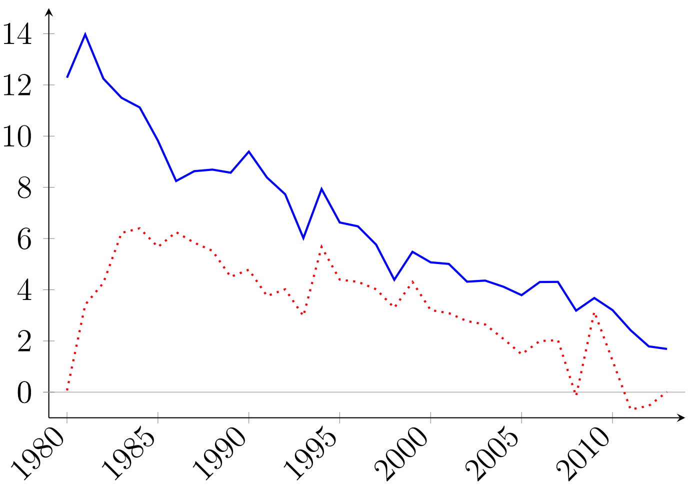
So there are pressures on interest rates from the value adding sector, which is higher indebted, and from a similarly higher indebted financial sector. As long as these developments do not reverse, there is no room for higher interest rates, without other stakeholders needing to cut back on their claims in the production process. This has vast implications for future developments of interest rates in most advanced economies of the world, as these are probably bound to be low for a longer period of time, if the other stakeholders do not significantly abide from their claims, or debt levels are reduced substantially.

The chapter is structured as follows. Section 2.2 will give a short overview of the prevailing theories of why interest rates fell over the last couple of decades. In Section 2.3 the rationale, as for why looking at the origin of interest in the economy is important to understand the evolution of interest rates in the past, will be given. Section 2.4 then captures the underlying developments of interest rates and debt levels, while Section 2.5 looks at the distribution of factor incomes. Section 2.6 specifically accounts for the impact of the financial sector towards lower interest rates. Section 2.7 concludes.

2.2 Literature Review

The drop in short- and long-term interest rates in advanced economies over the last 40 years has received broad attention in academic research and policy discussions in the last couple of years. Several factors have been identified to potentially contribute to this decline. Although the literature mainly ascribes the secular decline to inflation adjusted real interest rates, a large part of the decline, especially since the 1990s, when inflation became anchored in most advanced economies, can be attributed to a decline in nominal rates (see Figure 2.1).

Figure 2.1: Reference interest rates on 10-year government bonds



Note: Nominal (——) and real (⋯⋯), simple average over France, Germany, the UK and the US. Source: IMF.

There are three main categories of explanations in the literature, where most of the theories of falling interest rates can be attributed to.

The first is pointing towards a shift in the savings-investment schedule across the world. Substantially higher savings rates, especially in emerging economies, but also in some advanced ones like Germany, have put pressure on rates because of a surplus of savings over investments. Bernanke (2005) ascribes this process especially to emerging markets, specifically to south-east Asian countries, shifting their policy objectives after the *Asian Financial Crisis* in the late 1990s towards building up foreign reserve portfolios, and therefore maintaining high current account surpluses. He coined the term of a Global Savings Glut in this regard.

Gordon (2010) on the other hand, points towards a lower investment demand schedule in advanced economies, due to the less capital intensive business models observable in the last two decades, especially in the tech-economy (see also Bean et al. (2015)). Specifically software companies only need a small fraction of financing in contrast to more traditional companies to generate the same added value. This puts a downward pressure on interest rates, as less financing is needed for the same amount of added surplus.

Since the Global Financial Crisis another explanation has been given for the occurance of low interest rates, the so called *Balance Sheet Recession* (see Koo (2009), who tackled this subject for the aftermath of the burst of the housing bubble in Japan in the early 1990s). Proponents of this theory stress that high debt levels force most economic agents to deleverage. While most agents (especially businesses and households) are trying to bring down their own debt levels, there is a dearth of consumption and investment, which leads to stagnating economic activity, and pushes down interest rate levels. Although this theory is also revealing that high debt levels might be a cause for the low interest rate environment, the reasoning as to why interest rates are low is different to the theory in this chapter. The Balance Sheet Recession theory places an emphasis especially on the notion that economic agents are not able to service their debt anymore or take on new loans in the aftermath of a crisis caused by high levels of indebtedness. The focus is thereby on the principal, and not necessarily on interest obligations, while only looking at the ability to service debt, and not on how these payment obligations are earned in the first place. Furthermore, this theory cannot completely explain the secular falling trend in interest rates before the Financial Crisis.

According to Favero et al. (2013), demographics might also play a role in the savings-surplus. The authors specifically ascribe higher savings ratios due to the life cycle hypothesis, which tries to explain the savings ratio of the population over time. This hypothesis postulates that the working age population accumulates savings over the time of their working age to life off of these during retirement and to cater for intergenerational transfers. A higher proportion of the working age population should therefore lead to a higher savings rate. Globally, the working age population rose from around 50% to about 58% over the last 30 years, which then contributed to higher savings rates, and therefore to lower interest rates. Additionally, today there is more risk on the safety of pension systems due to aging societies, especially in advanced economies, but also emerging ones like China for example. This induces people to save even more during their working age, as expected pensions become less and less secure due to the larger pool of retirees (see e.g. Rachel and Smith (2015), von Weizäcker (2015)).

Contributing to this trend is rising inequality within many advanced economies (see e.g. Rachel and Smith (2015)). Since wealthier people save a higher proportion of their income (see Saez and Zucman (2014)), a higher concentration of wealth and income at the top means less mass consumption and higher desired savings, which also puts a pressure on interest rates (see also Kumhof et al. (2015)).

A second line of reasoning explains lower interest rates by a shift in demand from risky to more safe assets, especially after the Asian Financial Crisis, the *Dot-com Bubble* and the Global Financial Crisis (see e.g. Caballero and Farhi (2013), or IMF (2012)). Investors today are more reluctant to invest in riskier assets than before, which suppresses interest rates, too. There is also a link to the Savings Glut argument of Bernanke, as most of the reserve accumulation since the middle of the 1990s occurred in safe government and high grade corporate bonds, and less so in more risky assets (see also Gourinchas and Jeanne (2012)).

The third strand in the literature (but mainly prevailing in the policy debate) is pointing towards a central bank induced fall in interest rates. Proponents of these theories ascribe the interest rate fall driven by expansive monetary policies by the major central banks in the last three decades (see e.g. the overview and argumentation in Hoffmann and Schnabl (2016)). According to Bindseil et al. (2015), such an argumentation is quite unconvincing, as permanent deviations of central bank refinancing rates far below the natural Wicksellian-rate would lead to inflationary pressures. But these have not materialised since the 1990s, as inflation is firmly anchored across the advanced economies (see also Constâncio (2016)). However, central banks might have recently contributed to lower long-term rates through their proclamations to hold rates low for a longer than usual time. But this is certainly not ascribable to the more secular trend visible before the Global Financial Crisis (see also Adrian et al. (2015)). Furthermore, a high deviation of policy and market rates would be visible in the data, which is not, as risk-adjusted long-term rates track policy rates quite closely (see e.g. De Bondt (2005), Hanson and Stein (2015), or Illes and Lombardi (2013)).

While most of the above mentioned theories only look onto the demand side of the distribution of interest, the following section accounts for the secular decline in interest rates from the production side of interest payments.

2.3 Maximum Interest

Interest is a claim on a part of the produced output. By providing funding for companies, households and governments, creditors receive a claim on a part of future surpluses of debtors in the form of interest payments. But these have to be earned first through economic activity (the supply of interest). Interest can then only be distributed from these surpluses. Therefore, there is a natural boundary to how much interest can be distributed in an economy.

Suppose that all added value would only flow towards interest payments. This would imply that all other stakeholders (entrepreneurs, land owners and labour) would be left without any compensation. Thus, the (theoretically) maximum amount of paid out interest (at least in the long-run) can be abstracted empirically by the amount of value added to the whole amount of interest bearing assets[1]:

$$Interest_{max} = \frac{Value\ Added}{Debt} \tag{2.1}$$

But interest is not the only payment obligation which arises out of the added value, as the generated surplus from economic activity has to be distributed generally between different stakeholders. This is reflected in national income accounts statistics. Total factor income is represented as follows:

$$\begin{aligned} Total\ Factor\ Income = {} & Employee\ Compensation + Rental\ Income + \\ & Proprietor's\ Income + Corporate\ Profits + \\ & Net\ Interest \end{aligned} \tag{2.2}$$

For reasons of clarity, throughout this chapter only three factor income groups shall be considered. Profits, proprietor's income and rental income are considered together as income from economic activity, which shall also cover dividends for external capital providers, who do not receive income in the form of predefined interest payments. Thus, income is considered here to be divided between:

[1] More conveniently, instead of the added value, GDP is applied in the empirical section, as both amounts are almost identical in most (advanced) economies, since the amount of taxes minus subsidies is quite small, and GDP data is available for a longer period of time and for more countries.

1. Employees of the companies, who are rewarded for providing their services in the production process. Generally this is compensated for at the amount of their marginal productivity by wage payments.

2. Capital providers, who offer financing in the form of credit, are compensated in the form of interest payments.

3. Company owners and entrepreneurs, who are rewarded for their economic activities through residual claims (e.g. dividends, self-employed income, retained profits, rents). Their premium is a form of compensation for the risks they conduct (see Knight (1921)).

With these three stakeholders all competing for a part of the *GDP-pie*, company owners and entrepreneurs, and/or employees would need to abide from a part of their claims in the production process, if the level of interest rates should be held constant in an environment where the growth of interest bearing financial claims outpaces economic growth. If labour and entrepreneurs do not cut back in their claims in the same magnitude as debt increases, then the individual interest for each creditor has to be smaller, which implies that average interest rates have to fall. This does per-se not imply that nominal interest rates have to be low in such an environment. This observation could also occur in a higher interest, higher inflation paradigm with a fast growing economy, as only the relationship between debt obligations and real economic growth is binding for this ratio.

It is certainly possible to meet the demand for interest payments in the short-run by liquidating assets (living off the substance) or by issuing new debt instruments, which moves the obligation to pay into the future. But in the long-run this is not a viable option, as either capital is getting depreciated too much or the debt burden is getting too large to service, if the productive capacity does not keep up with the higher amounts of debt. Although it might theoretically be possible that GDP is growing with the same rate as interest bearing assets (even if they grow substantially), this is not what is observable over the last 40 years. Even if this would be the case, there is still a natural limit to debt and interest payments in the long-run, which is bound by the added value in relation to the financial obligations which have to be met.

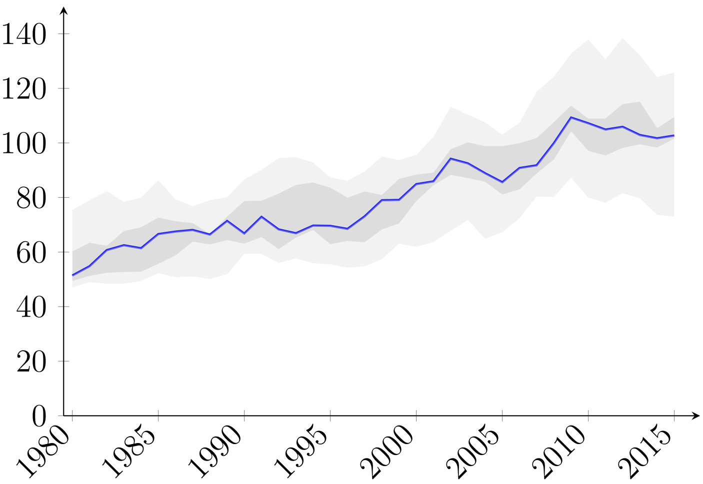
2.4 Empirical Observations

The previous section explained theoretically, why there might be a boundary for interest payments in the long-run. Moreover, this long-run maximum fell during the last 40 years, as the the debt-to-GDP ratio rose in almost all advanced economies. Thus, even if all added value would have been redirected towards interest payments, average interest payments would have needed to fall, since the added value has to be distributed towards a larger base of interest bearing assets. This trend alone put a pressure on interest payments, even without specifying which stakeholders receive which amount of the added value.

Furthermore, as total nominal interest payments did not rise proportionally with the outstanding amount of debt, each individual claim received a smaller proportion of the total amount of interest paid out in a specific period. Thus, actual average interest rates had to fall, too. This observed trend will be analysed in more detail in this section.

Over the last 40 years, the debt-to-GDP ratio has risen in most advanced economies. As laid out in Section 2.1, most value added is produced by non-financial corporations. Therefore, the main focus is on non-financial corporate debt data. Figure 2.2 shows the growing debt ratios by depicting the dispersion of the non-financial corporate debt ratios for 13 OECD countries. While debt levels at non-financial corporations where at between 50% and 70% of GDP in most countries in the early 1980s, this ratio has risen to around 100% today, with some countries even having non-financial corporate debt levels of above 150%.

Figure 2.2: Median non-financial corporate debt ratio



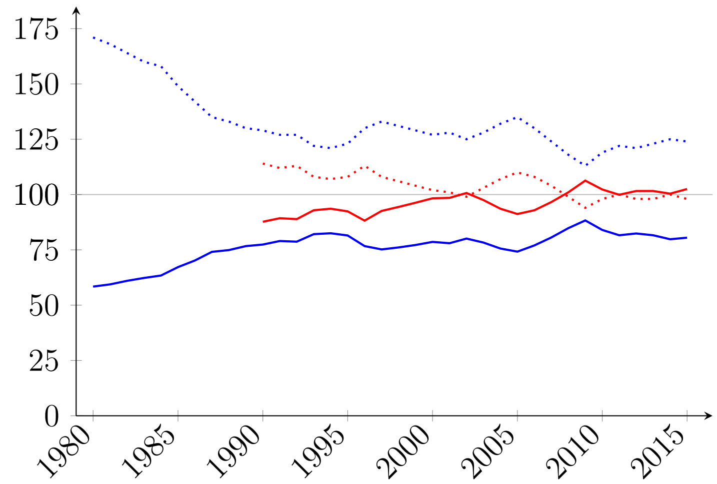
Note: Debt ratios as a percentage of GDP for the country sample (——), with the 60/40 (dark grey) and 80/20 (light grey) confidence intervals. The country sample consists of Australia, Belgium, Canada, Finland, France, Germany, Italy, Japan, Norway, Portugal, Spain, the United Kingdom and the United States. Source: BIS.

As the debt-to-GDP ratio has grown exceptionally in the past, the maximum interest, which can be distributed, has fallen considerably. Since 1980 the maximum amount of interest, if measured by the non-financial corporate GDP-to-debt ratio (only including bank credit), has receded from around 180% to around 120% today (see Figure 2.3).[2] Using a broader definition, by also including debt securities (like corporate bonds) issued by non-financial corporations, then the maximum

[2] Debt in the empirical section is assessed with the fair value. Movements in the debt stock therefore do not allow to draw conclusions towards the amount of interest which has to be paid. Falling debt levels would not per-se imply that interest payments are receding automatically, since it might just be because of revaluations of the outstanding amount in the balance sheet, while the debt burden for the debtor is staying constant (see the following Chapter 3 for an in depth analysis of this problem). Empirically, the amount of outstanding debt is therefore just serving as a proxy to which extent interest has to be paid (in relation to the average interest rate), as data on the actual amounts of interest payments are not available for this long period of time for many countries.

interest stands at around 100% of GDP today.

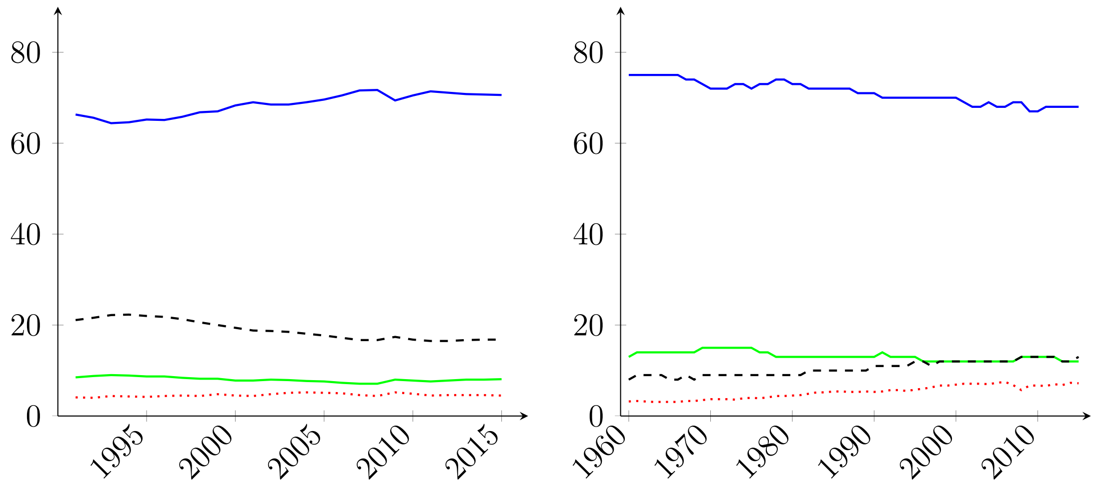
Figure 2.3: Debt-to-GDP ratios for non-financial corporations



Note: Debt issued by banks to non-financial corporations (——) and including debt securities issued by non-financial corporations (——), plus the corresponding maximum interest (······ and ······) in %. The country sample is as in Figure 2.2. Debt securities data missing for Japan until 1997 and Norway until 1995. Note, that this ratio is calculated as the total amount and not the individual country median, thus the differing magnitude of the lines compared to Figure 2.2. Source: BIS.

The rationale for focussing on debt levels of non-financial corporations is that they are the most likely entities which generate economic surplus from which they can distribute interest payments, without sacrificing current or future payments. The exception is income generated by the state, the private non-corporate sector and financial corporations through their own economic activities. But the majority of the added value is produced by non-financial corporations. In Germany, around 70% of the production value is made by these (see Figure 2.4(a)). Quite the same picture prevails in the USA. There, the non-financial corporate sector also contributes to around 70% of the added value, although financial corporations increased their share in the production from around 3% to about 7% of GNI since the 1960s. The remaining 20% are produced by non-corporate private businesses and the general government (see Figure 2.4(b)).

Figure 2.4: Contribution to national income



(a) Germany (% of NNI) **(b)** USA (% of GNI)

Note: Non-financial corporations (——), financial corporations (······), government (——), private non-business sector (- - -)). Sources: Destatis, BEA.

Due to that reasoning, one would consequently need to apply the maximum interest for the non-financial corporate sector by dividing the added value in the non-financial corporate sector by the total amount of debt in this sector. This can be done in the case of the US or Germany for example. But on an international level, data availability does not allow for such a differentiation, as such detailed statistics are not available for a time horizon spanning back to the 1980s in many countries. That is why, on the international level, total added value, respectively total GDP, is applied as the denominator. But, as non-financial corporate added value is lower than total added value and quite stable over time, it would only push down the maximum interest rate. In the US for example, the difference is fluctuating stable at around 50% of the non-financial corporate debt ratio as measured to total and to only non-financial corporate value added. Thus, the maximum interest today would then be only 100%, instead of 150%, but with the same falling trend being visible.

As stressed above, most of the value added is produced by the non-financial corporate sector. Although there is still a decent amount of value added in the other sectors, these sectors hold exceedingly more debt in relation to their own economic activities. Thus, they are relying on other means to generate income, to service their interest obligations.

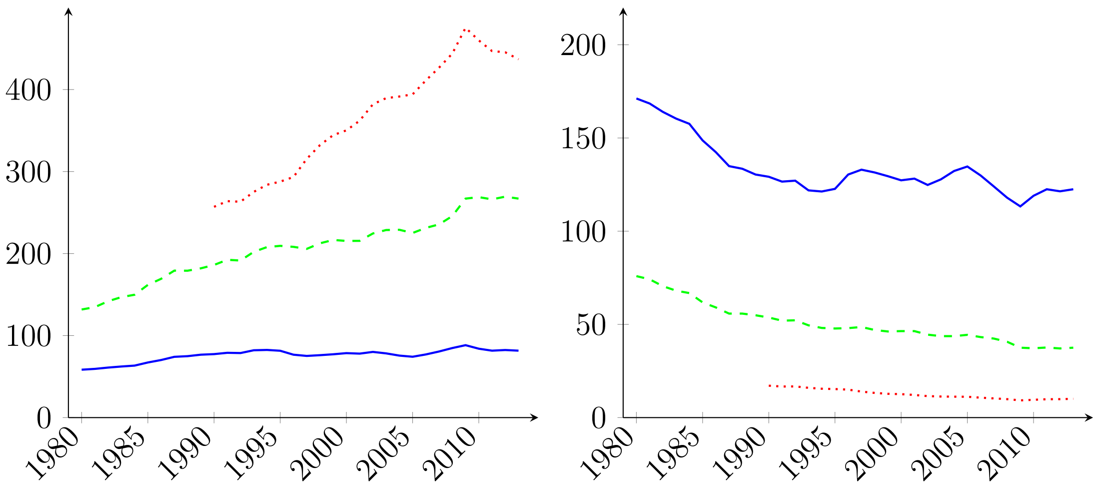
For instance, the majority of households does not add value on their own account. Households are predominantly employed in the corporate sector (to which the surpluses are being ascribed) and earn income in the form of wage payments. These household debtors pay interest by foregoing labour income, which would otherwise be used for consumption or saving purposes. But these incomes have also to be earned by companies in the first place, and are then distributed towards workers in the form of labour income. Growing debt in the household sector therefore does primarily only contribute to a falling percentage of income which can be used for consumption or savings purposes, as a larger share has to be used for interest payments (if interest rates are presumed to be stable).

The same reasoning applies to government debt, as interest on these are paid primarily by taxing the private sector, which represents only a shift from income of households and profits of firms, and is thus not flowing out of the added value generated by the state itself.

It is empirically not distinguishable to which part financial corporations, the non-corporate private sector and the government pay interest from funds received through their own economic surplus generating activities, or merely by receiving funds shifted from other sectors (like wages, taxes and interest income from the non-financial sector). Therefore, the main focus of the empirically distinguishable binding interest payment constraint lies on the non-financial corporate sector's surplus.

But to account for the whole picture, total debt has to be considered as well. As the growth in the debt ratio of the non-financial corporate sector was slower than in the other sectors, the fall in the maximum interest becomes even more drastic while applying broader debt definitions. In Figure 2.5, total private sector and gross public debt are considered together. Leaving out financial corporations, the theoretically achievable maximum interest fell from around 75% in 1980 to 37% in 2013 for the country sample. Additionally integrating financial sector debt, the maximum would stand at 29% in 2013. Adding debt securities issuance on the own account of the corporate sector, debt in the country sample would even grow to above 400%, which would then result in a maximum interest of below 25% in 2013.

Figure 2.5: Debt-to-GDP ratios and maximum interest



(a) Debt Ratios **(b)** Maximum interest rates

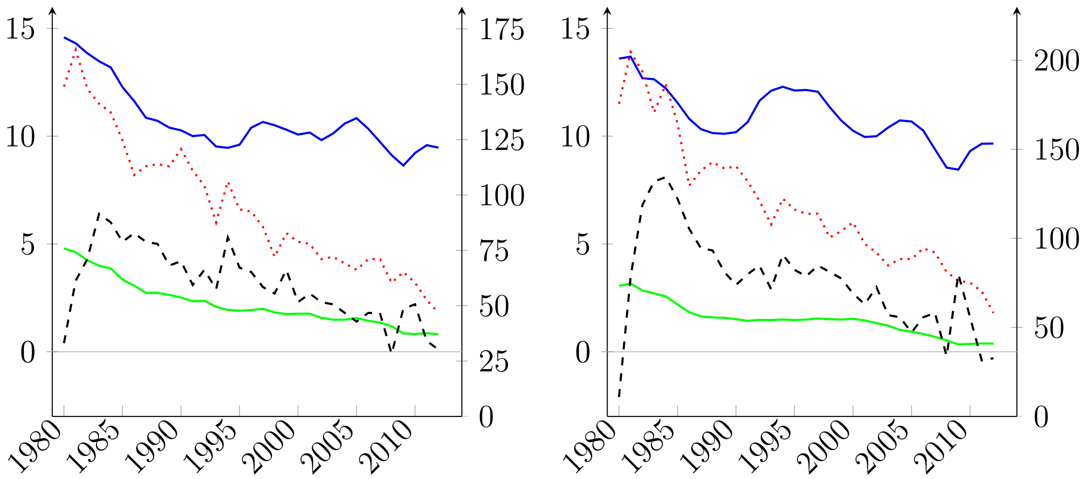
Note: Debt-to-GDP ratios for non-financial corporations (——), the non-financial sector (non-financial corporations + private households + government) (- - -), and all sectors including debt securities (······), plus the corresponding maximum interest rates for non-financial corporations (——), the non-financial sector (- - -) and all sectors including debt securities (······). The country sample is as in Figure 2.2. Government debt data for Belgium is missing in 1980 and 1981. Therefore, a linear growth of government debt for Belgium from 1979 to 1982 is assumed and interpolated values are taken there. Sources: BIS, Jordá et al. (2016).

This 25% maximum interest threshold would imply that if all surpluses are redirected towards interest payments, each financial claim could receive 0.25 times the headline amount in interest, which is way down from the from the amounts prevailing in the past. But as entrepreneurs and labour have also to be rewarded adequately for their part in the production process, not all generated value can flow to the creditors. The maximum interest is therefore only a theoretical concept, but it shows the limits of interest distribution quite forcefully.

This general downward trend of the maximum interest over the last 40 years alone put a pressure on average interest rates, as the pie from which interest can be distributed is getting smaller for each individual debt contract, even without specifying if labour and entrepreneurs are rewarded adequately. More specifically, today each amount of debt is facing a smaller share of the added value from which interest can be paid out. Thus, in a higher indebted world there is a natural tendency towards lower interest rates, if entrepreneurs and labour do not significantly cut back on their claims in the production process.

What Figure 2.6 shows quite emphatically is the lockstep with which the decline in interest rates fell together with the fall of the maximum amount of interest which can theoretically be distributed (for the country sample and the USA). From the 1980s on, long-term nominal interest rates fell from above 10% to around 2% today. This decline cannot be attributed to falling inflation rates alone, for which creditors want to be compensated, as real interest rates also receded from around 6% in 1980 to around 0% today. During the same time, the maximum distributable interest fell quite equally.

Figure 2.6: Maximum interest and bond rates



(a) Country sample

(b) USA

Note: Reference interest rates on 10-year government bonds as in Figure 2.1 (nominal (······, lhs) and real (- - -, lhs)), and the maximum interest for non-financial corporations (——, rhs) and the non-financial sector (——, rhs). Sources: BEA, BIS, FRBNY, IMF, Jordá et al. (2016).

This evolution is also confirmed by a simple correlation analysis. In Table 2.1 the cross-correlations of the 10-year nominal interest rates with the different maximum interest rate definitions are listed. The upper part for the whole country sample applies the nominal interest rate as in Figure 2.1. Correlations from the raw data (termed *simple*) are very high throughout, irrespective of which maximum interest rate definition is taken. They are even higher while taking a more long-term view using five year averages, to eliminate yearly fluctuations which are not explainable by long-term trends. In the lower part of Table 2.1, the same approach is applied for US data. Here, the 10-year nominal interest rate for US Treasury bonds is taken as a reference. Additionally, AAA rated corporate bond yields are also considered, to further reflect the interest obligations for the corporate sector. The same pattern as for the whole country sample emerges, with only slightly lower coefficients for the maximum corporate interest, irrespective of the applied interest rate. The results also do not change much using short-run interest rates, like 3-month Treasury bill or money market (LIBOR) rates.

Table 2.1: Cross-correlations between interest rates and the maximum interest

	10yr nominal rate	
	simple	5yr avg
Max. interest	0,9662	0,9794
Max. private interest	0.9468	0.9637
Max. non-fin. corp. interest	0.8312	0.8207
Max. non-fin. corp. interest*	0.8939	0.9109

*only France, Germany, UK, US

	10yr nominal rate		AAA corporate bond rate	
	simple	5yr avg	simple	5yr avg
Max. interest	0.9669	0.9861	0.9681	0.9875
Max. non-fin. interest	0.9501	0.9546	0.9534	0.9577
Max. corp. interest	0.7727	0.7733	0.7507	0.7581

Note: Upper part: country sample; lower part: USA. Sources: BEA, BIS, FRBNY, IMF, Jordá et al. (2016).

However, these correlations do not mean that there are no other explanations for low interest rates, as mentioned in Section 2.2. It merely adds to these theories from another perspective. Additionally, no prediction is being made here about possible causalities, as higher debt-to-GDP ratios do not strictly imply that the percentage of interest paid out cannot remain stable or even rise. Merely a simple indicator about the parallel secular trends of the ability to distribute interest and actual interest rate levels over the last 40 years is given here.

2.5 Distribution of Factor Income

Until now, no observations have been made on how GDP has been distributed to the different stakeholders. The maximum interest just laid out the basic concept of how high interest rates can be, if all added value is flowing towards interest payments. This section now concentrates on the evolution of factor income over the last 40 years, to see to which extend the income distribution might have shifted in light of the larger amount of debt obligations.[3]

So far, it could be seen that while the debt-to-GDP ratio rose, interest rates likewise did fall over the last four decades. But, even if the credit-to-GDP ratio is growing, interest rates could remain stable or even rise, if profits and labour income would fall to compensate creditors.[4] But if labour is going to be rewarded at (or near) its marginal-productivity and entrepreneurs (including stockholders in the form of dividends) should still be able to reap in benefits for taking economic risks, average interest rates have to fall, if debt-to-GDP ratios rise.[5] This then does not mean that total distributable interest has to shrink relative to the added value. It only bears the consequence that the piece of the interest pie available for each debt contract is getting smaller.

The rewards for each group of stakeholders, as outlined in Section 2.3, can be seen in Figure 2.7 for the United States.[6] It should be noted that interest payments are only depicted as total net interest in the whole economy, which empirically is not reflecting that the gross amount of interest payments generated by economic activity should really be the concept of choice here. This restriction has to be

[3] There is no detailed long-run data for most OECD countries available, that is why the main focus in this section is on the United States (and to a lesser extent Germany and Japan).

[4] Or if for example a larger part of labour income is used to pay private debt obligations, resulting in a reduction of consumption and/or savings.

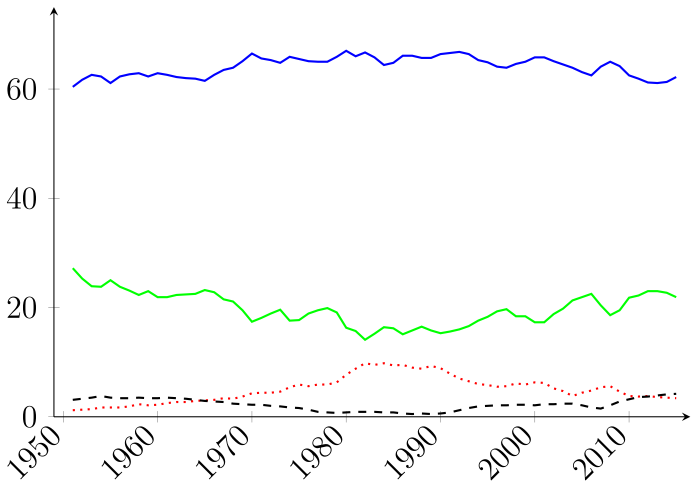
[5] To which extend factor income is distributed towards the different stakeholders is certainly an outcome of a negotiation process between labour, land and company owners and external capital providers. There is no natural law, which forces a certain primary distribution of income.

[6] Abstracting here that the US cannot be considered as a closed economy. More consequently, an international perspective would have to be taken, to better reflect cross-border capital transfers. But this is not possible, since detailed long-run time series are not available in many countries. Mostly, only the compensation of employees is available for such a long-term perspective.

made because more detailed data is not available for the US. Nevertheless, it might reveal a general picture of the level of interest paid out.

What is apparent is that labour income has been quite stable in the US since the 1950s, fluctuating between 60 and 65% throughout. Interest income has been growing from 2% of GNI in the 1950s to almost 10% in the late 1980s, to subsequently fall to around 3% nowadays. Interest income in the 1980s ate up a good proportion of entrepreneurial income. Consequently, profits and proprietor's income fell to under 20% in the middle of the 1980s, before growing to around 25% today again.

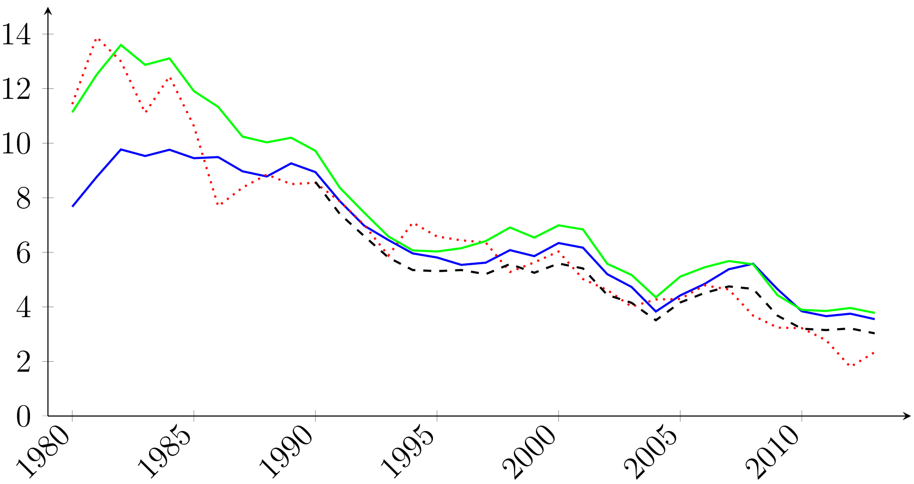
Figure 2.7: Factor income as a percentage of GNI for the USA



Note: Compensation for employees (——), profits and proprietor's income (——), net interest (⋯⋯) and rents (- - -) for the USA. Source: BEA.

But only looking at the total amount of interest paid out gives no hint about the level of interest rates. The following Figure 2.8 is thus quite enlightening, as the amount of interest paid out is not only depicted in relation to GNI, but also in relation to debt in the non-financial corporate sector, the denominator in the distribution of interest payments towards the specific financial claims.

Figure 2.8: Paid-out interest



Note: Net interest as a percentage of GNI (——), non-financial corporate debt (——), and non-financial corporate debt plus debt securities (- - -), as well as nominal interest rates on 10-year Treasury securities (······) for the US. Sources: BEA, BIS, FRBNY.

It can be seen that distributed interest as a percentage of total debt roughly equals the nominal interest rate in the long run. Total distributed interest fell from around 10% of GNI in the the 1980s in the US to around 4% today, while non-financial corporate debt rose from around 60% of GNI to around 80% in the same span. Consequently, the interest rate distributable per non-financial corporate debt share fell from around 13% in the beginning of the 1980s to roughly 4% today. The nominal risk free interest rate (illustrated by 10-year Treasury bonds) matches this evolution almost one for one during this period. Cross-correlation analysis also confirms the eye test here, as the coefficients are above 0.9 (see Table 2.2).[7]

[7] It certainly might be that the nominal Treasury bond rate does not represent the actual average amount of interest rates for all debt contracts payable by corporations, as market rates do not per-se equal the 10-year Treasury bond rates. But loan rates (cross-correlation of 0.92 with 10-year Treasury rates), corporate bond rates (cross-correlation of 0.99) and estimates of risk free natural interest rates (e.g. by Laubach and Williams (2015)) are matching this trend quite equally.

Table 2.2: Cross-correlations of paid-out interest

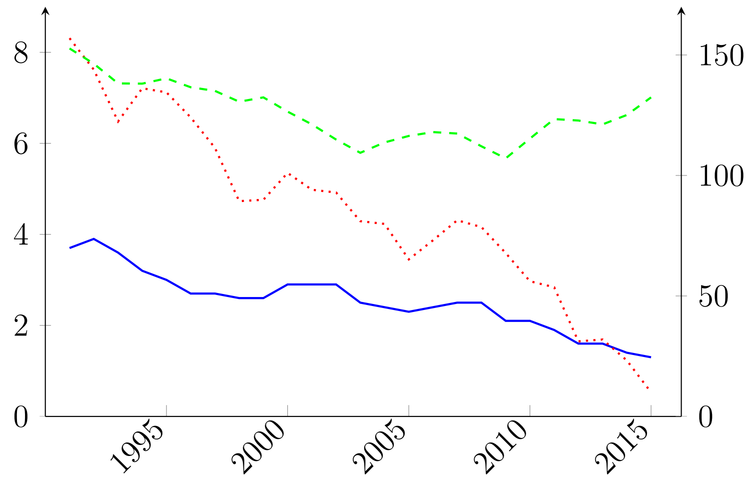
	10yr nominal rate
Interest/GNI	0.89354
Interest/Non-fin. corp. debt	0.95261
Interest/Non-fin. corp. debt + debt securities	0.92104

Note: Cross-correlations between the 10-year nominal government bond rate and the net interest amount paid in relation to the specific definitions in the US. Source: BEA, BIS, FRBNY.

Consequently, interest rates are low today, because interest payments per share of debt have receded, as total interest payments (the nominator) have fallen as a percentage of value added and debt (the denominator) has risen faster than added value. In sum, not only did the ability to distribute interest (the maximum interest) fall, but also the actual relative amount of distributed interest, too. Thereby highlighting the constraints on the ability to earn interest through higher indebtedness, which lead to lower average interest rates over the last 40 years.

A problem with the US statistics is that they only show the net amount of total interest payments in the economy. Interest paid out only by the non-financial corporate sector cannot be measured for the US in gross terms. But, more detailed accounts can be found for example in German national income statistics. In those, the gross amount of interest paid out by non-financial corporations can be seen more distinctly. Figure 2.9 shows the gross amount of interest in relation to net national income (NNI) paid out by the non-financial corporate sector to all other stakeholders. This gross amount shrank from almost 4% in the early 1990s to 1.3% of NNI in 2015 (earlier data before the German unification is not available). During the same time, yields on 10-year German government bonds (which can be seen as long-term risk-free assets) shrank quite dramatically, too.

Figure 2.9: Interest and debt for Germany

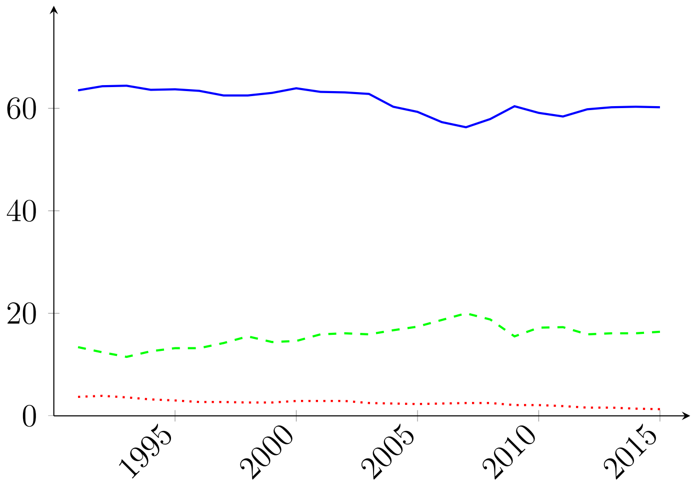


Note: Interest paid out by non-financial corporations as a percentage of NNI (——, lhs), nominal interest rate on 10-year government bonds (·······, lhs), and the maximum interest for non-financial corporations (- - -, rhs) for Germany. Source: BIS, Destatis, ECB.

For Germany, the fall in interest paid out by non-financial corporations is also visible, although this drastic decline certainly cannot be fully explained by a rise in debt levels since 1990 (earlier data is not publicly available). Interest payments from non-financial corporations as a percentage of NNI fell from around 4% in the 1990s to below 2% today. In the same time, non-financial corporate debt rose from around 65% to above 90% of NNI until 2009, while subsequently falling to about 75% in 2015. Simultaneously, the maximum interest of non-financial corporations fell from around 150% to about 100% from the early 1990s until 2009. This rise in the debt level is mainly attributable to debt securities, as they rose threefold between 1991 and 2009.

German data also shows, that labour and entrepreneurial income did not fall during this time (see Figure 2.10), even as non-financial corporate and also total debt in the economy grew (from around 170% to above 250% of GDP since 1990). This also implies that average interest rates had to fall, as entrepreneurs and labour did not abide from their share of added value. In spite of growing debt obligations, interest payments as a percentage of NNI even fell from about 4% to slightly above 1% since the early 1990s, leading to lower average interest rates.

Figure 2.10: Factor income for Germany

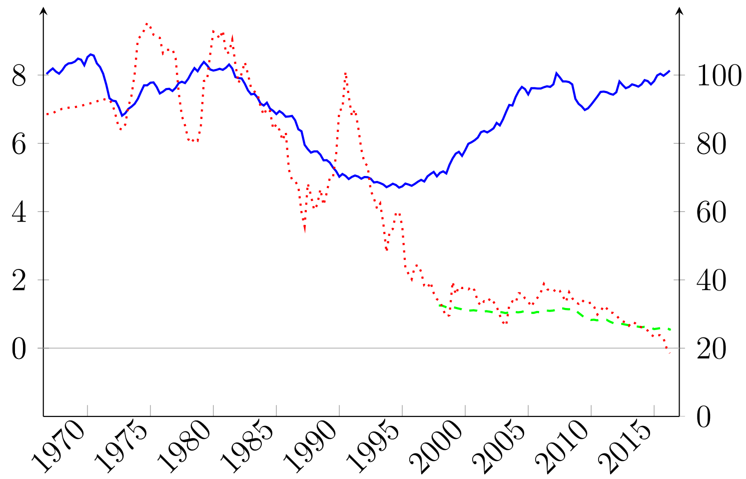


Note: Compensation for employees (——), corporate surpluses (- - -), and interest paid out by non-financial corporations (······) as a percentage of NNI for Germany. Source: Destatis.

This is also visible for Japan, which was one of the first advanced countries, where interest rates distinctly began to fall. The fall in nominal interest rates fell together with drastically rising non-financial corporate debt ratio. This is depicted by the falling non-financial corporate maximum interest in Figure 2.11.

Even as non-financial corporations where able to delever after the housing market crash in the early 1990s, interest rates did not rise, as other sectors (especially the government) increased their indebtedness, which resulted in a growing debt-to-GDP ratio for the whole economy, and thus in a lower total maximum interest, as calculated by these broader definitions (see the green dashed line in Figure 2.11; earlier debt data is not available for all other sectors).

Figure 2.11: Interest and debt for Japan



Note: Maximum non-financial corporate interest rate (——, rhs), maximum non-financial interest rate (corporations, households and government) (- - - , rhs), and 10-year government bond rate in % (·······, lhs) for Japan. Source: BoJ.

Although the above described correlations between debt levels and interest rates do not mean that there is a direct causation, the lockstep is quite striking and certainly plausible. While it could be argued that the fall in interest rates stems from the demand side (which is definitely true to a certain extent, see the theories in Section 2.2), the ability of non-financial corporations to supply interest payments out of added value surely fell during the last 40 years, which then contributed to the lower average interest rates through the channels laid out above.

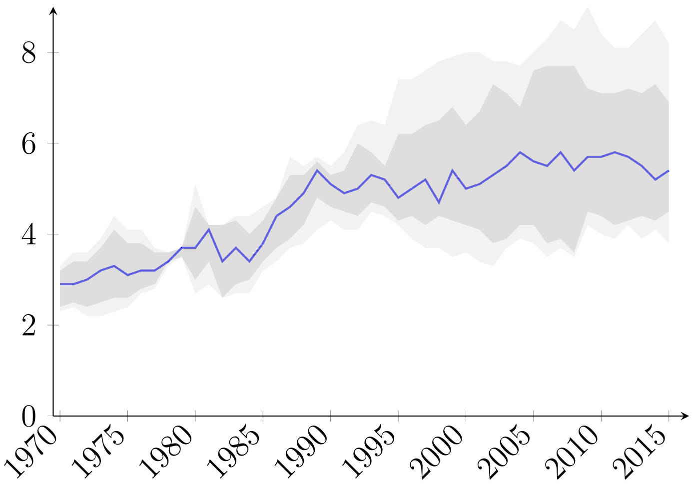
Additionally to the lower ability of the non-financial corporate sector to provide interest payments, the developments in the financial sector itself lead to a further pressure on interest income. This development will be described in the following section.

2.6 Impact on Interest from Financialisation

Once interest has been paid out by non-financial corporations to (mostly) financial corporations, it can be used to cover costs for labour, operating expenses and also for their own debt obligations (interest payments). Financial corporations are therefore also bound to pass on interest by their ability to raise income. But interest payments from the non-financial sector are not the only income for financial corporations, as they can also generate income by undertaking intermediation activities, from which they receive fees (providing payment services for the general public for example), or advisory income (by doing investment banking activities).

The difference between non-financial and financial corporations is that most financial sector intermediaries (mostly non-bank financial intermediaries) do not produce much of a surplus themselves. The financial sector is accountable for only 4% to 7% of GDP in most advanced economies (see Figure 2.12). Most of the financial sector's business activities are in the form of redirecting funds within the financial sector itself, as for example roughly only 15% of the financial flows from banks in the US go to businesses (see Turner (2015)). The rest is spent on buying and selling existing financial instruments. This closed loop of finance of buying and selling existing assets like stocks, bonds, or refinancialisation of existing mortgages, instead of going into new business investment, is mostly not contributing to a large amount to GDP growth, and therefore does not enhance the financial sector's ability to earn interest themselves.

Figure 2.12: Median financial sector size

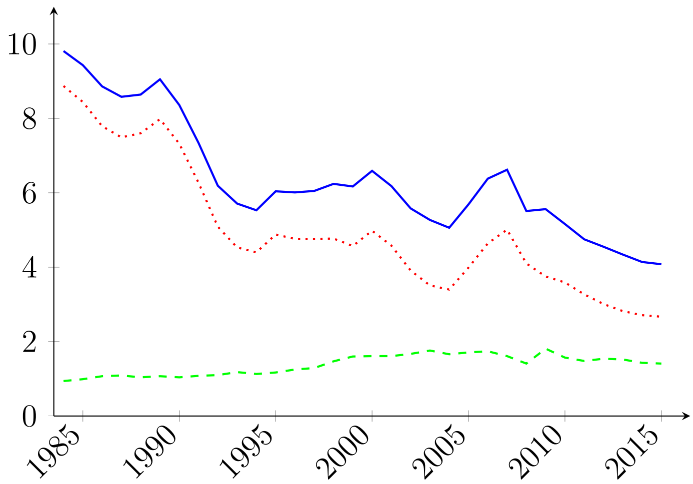


Note: Contribution of the financial sector to GDP (in % of total GDP) (——), with the 80/20 (dark grey) and 90/10 (light grey) confidence intervals. The country sample consists of Australia, Belgium, Canada, Finland, France, Germany, Italy, Japan, Korea, Norway, Portugal, Spain, Sweden, Switzerland, United Kingdom, and United States. Source: OECD.

The financial sector is thus constrained in its ability to distribute interest by their ability to raise non-interest income plus the interest income they receive from the non-financial sphere. In the US, the share of interest income to GDP which flows from the private sector to the FDIC-insured commercial banks and savings institutions fell drastically during the last 40 years (from about 9% in 1980 to around 3% today). Conversely, non-interest income could not make up this fall (total income fell from around 10% to 4% of GDP for commercial banks and savings institutions since 1980). As a result, total income has fallen. Figure 2.13 shows this development.

Although the financial sector today is responsible for a higher share of value added in most advanced economies (see again Figure 2.12), it might not be able to generate enough non-interest income, to make up for the loss of interest income from the non-financial sector to keep their interest expenses at the same level as before.

Figure 2.13: Annual income of US banks



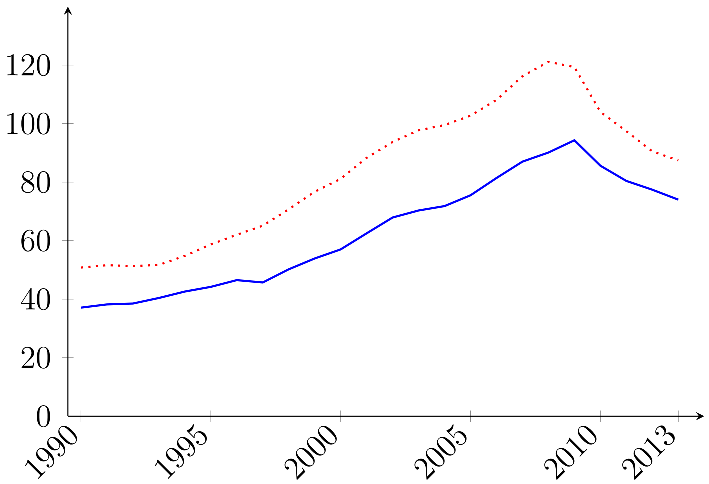
Note: US FDIC-insured commercial banks and savings institutions total income (——), interest income (······), and non-interest income (- - -) as a percentage of GDP. Source: FDIC.

Furthermore, not only did income from the non-financial sector recede in the last 40 years, outstanding debt in the financial sector also grew faster than financial sector GDP during this period (see Figure 2.14). This puts, through the same mechanism as for the non-financial corporate sector, a further pressure on interest payments, as a larger debt share is facing a smaller income share. The ability to pass on interest on debt contracts, which the financial sector issued itself, has therefore also receded.

Additionally, it is not only commercial banks for which it becomes more difficult to pass on interest themselves. Within the financial sector, non-bank financial intermediaries (NBFIs) are bound by the same constraints. The size of the shadow banking sector—measured by its outstanding liabilities—in the US alone grew from 20% to about 140% in relation to GDP at the beginning of the Global Financial Crisis (see Figure 2.15).[8] The shadow banking sector is mainly

[8] See Poszar et al. (2013) for a definition of the shadow banking system for the US.

Figure 2.14: Bank debt

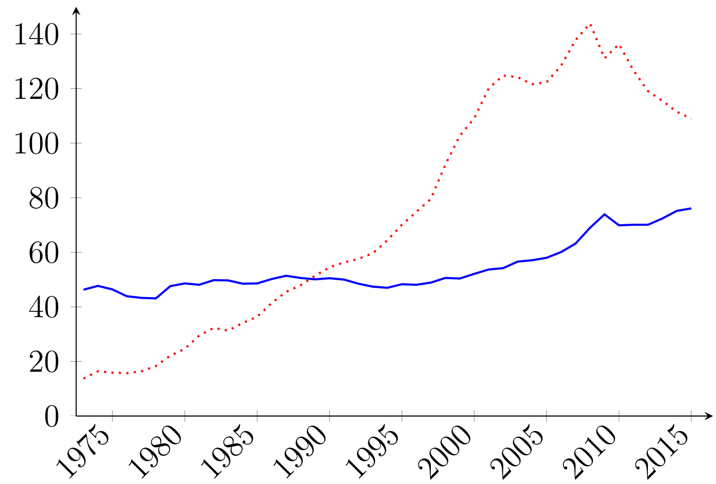


Note: Debt for the country sample as in Figure 2.3 (except for Norway; Japanese data only available from 1997 on) (——), and the US (·······) as a % of GDP. Source: BIS.

depending on the surpluses which other financial intermediaries (foremost banks through credit extension) and the non-financial sector generate, and which pay them for their services. To a smaller extent, they generate added value themselves by offering liquidity services for example. But as the shadow banking sector grew much faster than GDP (and also GDP generated by the sector itself) and interest income as a percentage of GDP fell, also their ability to pass on interest receded, as labour and company owners of these NBFIs have to be compensated as well.

Not only has higher financialisation lead to a lower ability to pass on interest within the financial sector through higher debt levels, there is growing evidence that in many advanced economies financial sectors might have become so big that they are detrimental to economic growth (see for example Cecchetti and Kharoubi (2015), Jordá et al. (2013), Philippon (2015), Philippon and Reshef (2009), and Turner (2015)). Cecchetti and Kharoubi (2012) for example show that from a certain point of financial development, additional growth of the financial sector becomes a drag on economic growth. They argue, that the size of financial sectors in many advanced economies today might already be at a point where the

Figure 2.15: Financial sector liabilities in the USA



Note: Total liabilities as a percentage of GDP of commercial banks (——), and the shadow banking sector (······) for the USA. Shadow banking liabilities are as in Poszar et al. (2013) from government-sponsored enterprises, government-sponsored enterprises and federally related mortgage pools, issuers of asset-backed securities, money market mutual funds, plus U.S. government agency securities and open market papers. Source: FRBNY.

marginal costs are outweighing the marginal utility.

One reason is that much of the growth in debt has been in mortgage credit to private households in the past. Many of these activities are contributing relatively little to productivity growth (see Cecchetti and Kharoubi (2015)). This might be the case because these credits are often just used to refinance or buy existing mortgages (see Philippon (2015)). Such transactions have little immediate effect on economic activity, and thus do not enhance the ability to earn interest. Cecchetti and Kharoubi (2015) therefore argue that by extending debt mainly towards low productive investments, average productivity and economic growth fell during the last decades. Through this, the *GDP-pie* from which interest can be distributed additionally shrunk relative to the amount of interest bearing assets.

Furthermore, as more human capital in the financial sector is redirected from liquidity services towards credit activities, there is a shift in the form of employment visible in the financial sector (see Philippon and Reshef (2009)). There is a reduction in routine work through technological progress visible, which is substituted by more complex jobs in credit monitoring, in designing, originating and trading complex products, and in advisory services. These jobs have a higher productivity, and are therefore remunerated higher. This has the effect that average wages in the financial sector have outperformed wages in all other sectors. The majority of the benefits thus go to a small group of highly skilled workers in the financial sector, who earn extraordinarily high wages. These wealthy individuals save on average a higher proportion of their income, which is contributing to lower interest through higher savings rates. Philippon and Reshef (2009) estimate that the higher financialisation since the 1970s is responsible for around 15-25% of the total increase in the GINI coefficient as well as the Theil index in the US. Higher inequality in turn might have led to slower growth across the developed countries in the last decades (see e.g. Rachel and Smith (2015), Stiglitz (2012)). Furthermore, Cecchetti and Kharoubi (2015) show that these highly skilled workers may generate negative externalities for other sectors, as they might be able to persuade borrowers to invest in projects with lower productivity, which then could lead to a slowdown of total factor productivity.

Additionally, technical progress in the financial sector put downward pressures on interest rates as well. Through better monitoring and risk management, and lowered intermediation costs, financial intermediaries are able to lower average interest rates which they offer. Moreover, through better hedging, pooling and monitoring financial sectors have become more liquid in the last couple of decades. This in turn implies that investors have to pay a lower liquidity premium, which c.p. lowers interest rates (see e.g. Nagel (2016)). Furthermore, rising securitisation activity increased loan supply through higher liquidity and increased profitability of banks (see Altunbas et al. (2014) for an overview). On the other hand, effective credit demand also rose, as banks have lent to riskier borrowers. As similarly alternative financing demand has risen, total credit creation rose, which is visible in the higher debt-to-GDP ratios. Thus, securitisation activity and alternative financing also contributed to the increased pressure on interest rates.

The financial sector might therefore be contributing to lower growth rates, and as a consequence to lower interest rates twofold. By issuing more debt, especially for unproductive uses, growth slowed and the ability to earn interest receded. Furthermore, technological progress and changes in business models in the financial sector also put pressures on interest rates.

Nevertheless, even if these pressures were not present, financial intermediaries would still face the constraint of lower interest income from the non-financial corporate sector through their higher share of outstanding debt. Thus, the long-run trend in lower average interest rates is not only explainable from demand side induced progresses, but also by the aforementioned supply side developments.

2.7 Conclusion

This chapter lays out an alternative supply side perspective as of why interest rates have fallen considerably since the 1980s around the world. This view is based on the premise that interest can only be sustainably distributed in the long-run through the added value in the economy. Since a larger amount of debt is facing a proportionally shrinking amount of added value, there is a pressure on average interest rates.

Through higher indebtedness in the non-financial corporate sector, the maximum interest for non-financial corporations has receded from around 180% in the 1980s to around 100% today (and even lower, if only added value of non-financial corporations is considered). This alone puts a pressure on interest payments, even if labour and entrepreneurs would cut back on their claims to the produced economic value. Subsequently, the lower amount of paid out interest to the financial sector has led to a lower ability of these entities to pass on interest payments on their own debt securities as well, as the nominal amount of income from interest shrunk and financial institutes face a higher debt burden themselves, while not being able to make up this shortfall by raising their non-interest income to the same extent. Furthermore, the growing financial sector supposedly contributed to lower economic growth in the last couple of decades. This puts further pressure on the denominator in the maximum interest, leading to lower average interest available for each amount of debt. Additionally, higher liquidity through better intermediation led to lower liquidity premia, which lowered interest rates, too.

If average interest rates shall for example rise by just one percentage point, a shift from all other factor income groups of four percentage points towards interest would be needed, as the maximum interest for all debt obligations stands at about 25% in the country sample (with a debt-to-GDP ratio of 400%).

On these grounds, the notion that central banks should just raise policy rates to prop up interest rates in the financial markets can be challenged. If central banks would raise interest rates drastically and market rates would therefore rise too, then a higher amount of added value would flow towards creditors, at the expense of workers, and/or entrepreneurs and company owners. Either labour income might then have to fall below their marginal productivity or workers could only spend a lower portion of their income on consumption, which might lead to slower economic growth, or entrepreneurs and company owners might not be rewarded adequately for their engagement to take entrepreneurial risks anymore. In the short-run it might certainly be possible to live off of the substance or refinance payment obligations by issuing more debt, if workers and entrepreneurs do not cut back on their claims, but these are no viable long-run options, because either the capital stock would be depreciated too much or default risks (because of over-indebtedness) would rise. That would probably lead to lower growth and inflation in the long-run, as financial instability risks would rise. Thus, central banks might be inclined to cut interest rates again. So, there might be no room for central banks to raise rates, without other negative repercussions potentially arising. Furthermore, market rates might not even rise in response to a policy rate increase, as creditors might not be able to generate enough income to pay all interest obligations, and simultaneously pay workers and reward company owners.[9]

This has the consequence, that if employee compensation and profits shall not fall below their fair share in the production process, interest can only rise sustainably in the long-run by lowering the debt-to-GDP ratio either through higher growth rates or by lower nominal amounts of debt. If none of these or a combination of these options come to pass, then average nominal interest rates are probably bound to be low for a longer period of time.

9 Although debt-to-GDP levels have slightly fallen during the last couple of years after the Global Financial Crisis (at least in advanced economies), this might not be enough to lead to a significantly higher ability to earn interest.

Chapter 3

Credit Measurement in Monetary Transmission

This chapter reviews the application of credit variables in empirical estimations of the transmission of monetary policy towards bank lending. Typically, to answer such a question, one should be interested in how the amount of newly issued credit develops in response to a monetary policy shock. But, contrary to the underlying theory, the majority of empirical studies employs the outstanding stock—or the change thereof—as the relevant credit variable. This chapter argues, that there are several drawbacks in applying stock measures of bank loans in these settings, as the change in the outstanding amount of credit is not only representing newly issued loans, but also other factors, like repayments, revaluations, write-offs, and sell-offs due to securitisation. The insights of this chapter are based on a previously published paper (Behrendt (2016b)).

3.1 Introduction

As credit developments are getting more into the spotlight of research and the policy discussion since the Global Financial Crisis, it can be asked, if the right measures of lending are used in empirical models of the credit channel. While analysing the impact of monetary policy towards credit developments, empirical studies predominantly use the outstanding stock of bank loans as their credit variable (see e.g. Altavilla (2015), Bernanke and Blinder (1988, 1992), Carpenter and Demiralp (2012), Carpenter et al. (2014), Ciccarelli et al. (2015), Driscoll (2004), Gambacorta and Marqués-Ibáñez (2011), Giannone et al. (2012), Jacobs and Rayner (2012), Lown and Morgan (2006), de Mello and Pisu (2010), Nieto (2007), Tabak et al. (2010)). But as the stock variable also contains information about previously extended loans, the change in the stock amounts to the extension of loans minus repayments, write-offs, sell-offs due to securitisation, and the net of revaluations. But, in the assessment of central bank policies towards credit creation, it is of primary interest how current and future lending evolves, and not how the amount of previously issued credits change, because the effects of prior extended loans already played out, and only new lending has a direct impact on the real sector. Certainly, the real economy can be affected from previous lending activities through monetary policy, as for example interest rates might be linked to current policy rates, which might lead to higher default rates when policy rates rise. But this is to a lesser degree in the direct control of central banks, and should therefore probably be not as high on the policy agenda as the more direct impact on current and future lending behaviour. This shall not mean that the credit stock is a redundant variable, since it can contain valuable information regarding sustainability of debt levels, or about stress in financial markets, but these repercussions might at best be dealt with by other instruments—mainly macroprudential policies (see e.g. Claessens (2014), or IMF (2013b) for an overview)—and/or by other empirical set-ups, rather than in the estimation of the impact of monetary policy towards lending activity. Focusing only on the stock of credit could thus potentially lead to inaccurate policy advice.

Due to the inclusion of the other factors into the stock data, amounts of the change of the outstanding stock of credit and of new lending can differ quite substantially. What is visible in the data is that the change in the stock is highly attributable to economic conditions, which is to a large extent not being explainable by the underlying trends in new lending activity. It can therefore be expected that the results from using the credit stock in empirical studies could differ from the accompanying results using new loans. Thus, if parts of the composition of the stock—other than new lending—correlate with other objectives of monetary policy, the effectiveness of the credit channel might be overestimated. This might have important implications for the assessment of monetary transmission, and ultimately for the conduct of monetary policy.

The issues mentioned above are accounted for in this chapter. Moreover, the different theoretical arguments for using the amount of new lending instead of the growth in the outstanding stock of credit in econometric studies are laid out. What is thereby shown is that results in empirical studies could change quite significantly, when newly extended loans are considered as the credit variable instead of the outstanding stock of credit, especially in turbulent times.

This chapter is organised as follows: First, the theoretical case for using new loans instead of the outstanding stock of credit in monetary policy analysis is made in Section 3.2. Section 3.3 then lays out the points of criticism with the other factors except new lending that comprise the change in the outstanding stock. Section 3.4 presents literature which is accounting for some of the criticism presented in Section 3.3. To investigate the soundness of the rationale empirically, some stylised facts from credit data of the Euro area, the United States, and Brazil are shown in Section 3.5. Section 3.6 then tries to find out, if movements in economic activity can even be explained by credit trends while using new lending. Section 3.7 concludes the chapter.

3.2 Motivation for using New Lending

Two arguments can be brought forward to justify the use of new lending instead of the outstanding amount of credit in empirical studies of the monetary transmission process towards bank lending. The first one, sometimes mentioned in the literature, is that there might be an issue of stock-flow consistency in the analysis of credit developments (see Huang (2010), Biggs et al. (2009), also see Table 3.1). While analysing monetary transmission mechanisms or business cycle fluctuations in the literature, the change in the outstanding stock of credit (a stock variable) is often analysed in comparison to the change in the GDP (a flow variable) (see e.g. Claessens et al. (2009)). But both are on a different level of integration.

Table 3.1: Stock vs. flow level comparison

Level of Integration	GDP	Credit Stock	New Lending
1		D	
2	GDP	ΔD	L
3	ΔGDP	ΔΔD	ΔL

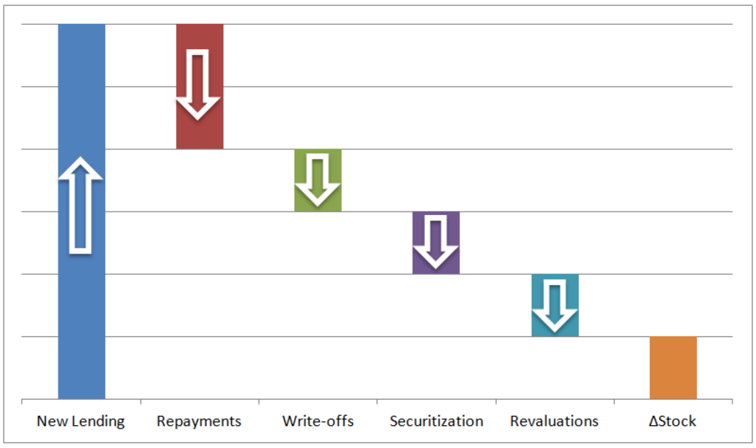
Biggs (2008) and Biggs et al. (2009) specifically draw their attention on this stock-flow issue, while trying to explain movements in economic activity as a result of underlying credit trends. Previous studies, like Calvo et al. (2006) and Claessens et al. (2009), using the change in the stock of outstanding credit, only find a loose and lagging relationship between credit developments and economic activity. Biggs et al. (2009) on the other hand try to remedy this puzzle. They state that one has to compare flow with flow variables, and thus use a proxy for new lending as the flow variable in their analysis, by applying what they call the *credit impulse* (see also Biggs and Mayer (2013)). In their view, the change of the credit stock represents the amount of new lending. This is then a flow variable, which should be compared to GDP. As a result, they find that the change in domestic demand is highly correlated with the change of their credit impulse, which they measure as the second difference of the outstanding stock as a percentage of GDP. This was not the case in previous studies, as those applied the first difference of the stock of outstanding credit, when comparing it to GDP or domestic demand growth. Additionally, their results show that developments in domestic demand can be explained by credit trends with a lag, and not the other way around, as found in earlier studies like Calvo et al. (2006)).

While the credit impulse can tackle an important deficiency in the literature, another problem is still not accounted for, and also not rigorously brought forward in the existing literature. Most empirical estimations of the transmission process of monetary policy towards bank lending try to answer, how the amount of newly issued credit changes (see e.g. Bernanke Blinder (1988, 1992), Carpenter et al. (2014), ECB (2009a), Gambacorta and Marqués-Ibáñez (2011), Lown and Morgan (2006)). Most of these studies follow this argumentation in their theoretical motivation, but apply the stock of outstanding credit instead of new lending in their empirical sections. But, the change in the outstanding stock includes also maturing loans, revaluations, securitisation activity, and write-offs (see Equation 3.1 and Figure 3.1):

$$\begin{aligned} \Delta Stock\ of\ Credit = {} & New\ Lending - Maturing\ Loans - \\ & Write\text{-}offs - Securitisation\ +/- \\ & Revaluations \end{aligned} \tag{3.1}$$

These inclusions most likely lead to either an under- or over-reporting of the true amount of new lending in an economy, depending on the size of the other factors in relation to new lending. This can have a crucial influence towards the conduct of monetary policy if a central bank wants to assess credit developments. If, for example, c.p. more loans have to be written off because of an exogenous event, there would be a reduction in the growth of the credit stock visible. This might induce the central bank to relax monetary policy in an anticipation of a weaker economy, even though net new lending might not have changed.

Figure 3.1: Composition of the change of the credit stock



In this context, it should be asked what the economically important variable is, which central banks try to influence in their monetary transmission calculus. As only the actually drawn loans have an immediate impact on economic activity, the concern for the impact of monetary policy on bank lending should be on the amount of newly extended (and withdrawn) credit in a specific period, as otherwise, through the use of the credit stock in monetary policy analysis, all changes to previously granted loans, which are still in the books of the banks, would get incorporated into the estimation. Although repayment structures, and the amount of revaluations and written off loans can contain valuable information about financial risks, these information are not really crucial to assess the impact of monetary policy on current and future credit origination, which should be the main objective of central banks in assessing the transmission of their policies into credit markets (see also ECB (2009a) for a similar argumentation). An existing credit might drain some purchasing power from the creditor as he repays the loan, but the impact on aggregate demand of the initial credit and the multiplier effect already played out, and have therefore no immediate impact on new spending, and thus on monetary developments and inflation dynamics. The inclusion of the other factors into the change in the stock variable could therefore lead to inconsistencies in the conduct of monetary policy.

An easy solution to this problem would be to simply apply new lending data instead of the stock. But there is the problem that data on new lending is not readily available in many countries/country groups. Only a few central banks even collect data on newly issued credits comprehensively, and if they do, these data are mostly confidential. Data availability for the other factors contained in the change in the stock is available to an even lesser extent, if at all. Thus, calculation of new lending out of the stock and the other factors is nearly impossible.

3.3 Factors Affecting the Change in the Stock of Credit

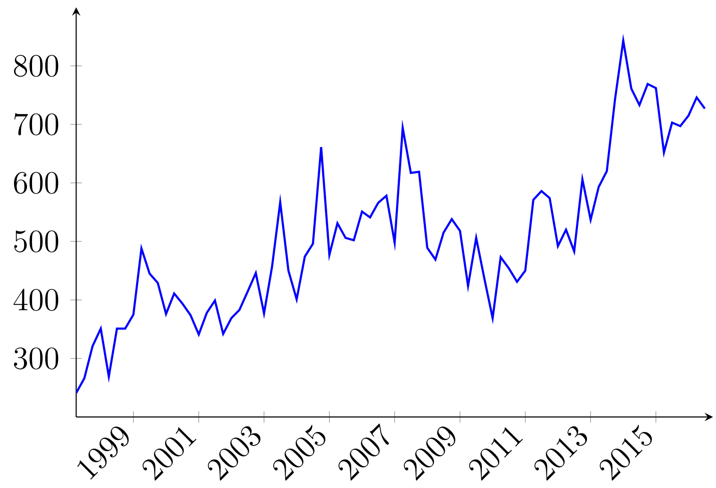
The outstanding stock of credit could be a good proxy for new lending activity, if the other factors that affect the outstanding amount of credit would be stable and uncorrelated with other objectives of monetary policy, like inflation or economic output. But the change in the stock is misreporting the underlying amount of new lending in the economy, since the other factors are highly correlated with the state of the economy.

But first, the validity for also incorporating each factor into empirical estimations is shown in the following paragraphs for each factor.

Repayments in general lead to an underreporting of the true amount of new lending while using the outstanding stock of credit, as they drag the change in the stock downwards. Furthermore, as repayment structures do change over time, variations in the stock data are generated, which are not be attributable to changes in loan creation. A slowdown of credit growth might be due to lower credit extension, but it can also be due to earlier repayment. Ivashina and Scharfstein (2010) try to include these loan retirements in their analytical framework, but have trouble to account for it by using data from the Federal Reserve Board of Governors (FRB) on commercial and industrial (C&I) loans. That is why they use data from the Reuters' DealScan database on syndicated loans. Although these loan data are a true flow data covering newly sold syndicated loans, it cannot be traced back when the underlying loans where originally extended, which is of main interest for the conduct of monetary policy.

In addition, the growth rate in the outstanding stock c.p. changes if the average length of the granted loans fluctuates (see Antoniades (2014)). But as central banks do not have direct control over private sector contract arrangements, repayment trends should also not affect the immediate decision set of central banks while analysing credit developments. In this regard, Figure 3.2 depicts the average maturity of C&I loans in the United States, as captured in the Survey of Terms of Business Lending (STBL). As shown in this example, a movement towards longer running loans would lead to a higher growth path of the outstanding credit stock over the long-run, even if nominal new lending would remain at the same level, as credits are repaid slower, and are therefore longer and for a higher value in the books of the banks. Thus, the prediction of the bank lending channel, that tighter monetary policy reduces loan supply, could stem from banks reducing average maturities, and not necessarily because of a cutting back on loan origination. This argument is also stressed by Black and Rosen (2007).

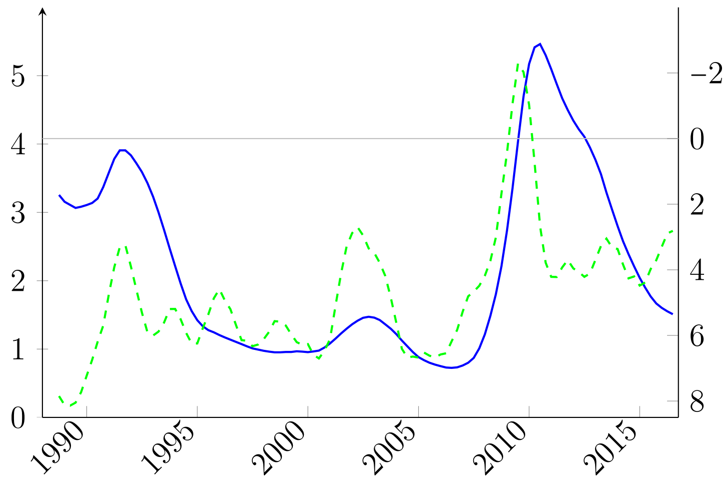
Figure 3.2: Weighted-average maturity for all C&I loans for the USA



Note: Duartion in days for the USA. Source: Board of Governors of the Federal Reserve System.

Write-offs of existing loans also drag down the stock of credit, and therefore lead to an under-reporting of the actual amount of new lending. As write-offs are quite volatile, policy makers cannot differentiate which amount of the change in the stock is due to new lending activity and which is due to unexpected loan failures. Additionally, write-offs are probably highly correlated with economic activity. If the economy is on a downward path, more and more loans become non-performing, as it gets more difficult for borrowers to service their debt obligations. This can be seen in Figure 3.3. Here, the non-performing loan (NPL) ratio, which is defined as the percentage of loans that are 90-days or more past due or nonaccrual to the amount of total loans, is depicted together with the yearly GDP growth for the United States. Once economic growth falls (shown here as an upward movement of the green dashed line, because of an inverse y-axis), more and more loans become non-performing, and could lead to higher default rates. High default rates in an economic crisis could then even lead to a contraction in the stock of credit.

Figure 3.3: Non-performing loans and GDP growth in the USA

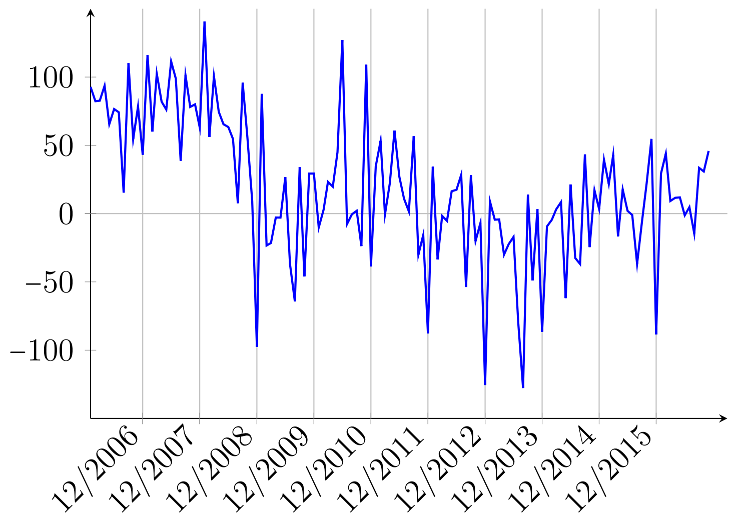


Note: 4quarter sums of non-performing loans in % of total loans at commercial banks (——, lhs) and yearly GDP growth in % (- - -, rhs, inverted axis) for the USA. Source: Fed.

Moreover, due to International Financial Reporting Standards (IFRS) banks have to account for specific risks in their loan portfolios, which have to be recognised through an incurred-loss-model. If there is external, objective evidence of a possible loss at the reporting date, this impairment has to be accounted within the subsequent re-evaluation at the present amount of the estimated discounted cash flows which seem reasonably feasible. This process is reversed if the origin of the impairment dissipates. Regarding loan portfolios at banks, this means that the credit stock is exposed to changes if there are any economic events which significantly lower or raise the probability of repayment. This in turn would lead to movements in the outstanding stock of credit (see again Figure 3.3). These movements do not have a direct effect on the real economy, but are just the consequence of past events, although they can have an indirect impact on future loan origination, as these risks might change the supply of credit due to changing profitability of banks. If such revaluations happen, central banks might be inclined to change their policy, even though new lending might not be affected by these cautionary measures.

What is visible from seasonally unadjusted loan data of the Euro area is that the stock often drops quite significantly in December (see Figure 3.4). Banks adjust their loan portfolio in December to recognise impairments before the reporting date. Although this effect might disappear once seasonal effects are accounted for, it might lead to undesirable reactions from central banks if not, especially since it can be difficult to estimate seasonal effects in real time.

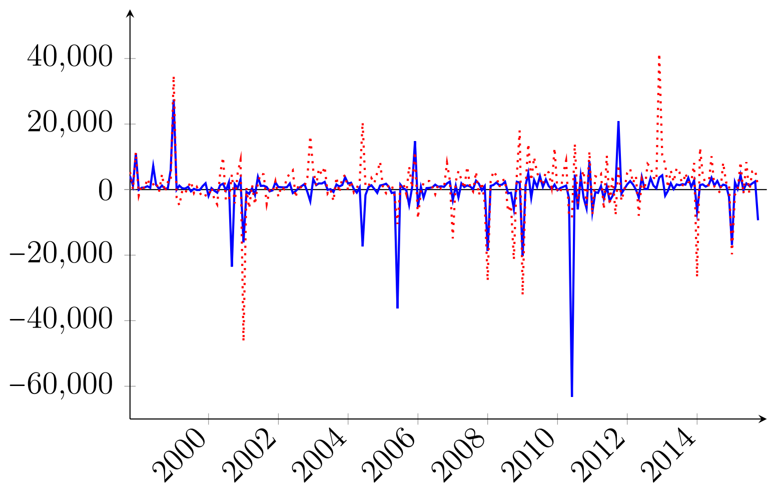
Figure 3.4: Monthly credit growth for the Euro area



Note: Non-seasonally adjusted absolute change in the credit stock of the Euro area (billion Euro). December data is highlighted by vertical lines. Source: ECB.

The ECB tries to account for write-offs and revaluations in their stock data. Their Manual for Balance Sheet Statistics states that data of outstanding amounts should be net of revaluations and write-offs. These shall be reported separately. The ECB then calculates two different series from the balance sheet data of the banks. The stock data contains the stock as reported on the banks' balance sheets, while the transactions (flow variable) are net of the stock adjustments (see ECB (2012)). Although the flow variable does then not suffer from an inclusion of write-offs and revaluations—as evidenced in Figure 3.5 that the amounts are generally higher than the simple change in the outstanding stock, especially for non-financial business loans who are certainly more prone to be revaluated and/or written-off—, they are still suffering from the incorporation of repayments and securitisation data. Additionally, absolute flows are negative in some periods. But as new lending activity could only be zero at minimum, one cannot draw a conclusion about new lending from the flow data of the ECB either.

Figure 3.5: Difference of the flow and stock of credit for the Euro area



Note: Difference between the flow and the change in the outstanding stock of credit for households (——) and non-financial corporations (⋯⋯) for the Euro area (million Euro). Source: ECB.

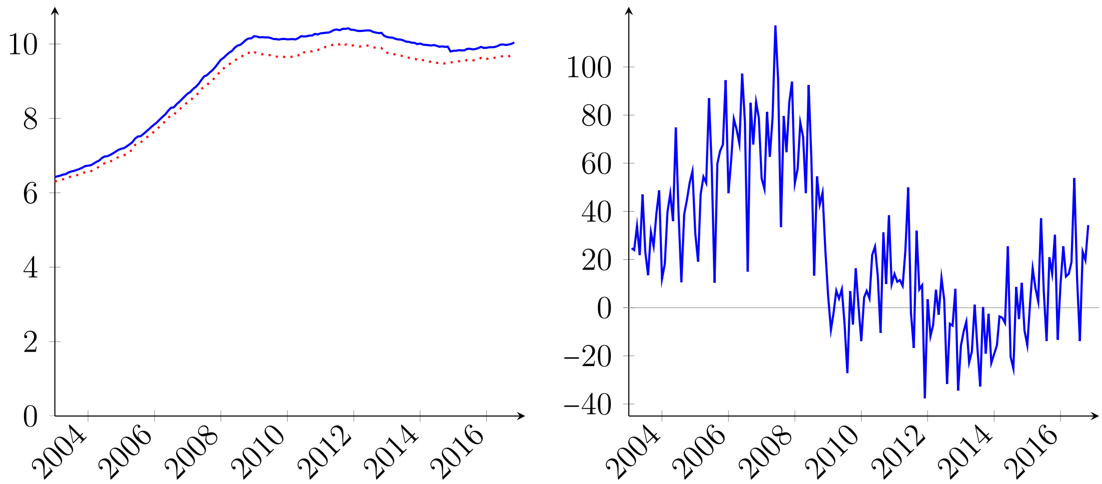
Another component which affects the stock of outstanding credit is securitisation activity (see Poschmann (2012) for an overview of the securitisation process). By offloading loans off the balance sheet through a final sell of the loan portfolio, the amount of credit extended gets underreported. Furthermore, it is conceivable that a credit goes unreported completely in some frameworks. As credit data is mainly published by using bank balance sheet reports, a credit which is extended and then sold off-balance (even if only partially) in the same reporting period may not be fully captured in the stock data at all.

Some central banks, like the ECB, specifically report securitisation additionally to the balance sheet data of the banks. These data would have to be added to the stock data in empirical analyses, to gain a more precise picture of new lending activities. Because of securitisation activity, the actual amount of new lending might therefore be underestimated using bank balance sheet data, if not accounted for. Altunbas et al. (2009) specifically gather these securitisation activities of European banks. They add data on securitisation activities onto balance sheet data of individual banks and subsequently estimate the effects of the bank lending channel. They find that securitisation may have a negative influence on the effectiveness of the bank lending channel (see also Loutskina and Strahan (2006)). But securitisation strengthens banks' loan supply on the other hand through additional liquidity and an offloading of risks, although it might also induce higher risk-taking in the loan extension process (see e.g. Altunbas et al. (2014)).

Figure 3.6 (a) depicts the outstanding stock of credit for the Euro area. The red dotted line represents the raw outstanding amount data and the blue line is the adjusted loan data, which accounts for sales and securitisation (see ECB (2015)) for an in depth explanation of this series). The adjusted data consequently is higher than the raw data, reflecting the amounts of derecognised loans no longer on the balance sheets. But, even though the flow of the adjusted loan statistic of the ECB shall cover data adjusted for sales and securitisation as well as write-offs and revaluations, it cannot account for repayments. Looking at the flow of the adjusted data in Figure 3.6 (b) confirms this, as the values in specific periods are still below zero. But as new lending cannot fall below zero, this variable still does not reveal the exact amount of newly issued loans, either.[1]

[1] There is another deficiency in this variable. The adjusted loan series is constructed by adding the amount of securitised loans mechanically on top of the reported balance sheet data. While

Figure 3.6: Adjusted credit stock for the Euro area



(a) Credit Stock **(b)** Flow of the adjusted stock

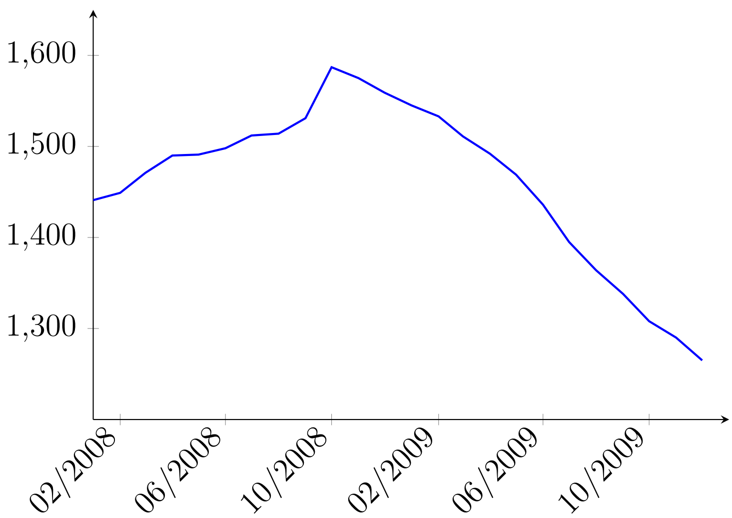
Note: Outstanding stock (······) and adjusted stock of credit (——) in trillion Euro in (a) plus the absolute flow of the adjusted stock of credit (——) in billion Euro in (b) for the Euro area. Data is non-seasonally adjusted. Source: ECB.

Thus, it is evident that from only looking at the change of the outstanding stock, one cannot easily recognize the level of new lending. The ECB for example wrote in their Monthly Bulletin from February 2010 that "... in December 2009 ... the annual growth in loans to the private sector was zero" (ECB (2010), p.5-6). From the raw stock data one just does not know if for example there was no new credit issued and no loans repaid, or if all loans matured and the same amount was created in the specific period. Certainly, there was still a decent amount of new credit extended, so the actual outcome had to be between the two extremes above. But to which extend is not visible without data of the other factors.

then the additional amount of the securitised loans in the original period are represented clearly, the effects for the following periods are not evident. Since most likely the length of the securitised loans is not known, the trajectory of repayments is not obvious either. Even if it would be and would be accounted for, the further development of these securitised loans is also not known. If the loan has maybe already been paid back earlier or had to be written off is influencing the height of the added securitised loans in the subsequent periods in the adjusted series.

A more general problem with credit data for the conduct of monetary policy is that it is not identifiable if a loan extension really led to spending in the real economy. In the aftermath of the Lehman collapse there was quite a big spike in C&I lending in the United States visible. The stock of outstanding C&I loans rose by 56 billion US$ in the month of October alone (see Figure 3.7). This unexpected spike is also visible in new lending data. C&I loans, as captured by the STBL, rose from an average of 85 billion US$ in each of the first three quarters 2008 to 105 billion US$ in the fourth quarter of 2008. This spike in both data series can certainly not be explained by seasonal factors or rising economic activity.

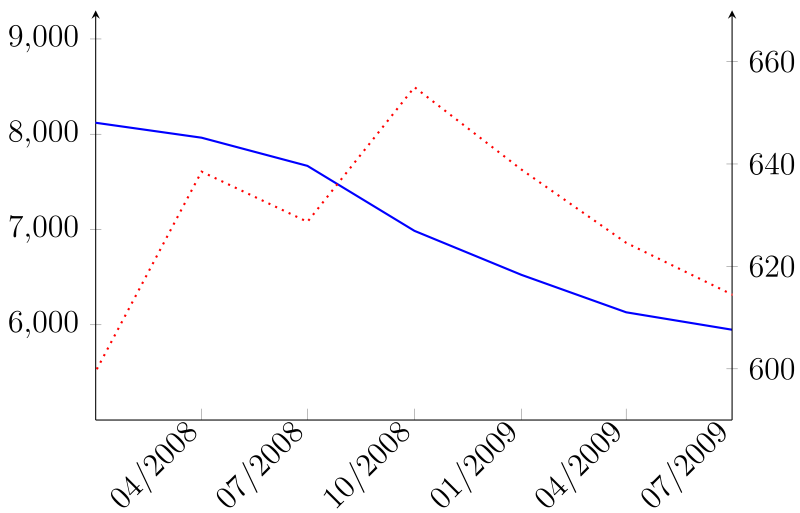
Figure 3.7: Outstanding stock of C&I loans for the USA



Note: Billion US$. Source: Fed.

Ivashina and Scharfstein (2010) explain it by the fact that many firms drew down on their previously granted credit lines due to concerns on access to credit in the future. As shown in Figure 3.8, unused credit lines fell quite drastically during this period (see also Meisenzahl (2015)). The spike in lending activity posed as insurance for firms in case of a credit market cut off, and does not represent new investments in the wake of this negative shock to the economy. As a result, off-balance sheet commitments were converted into on-balance sheet loans, without necessarily leading to new spending and investment. Delta Air Lines for example noted that they want ”to increase [its] cash balance”, while General Motors said that they want ”to maintain a high level of financial flexibility in the face of uncertain credit markets” (see Ivashina and Scharfstein (2010, p.327); see also Huang (2010) for the same reasoning). It probably makes a huge difference for the effects on economic activity, if a credit is just sitting idle in the vaults of the firms, or if it is used for new investment projects. But this is certainly not observable by only looking at aggregate stock or new lending data, if not specifically accounted for in the frameworks.

Figure 3.8: Unused commitments at US banks



Note: For all loans (——, lhs) and C&I loans (⋯⋯, rhs) for the USA in billion US$. Source: FRB.

Because of the above mentioned reasons, these accounting issues should not play a big role in monetary policy decisions, although developments in these variables should be monitored for macroprudential and financial stability purposes. But this cannot be accomplished from looking at the stock data only, since this does not provide clear indications as to which factor caused the stock to change, although some central banks try to mitigate this issue by subtracting write-offs, revaluations and securitisation out of the stock data.[2]

3.4 Literature Accounting for the other Factors in the Credit Stock

Recent literature in the line of Kashyap and Stein (2000) tries to capture new lending activity more rigorously in micro banking settings, while analysing bank lending and firm balance sheet channels. Jiménez et al. (2014) for example use data from the confidential credit register of the Spanish central bank on loan applications to assess determinants for credit extensions or rejections (see also Abuka et al. (2015) for an estimation of the bank lending channel in Uganda; and Garcia-Escribano (2013) for an application to Brazilian data). They have access to information on all business loans granted by all banks in Spain. Although they present valuable insights to what determines credit supply and demand, the impact of monetary policy decisions from a macro perspective is not analysed in this and the other mentioned studies.

Even though some authors, who are applying macro data to depict the impact of credit to the real economy, are aware of certain aspects of the issues with the

[2] Furthermore, what is also not covered in conventional stock data, as reported by central banks and used in many monetary transmission studies, is lending from non-bank financial intermediaries (NBFIs). As these lending activities to the private sector gain more and more importance (see again Chapter 2), central banks should also focus on these developments while formulating their monetary policy decisions. Although NBFIs have no direct access to central bank refinancing, their lending activities have an impact on economic activity, and therefore inflation dynamics as well. By only looking at the stock of outstanding credit—and also new lending activities—from MFIs, valuable information about the transmission mechanism could be lost. But this would be a topic for further research, and cannot adequately be analysed in this thesis.

stock data, they do not account for all mentioned arguments rigorously. As stated above, Biggs (2008) and Biggs et al. (2009) are trying to avoid the stock-flow issue, but do not use data for newly extended loans either. Although they are explicitly stating that they use a variable of new lending: "consequently our preferred credit measure is the change in ***new credit issued*** as a % of GDP" (Biggs (2008), p.2; highlights by the author), their credit impulse data is just the second derivative of the stock of outstanding credit in the economy, and therefore still contains effects from the other mentioned factors. Thus, one would need to compare the change in new lending to the change in GDP in such frameworks, to eliminate the stock-flow issue, and to account for the inclusion of other factors than newly extended credits in the stock data (see Table 3.1).

For most of the data, Biggs (2008) and Biggs et al. (2009) draw on the International Financial Statistics (IFS) from the International Monetary Fund (IMF), which states the outstanding amount of credit. Regarding the U.S., they use flows-of-funds data, which draws on data from the Reports of Condition for U.S.-chartered depository institutions (the so called Call Reports), to construct the credit impulse. Although the usage of the flow-of-funds data might seem like applying new lending data, the flows of total credit market borrowing, as stated by the Federal Reserve System (Fed) in the Financial Accounts of the United States, is only the difference between the credit market debt outstanding in each period, adjusted for some general revaluations.[3] Data from the IMF also does

[3] As a technicality, revaluation accounts (labelled as FR) in the Financial Accounts framework of the Fed do not exceed a magnitude of two million US Dollar in any particular quarter during the period from 1990 to 2015 (see the Z1 Data as provided by the Fed at `https://www.federalreserve.gov/releases/Z1/current/default.htm`). Therefore, these revaluations cannot explain the drastic differences in the aforementioned data. It is furthermore implausible that revaluations of all commercial banks amount to only such a small amount, while the total loan portfolio exceeds well over 10 trillion US Dollars.

not take into account the other factors, as they state only the published balance sheet data by the banks. The data in the above mentioned papers therefore still suffers from the accounting of maturing loans, revaluations not captured in the frameworks, securitisation, and write-offs. What is also evident is, that the flow of total credit market lending (table F.1 in the Financial Accounts of the United States statement[4]) is negative in some periods, because maturing loans, net revaluations, and write-offs were higher in these periods (for example during the GFC in 2009) than the amount of new lending plus other debt issuance.

Even literature of stock-flow consistent (SFC) models, who specifically try to avoid stock and flow inconsistencies, mostly use only the difference of the stock as their new lending variable. Many studies applying these SFC models to economic data for the United States use data from the flow of funds framework of the Fed, mentioned above (see for example Godley et al. (2007)). Papadimitriou et al. (2013) motivate their stock-flow identity in a SFC model for Greece as

$$Stock_{t+1} = Stock_t + Flow_t + NCG_t - DS_t \tag{3.2}$$

where the NCG stands for net capital gains and DS for the reduction in the stock, for example defaults. Anyhow, they report that "annual borrowing fluctuated around 7 percent of GDP from 1998 to 2006" (p.18), but only calculating the implied new borrowing from "the stock of loans outstanding" (p.18). While trying to avoid stock-flow inconsistencies by calculating the flow of credit, they still omit to account for the other factors affecting the change in the stock.

[4] It is to be noted that the data in the F.1 table labelled as Total Credit Market Debt Outstanding is constructed by adding up loans and debt securities. Instead of only incorporating bank lending, this framework also considers other forms of debt creation, like commercial paper and corporate bond issuance.

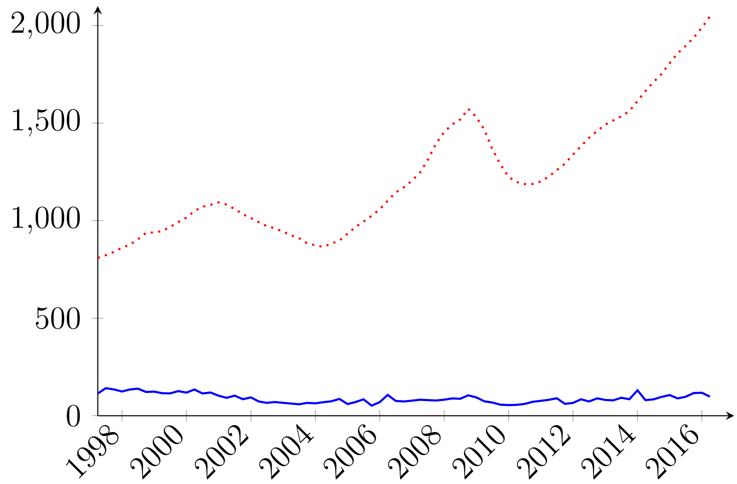
3.5 Stylised Facts of Lending Activity

As mentioned above, most central banks only disclose information from the aggregated balance sheets—and therefore stock data—of commercial banks, and not data on new lending activity. Therefore, most academic research still incorporates stock data on bank lending.

The Fed tries to capture data on new bank lending in their quarterly Survey of Terms of Business Lending (STBL), where they collect micro bank data. Every 13 weeks, the Fed asks a sample of commercial banks to provide certain price and non-price information about their granted commercial and industrial loans during the first full week of the 2nd month of each quarter (see Board of Governors of the Federal Reserve System (2013)). Since it is only survey based at selected institutions and covers only loans extended during one week, not all new loans are captured. Nevertheless, Figure 3.9 compares the amounts of new lending, as collected by the STBL and the stock of outstanding C&I loans on the balance sheets of US commercial banks. On average, new lending comprises about 7.8% of total loans for the period from 1997 until 2016 (although falling from about 15% to around 5%).

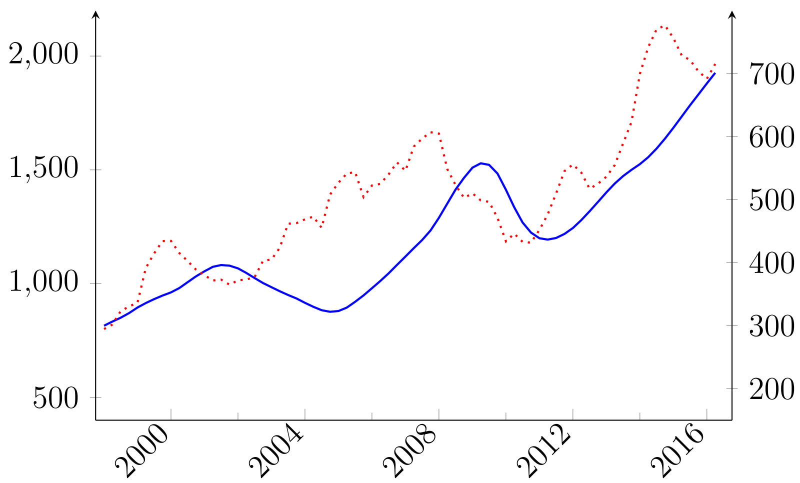
What is visible from this comparison is, that the level of new lending did not rise since 1998, but the stock increased almost threefold during the same period. New C&I loans are today about the same as 20 years ago. The rise in the stock of outstanding C&I loans in turn is mainly the result of longer-running loan contracts. As the amount of new lending did not grow, but in the same time loans were granted with a longer maturity, these loans are for a longer time and a higher amount on the books of the banks, and thus push up the outstanding amount of credit. This lock-step between the maturity and the outstanding stock can clearly be seen in Figure 3.10. The outstanding stock has a correlation with the average maturity of 73%.

Figure 3.9: C&I loans for the USA



Note: New C&I loans (——) and the stock of C&I loans of commercial banks (······) for the USA in billion US $. Source: Fed.

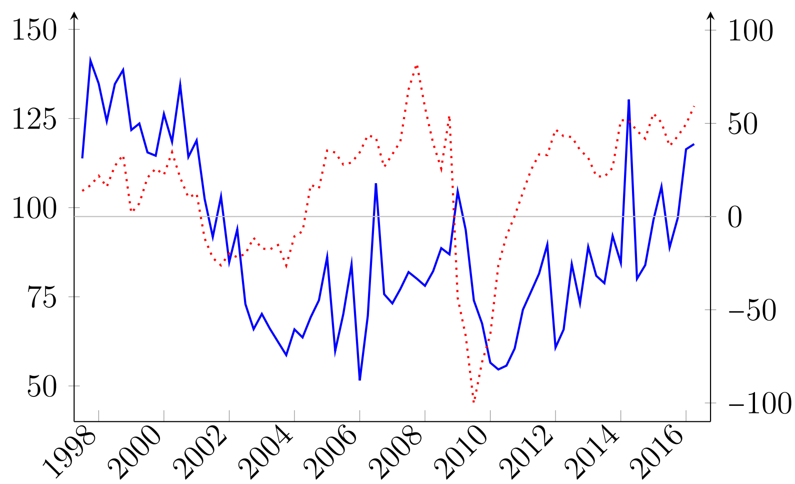
Figure 3.10: C&I loans and their average maturity for the USA



Note: Four quarter rolling averages of the outstanding stock of C&I loans in billion US $ (——, lhs) and the weighted average maturity of C&I loans in days (······, rhs) at commercial banks in the USA. Source: Fed.

Thus, these longer running loans are contributing overly to the rise of the stock. Consequently, looking at the stock overestimates the rise of lending in comparison to the actual amounts of newly issued credits. This overestimation of lending growth can certainly have significant and far-reaching consequences for the conduct of monetary policy. This is also validated by Figure 3.11. Except for a few short episodes after the Dot-com Crisis and the Financial Crisis, the stock grew quite noticeably throughout the observed period. The level of new lending on the other hand did not really expand, as it is basically at the same height as in 1997, although it dropped to lower levels in the time in between.

Figure 3.11: Change of C&I loans for the USA

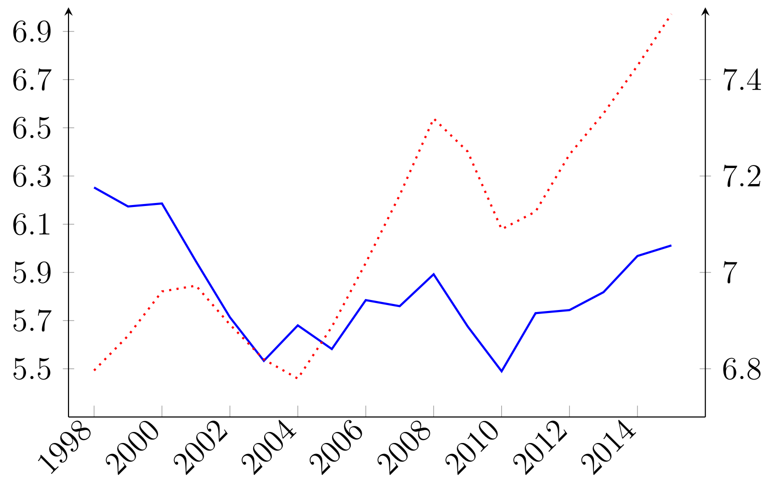


Note: New C&I loans (——, lhs) and the absolute change in the stock of C&I loans of commercial banks (⋯⋯, rhs) for the USA in billion US $. Source: Fed.

Furthermore, what can be observed is that the change in the stock does not move in sync with the amount of new lending. This can certainly stem from the selection of the reporting week in the new lending variable, as it might not be exemplary for the whole quarter. But what seems to be more plausible is that the other factors in the stock data influence the change more than the underlying trends in new lending activity. The correlation between the two series—new lending and the change in the stock—is only about 0.3, which means that 70% of the fluctuation in the stock data are not explained by new lending. While the stock shrank drastically after the Dot-com Bubble and during the Financial Crisis, the fall in new lending cannot explain the drop in the stock alone, especially during the Financial Crisis after 2008. Remember, that the spike in new lending in the third quarter of 2008 is because of precautionary borrowing from firms in fear of a credit market shut-down. Without this, the subsequent fall in new lending activity would not be as dramatic as it appears in the graph.

From 2005 on there is a huge acceleration in the growth rate of the stock visible, growing with an average of almost 15% annually between 2005 and 2008, while new lending only grew with an annual rate of about 10% during this period (see Figure 3.12 for the growing gap especially since 2004). Additionally to longer loan contracts, the sharp increase in the stock can probably be explained by a fall in NPLs, and therefore lower revaluations and write-offs after the turmoil from the Dot-com Bubble and 9/11 vanished (see Figure 3.13). Due to these lower write-offs and upward-revaluations, the stock grew at a faster pace than new lending afterwards. Therefore, the seemingly overly credit extension before 2008 can partially be explained by a higher growth in the credit stock due to falling write-offs, upward-revaluations of the loan portfolio and longer running loans, and not due to drastically accelerating bank lending (at least in the business sector), as new C&I lending did not grow with such a high rate. This, among other things, might explain why the perceived lending boom before 2008 did not lead to elevated inflation, since new lending did not grow as fast as implied by the change in the outstanding stock.

Figure 3.12: Log C&I loans in the USA



Note: Log new lending (——, yearly sum, lhs) and the log of the outstanding stock (⋯⋯, average yearly observation, rhs) for C&I loans in the USA. Source: Fed.

Figure 3.13: Non-performing loan ratios for the USA

Note: Non-performing loans in % of total loans at commercial banks for the USA (all loans (——) and commercial and industrial loans (⋯⋯)). Source: Fed.

This observation might also explain the puzzle of the credit-less recoveries mentioned by Claessens et al. (2009) and Calvo et. al (2006), and picked up by Biggs et al. (2009). After financial crises, NPLs make up a higher portion of the outstanding stock, which drags the outstanding stock downwards, mainly due to revaluations. The change in the stock is therefore to a large extent influenced by the high negative correlation with the NPLs, which is not supported by the underlying changes in new lending activity. This argument is also confirmed by the fact that new lending rose again since the third quarter of 2003, while the stock reached its low point not until the second quarter of 2004. This observation is especially significant for the paper of Claessens et al. (2009), since they only consider the first three years after a financial crisis in their model set-up. As this is precisely the time-span where downward revaluations are especially high. Even while new lending might pick up, this must not translate itself through to the stock data.

The same trends as after the Dot-com Bubble are also noticeable for the period between 2009 and 2011. While the stock still fell until the third quarter of 2010 (albeit slower than before), new lending already reached its low point during the first quarter of 2010. As a result, the stock generally can be expected to drop steeper than the underlying new lending activity during crisis times, and consequently recovers later, albeit if so with higher rates.[5]

Although there is no new lending data publicly available for consumer and mortgage loans in the USA, the same picture probably might apply to a certain extent, as is visible by a quite large drop in the total stock data in 2009, followed by a quick recovery after the initial risks vanished.

The ECB also does not compile data on new bank lending in a comprehensive credit register either. Therefore, data from the Monetary Financial Institution Interest Rate (MIR) statistics of the ECB is used here. The ECB collects data

[5] See for example Berrospide and Meisenzahl (2015) for an argumentation why new lending did not drop that significantly during the Great Recession.

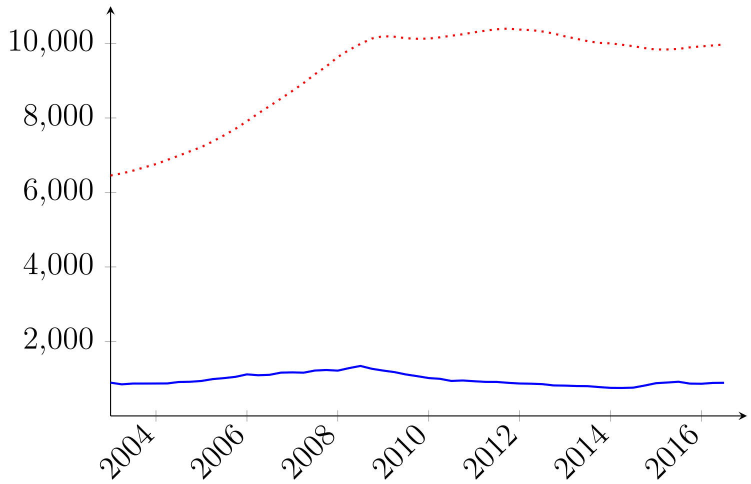
of "new business volumes" (basically new lending activity) as weights for the calculation of the aggregated MIRs, i.e. the average interest rate which creditors have to pay for a new loan. By doing this, the volume of the new loans is only aggregated through a sample, and does not cover all new lending activity.

Although this dataset might pose as a better alternative to the adjusted stock data, there are certain deficiencies in this data for the conduct of the analysis in this thesis. If for example a loan contract is renegotiated—i.e. if there was an initial rate fixation, but after several years the interest rate can be altered—this loan contract would be counted as a new loan in the MIR framework, even though there was no new loan creation, as the ECB is only interested in current interest rate conditions while collecting this dataset (subsequently, the stock would not rise on such a contract). The ECB only started publishing the amount of renegotiations in December of 2014. What is visible from this brief period is that renegotiations for loans to non-financial corporations make up about 20%, for mortgage loans 35%, and for consumption loans 10% of all new lending for each loan type in this set-up. Though, there are major differences for the different Euro area countries. As for example in Germany, the majority of loans are extended with a fixed rate over the whole duration, loan contracts in Spain or Italy are largely taken out with a fixed rate for a certain amount of time, which is then subject to renegotiations. Anyway, for this short period of time data on renegotiations are quite stable, giving rise to the assumption that they do not distort the new lending data severely in any direction. For data before 2014, it is not identifiable if these renegotiations make up a huge amount of the new loans or if there is great fluctuation.

Furthermore, a new loan that is just refinancing an old one would also be counted as an additional loan within this framework, even though no new spending in the real economy would be financed by this. Because of these shortcomings, the exact value of new lending (which is also followed by a transaction in the real economy) might not be illustrated precisely, but should rather be seen as an estimation of the true value. Despite these deficiencies, the data from the ECB MFI interest rate statistics on new business volumes might paint a more precise picture of new lending, instead of the stock of outstanding credit, until better data becomes available.

As for the USA, new lending does only make up a fraction of the outstanding stock (see Figure 3.14). New lending makes up around 11% of the size of the stock between 2003 and 2016. For non-financial business lending the new lending share is about 18% (the higher share is explainable by shorter durations of business loans in respect to e.g. mortgage loans, who typically last more than 10 years). These ratios show, that there is a high inertia in the stock. Even though amounts of new lending might fluctuate largely, this might not be translated into stock changes to a large extent, as new lending is only a fraction of the stock amount.

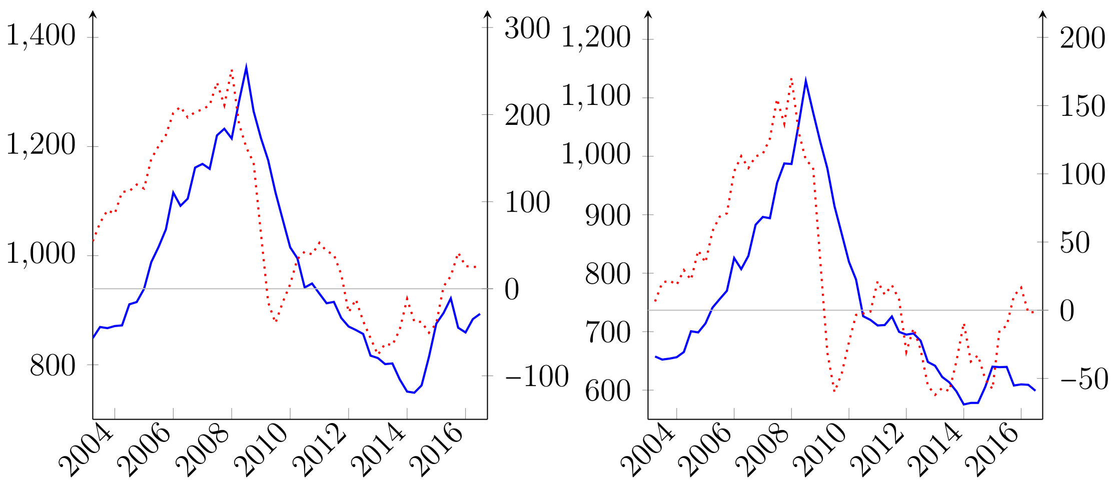
Figure 3.14: Loans for the Euro area



Note: New lending (——, quarterly sum) and the adjusted stock of credit (······) for the Euro area in billion Euro. Source: ECB.

Looking at flow data, quite the same observations as for the US data also applies for the Euro area. While the stock of outstanding credit still exhibited a positive (albeit slower) growth trajectory until the middle of 2009, new lending was already contracting in the end of 2008. As Figure 3.15 (a) shows by comparing the credit stock to total new lending, it becomes apparent that the stock began to fall in the second quarter of 2009, while net new lending already peaked in the third quarter of 2008. With default rates probably coming down again by the end of 2009 (visible by a stop in the growth of the percentage of NPLs (see Figure 3.16)), the growth in the stock of outstanding credit slowly recovered and grew from the first quarter of 2010 on. However, one has to be aware that movements in the NPL-ratio cannot be interpreted cleanly, since e.g. a fall in the NPL-ratio could be the reason because of a reclassification of NPL-loans as performing loans or by complete write-downs of previously non-performing classified loans. But contrary to the growth in the stock, new lending still contracted further. This apparent return to growth visible in the outstanding stock was therefore not due to higher credit creation, but rather due to the high volatility in revaluations and write-offs, as default rates certainly came down after the initial stages of the Financial Crisis.

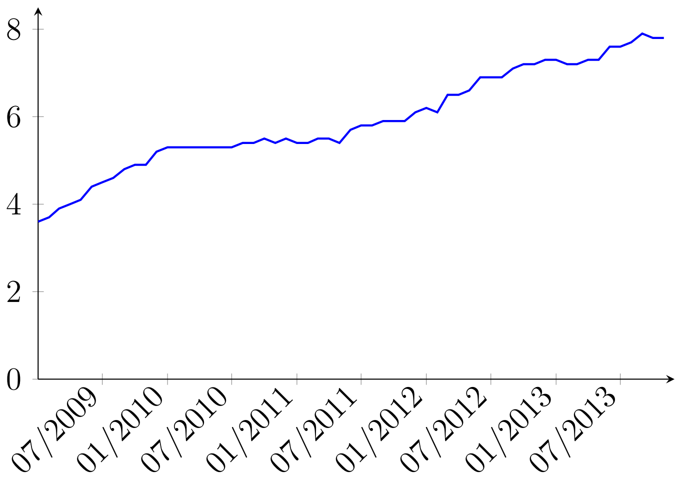
Figure 3.15: Change of loans for the Euro area



(a) Total loans **(b)** Loans to non-financial corporations

Note: New lending (——, quarterly sum, lhs) and the absolute change in the adjusted stock of credit (⋯⋯, rhs) for the Euro area in billion Euro. Source: ECB.

Figure 3.16: Non-performing loans for the Euro area



Note: Non-performing loans in % of total loans. Source: IMF, ECB.

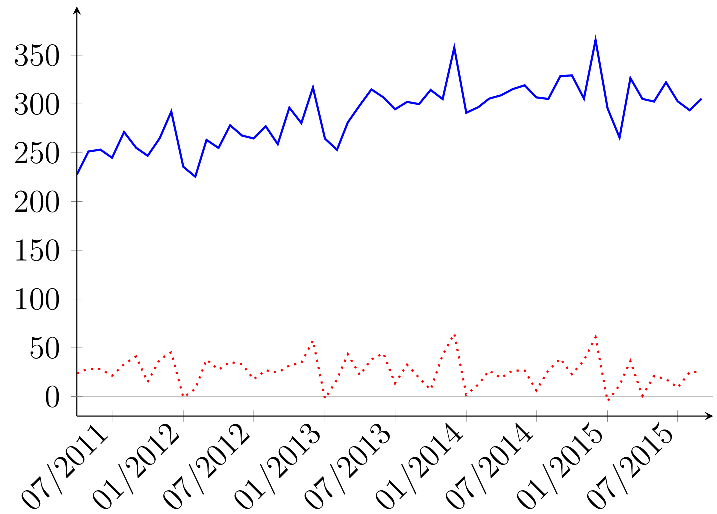
This is also evident while looking at business loans in Figure 3.15 (b). The outstanding stock of credit to non-financial corporations began to fall in the second quarter of 2009, while new lending already reached its peak during the third quarter of 2008. The stock did not fall significantly from the second quarter of 2010 onwards, while new business lending still fell at quarterly rates of between five and ten percent until the end of 2010, and still contracted further afterwards, albeit at a slower pace.

Evidently, the ECB stated that "the annual growth of credit to the private sector gradually strengthened further in the first four months of 2011, albeit remaining moderate. ***The expansion seen in credit*** to the private sector during the first few months of 2011 was driven mainly by MFI loans, with the annual growth rates of both MFI loans to households and MFI loans to non-financial corporations continuing to gradually increase" (ECB (2011b), p. 28-29), and "the annual growth rate of MFI loans to the private sector ... continued its modest upward trend, increasing to 2.6% in April, up from 2.4% in the first quarter of 2011 and 1.7% in the fourth quarter of 2010... Thus, the recovery observed since early 2010 in private sector loan dynamics is continuing, albeit at a gradual pace. ... The annual growth rate of lending to non-financial corporations ***turned positive*** to stand at 0.5% in the first quarter of 2011, up from -0.4% in the fourth quarter of 2010, and reached 1.0% in April." (ECB (2011b), p.31). Thereafter they note that "the annual growth rate of loans to non-financial corporations remained weak in the first four months of the year, but steadily increased further, continuing the gradual recovery observed since the second quarter of 2010. This ***increase in borrowing*** is in line with business cycle regularities and reflects improvements in business confidence and a gradual increase in the annual growth rate of gross fixed capital formation." (ECB (2011b), p.32; highlights by the author). But as shown above, this apparent return to growth was probably just due to a slowdown in the contraction-rate of new lending and lower write-offs and downward-revaluations, and not due to an *increase in borrowing*, as stated by the ECB.

The Banco Central do Brazil (BCB) is one of only a few central banks who compile data on new lending activities for public access, as they publish series on new credit operations in the economy. One can therefore compare the new lending data to the stock data directly (see Figure 3.17). It becomes visible, that the absolute change is significantly smaller than actual new lending, as the other factors in the change of the stock predominantly drag the stock downwards. New lending activity amounts to only about 12% of total outstanding loans.

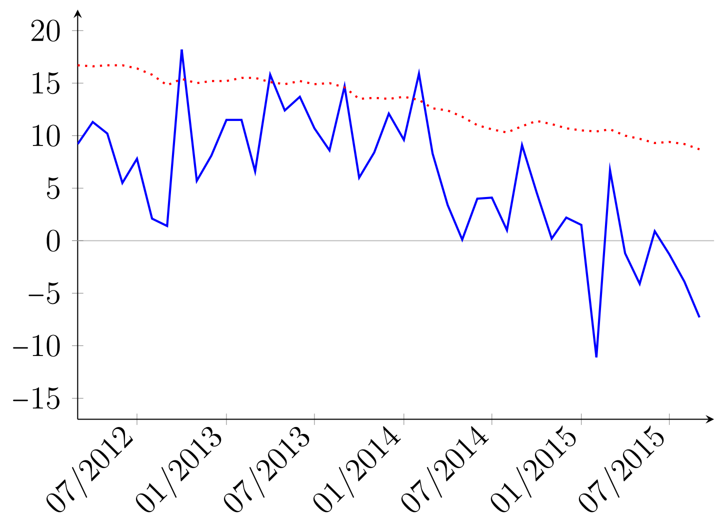
Additionally, while looking at the growth rates in Figure 3.18, it becomes visible that on average new lending basically did not grow anymore since the beginning of 2014. But by looking at the growth in the stock data, one would still see growth rates of over 10%, even though new lending is falling. But as a credit is only slowly repaid, it stays on the balance sheets for a certain amount of time. Therefore, the stock does not contract as much and as fast as it did rise while loans were extended. Furthermore, the correlation between new lending and the absolute change in the stock is also not that high at only 0.35.

Figure 3.17: Change of loans for Brazil



Note: New lending (——) and the absolute change in the outstanding stock of credit (⋯⋯) for Brazil in billion R$. Source: BCB.

Figure 3.18: Yearly loan growth for Brazil

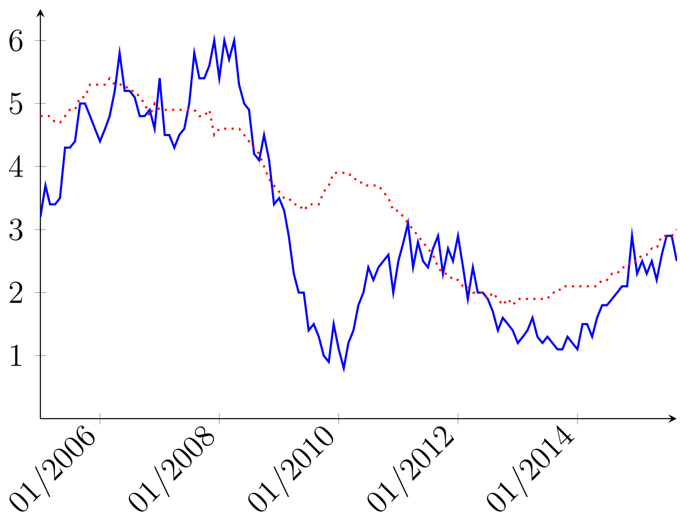


Note: Yearly growth in new lending (——) and the total outstanding stock of credit (⋯⋯) for Brazil in %. Source: BCB.

On the basis of the above observations, it can be argued that premature or delayed movements in the stock data could lead to responses of central banks which are not justified by the underlying fundamentals in new lending activity. This overestimation, among potential other factors, might be a reason why the ECB raised policy rates in the summer of 2011, amid still falling new lending in the Euro area. While giving high emphasis to the second pillar of the mandate, the monetary side, the ECB might have reacted too early with raising rates, and had to unwind this rise later that year. Specifically, they based a part of their decision on a strengthening growth of loans, citing in their Monthly Bulletin of June 2011: "The annual growth rate of MFI loans to the private sector ... [*increased*] to 2.6% in April" (ECB (2011b), p.31; additions by the author). Since this underlying pace of monetary expansion (together with ample liquidity) seemed to have "the potential to accommodate price pressures in the euro area" (ECB (2011a)), they raised their policy rates. But, new lending was still falling in the middle of 2011 with annual rates of about 10%, albeit at a slower pace than before. If the ECB would have looked on the underlying credit creation instead of the change in the stock, it might have come up with a different decision.

The example of Sweden in 2010/2011 might also support this argumentation. The Riksbank had fear of financial instability due to perceived risks of overheating in credit markets, especially in the housing market, because of high and rising growth data in lending. Therefore, they tightened policy to contain inflation and, as noted by the deputy governor Stevan Ingves, to curb the "excessive risks in the financial system" (Riksbank (2010)). While raising the policy rate from 0.25 to 2 percent in less than a year, the Riksbank wanted to bring down the "household credit growth [*which*] was about 9 percent" (Carlstrom (2015); additions by the author). Although this number can be challenged (see Figure 3.19 and also Svensson (2014)), it might nevertheless again be the result of a pick-up in the stock growth due to falling downward revaluations and write-offs after the Global Financial Crisis, and not per-se due to a pick-up in new lending activity.

Figure 3.19: Yearly loan growth for Sweden

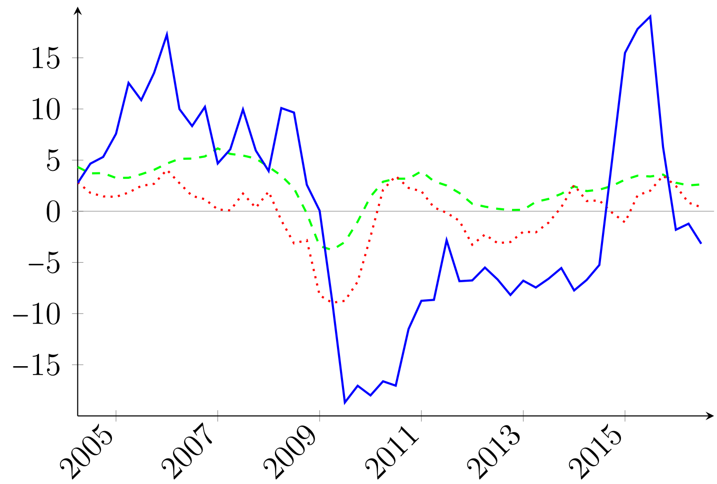


Note: Yearly growth of lans to non-MFI (Total (——) and to households (······)) for Sweden in %. Source: Riksbank.

3.6 Lending and Economic Activity

So far, we have seen how new lending behaves in relation to the outstanding stock. Coming back to the stock-flow discussion of Section 3.2, the application of new lending certainly has an influence on the relation between credit and economic activity. The question now becomes, as to how the other factors are correlated with economic activity, and therefore possibly overestimate the findings of previous studies. Applying the methodology from Biggs et al. (2009), it becomes visible that their credit impulse measure moves generally in line with GDP growth. Figure 3.20 shows the year-on-year growth rates for GDP and new lending, as well as the credit impulse as a percentage of GDP (calculated from the outstanding stock). The credit impulse and GDP growth have a high correlation of 0.85, which would underline the argumentation of the authors. But what can be expected is that the movement in the impulse generally stems from the volatile behaviour of revaluations and write-offs, which certainly have a high correlation with economic activity. This is underlined by the observation that the year-on-year growth in new lending has only a 0.57 correlation with GDP growth, which is still quite high, but not as robust as the correlation while using the stock.

Figure 3.20: Credit impulse for the Euro area



Note: Yearly GDP growth (- - -) in %, the credit impulse for the Euro area calculated from the stock (······), and the change in new lending (——) (as % of GDP). Source: ECB, Eurostat.

By calculating the equivalent of the credit impulse for new lending (using only the absolute difference as a percentage of GDP), the same picture prevails, as there is a correlation of 0.60 with GDP growth (see Figure 3.21 in the Appendix A3 on page 103).[6] Due to the co-movement of the other factors in the stock data with real economic events, one could reach the false impression that (new) lending moves closely in line with economic activity, as predicted by Biggs et al. (2009).

6 The correlation of the new lending and the stock impulse is only 0.45, further highlighting the distortions of the other factors in the change of the stock.

3.7 Conclusion

The analysis in this chapter identifies potential problems for monetary policy conduct when using the outstanding stock of credit while formulating policy decisions. Volatility in the stock does not need to arise from underlying trends in new lending activity, but can merely be a result of other factors, namely revaluations, write-offs, securitisation activity, and maturing loans, which are highly correlated with the state of the economy. As shown above, monetary authorities could formulate decisions which might not be in line with current and future developments in credit markets, if taking the outstanding stock of credit as its measure instead of looking at the underlying trends in new credit creation.

While the standard literature on monetary policy effects on bank lending is mostly looking at the change of the outstanding stock of credit in their empirical parts, the theoretical argumentations in the literature are certainly devised having new lending in mind. But most studies do not follow this thought process rigorously in their empirical sections (see e.g. literature in the line of Bernanke and Blinder (1988)). With a focus on the change in the outstanding stock of credit in almost all empirical studies and communications of central banks, two potential problems are identified in this chapter. First, the outstanding stock of credit incorporates data of maturing loans, revaluations, sell-offs due to securitisation, and write-offs. Second, problems can arise because of a mix-up of stock and flow variables.

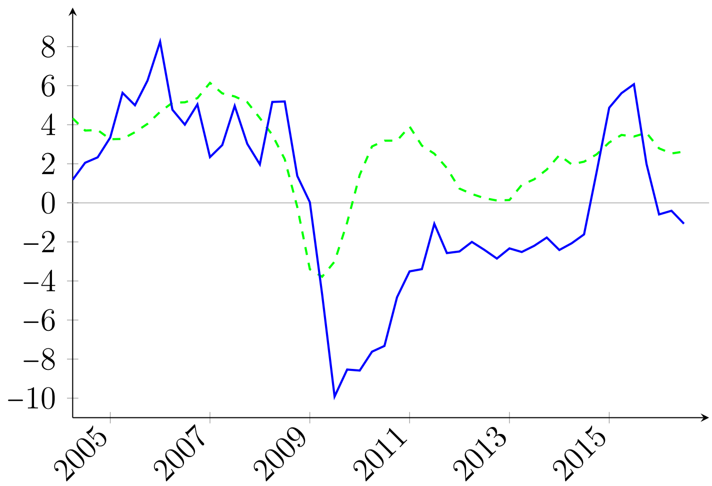
By using the amount of new lending, these two problems can be mitigated, as they do not suffer from distortions of the data due to information which are not in the direct control of central banks, and are therefore less crucial for the impact of monetary policy decisions on current and future lending activity, and their effects on the economy. Deviations arising from the incorporation of these additional factors into the stock data might therefore lead to diverging responses of central banks to monetary developments, which might stand in contrast to the implications of actual new lending activity.

Recent studies (f.e. Jiménez et al. (2014), Abuka et al. (2015), Garcia-Escribano (2013)) try to remedy the above mentioned issues by drawing on data from credit registers of certain central banks. In their micro-level studies about determinants of bank lending they incorporate approved new credit (lines), and try to answer questions about what are the specific determinants of loan extension. But these are generally not applied to macro studies of monetary policy transmission. One problem can be that the use of new lending in macro studies poses to be quite difficult, especially for academics outside of central banks, as most central banks have no publicly available credit register. While some have detailed credit registers, most central banks only publish data on the outstanding amount of credit, with data of the credit registers only available to the central bank's staff, if at all. Although the Federal Reserve publishes survey data on commercial and industrial loans in their STBL, not all loans are incorporated in this framework. Especially, crucial loans on mortgages, which can pose large threads to the economy because of possible over-indebtedness in the private sector, are not collected through this framework. Therefore, only a fraction of total new lending is being reported. In the Euro area data on new business lending in the MIR framework also possesses the same difficulties as the U.S. data, as mentioned before.

This chapter highlights, that it is crucial to assess to which extent new lending is responsible to the change of the outstanding stock of credit and which amount is affected from repayments, revaluations, securitisation activity, and write-offs. The built-up of explicit credit registers is therefore seen as important to formulate thorough analyses about lending and credit developments, and the monetary transmission towards bank lending.

Appendix A3

Figure 3.21: New lending credit impulse for the Euro area



Note: Credit impulse as calculated from new lending in % of GDP (——) and yearly GDP growth (- - -) in % for the Euro area. Source: ECB, Eurostat.

Chapter 4

Determinants of Lending Activity in the Euro Area

Chapter 3 laid out the theoretical argumentation for using data on newly extended loans instead of the outstanding amount of credit (or its change) in empirical estimations assessing the effectiveness of monetary transmission towards bank lending. This chapter applies these insights in a panel model of eight Euro area countries, which estimates determinants for loan extension, by comparing estimations using the outstanding stock of credit and new lending. Thereby, specific determining supply and demand side factors are identified in a simultaneous equation set-up using an instrumental variable approach. This chapter is based on Behrendt (2016a).

4.1 Introduction

Empirical models of determinants of bank lending mostly apply the change in the outstanding stock of credit as the dependent variable. This approach might be prone to inaccuracies. In Chapter 3 it is argued that to understand the transmission of monetary policy shocks and its effects towards bank lending, one should look at the amount of new lending in an economy, rather than the outstanding stock of credit. By taking the credit stock, empirical estimations might be distorted because of the inclusion of other factors in the stock variable, namely repayments, write-offs, securitisation activity and revaluations, over which the central bank has almost no influence. Furthermore, these are in part not attributable to economic developments, but are quite random, although e.g. write-offs and revaluations are highly correlated with the state of the economy. One mentioned example is the length of loan contracts, which has an impact on the speed of repayment and thus on the height of the outstanding stock, which consequently affects its growth trajectory. This chapter tries to take this argumentation to the data and estimate to which extent determinants of bank lending differ in regard to the model set-up.

For this, different empirical models are applied. Estimations using the amount of new lending, proxied by new business volumes from the Monetary Financial Institution Interest Rate (MIR) statistics of the European Central Bank, are compared to estimations applying the outstanding stock of credit. Due to the different behaviour of these two time series, it can be expected that the specific estimation coefficients vary in their significance, magnitude and possibly in sign. This would have important consequences for the conduct of monetary policy, and could lead to a more robust estimation of monetary policy transmission through the credit channel.

In most empirical analyses regarding such a question, the log change in the outstanding amount of credit in an economy is applied as the dependent variable, while mostly modelling AR(1) processes, with various supply and demand side determinants as independent variables. What is found in the literature is that there are certain bank and macro specific variables which determine bank lending in the aggregate. Generally, economic performance and inflation dynamics (past and expected) affect lending positively (Bernanke and Blinder (1988)). These are mainly determining factors for the demand side, while bank specific factors play a crucial role for the supply of bank loans. Kashyap and Stein (2000) and Kishan and Opiela (2000), among others, show that more well capitalised, less leveraged and more liquid banks have a higher lending capacity, and react to tightened monetary policy less severely, by shrinking their lending volumes less drasticly.

Most of these earlier studies rely on single equation estimations to capture the effects on bank lending. While these studies reveal the impacts of different determinants on final bank lending, they cannot show to which extent supply and demand effects affect the market outcome. It would be preferable to apply micro banking data to this problem (like e.g. Jiménez et al. (2014)), but this is not possible for the whole Euro area, since the ECB does not collect data in an European-wide credit register, like for example available in Spain or Italy. Therefore, this chapter has to draw on aggregate data, and model the empirical estimations for the demand and supply side in two different equations using two and three stage least squares set-ups, thereby taking into account the simultaneous behaviour of restrictions to bank lending on both market sides (see e.g. Carpenter et al. (2014)).

What is found in this chapter is that it does indeed make a distinct difference which credit variable is applied, as could be expected by the different behaviour of the change in the outstanding stock of credit in comparison to the underlying movement in new credit extensions. Not only do the magnitudes of the estimated coefficients differ, also significances and even the sign of the coefficients may change. This result has serious implications for the conduct of monetary policy, as central banks might react to changing credit conditions in a different—and maybe not justified—way while looking at the stock data, given the underlying trends in credit creation.

The chapter is structured as follows. Section 4.2 gives an overview of the empirical literature of the bank lending channel, with a special focus on what determines bank lending. The empirical model is then presented in the Section 4.3. The crucial determinants, which are applied in the different specifications, are motivated there. In Section 4.4 the different empirical models are estimated. Thereby, a panel model for eight Euro area countries, to account for the specific country effects, is estimated, to reveal if there are indeed differences using the specific credit variables. To account for certain demand and supply determinants separately, a two equation simultaneous estimation is applied. Section 4.5 concludes the chapter.

4.2 Literature Review

The analysis of monetary policy effects towards bank lending faces two crucial problems. The first refers to how banks are able to insulate their loan portfolio from monetary policy shocks. The main analysis here deals with the question on how banks can adjust their internal funds in a way to not be affected negatively to a changing monetary policy stance. Secondly, from an economical point of view it is quite complicated to disentangle demand from supply side factors in credit markets. The question here is, if a reduction in lending stems from a reduction in loan demand or from a decline in loan supply (see Peek and Rosengreen (2013) for an overview).

Regarding the first issue, evidence of empirical studies on the adjustment process of the loan portfolio of banks towards a monetary policy shock show that monetary tightening leads to a reduction in the asset portfolio through shrinking securities. Only with a delay a reduction in lending sets in (see Bernanke and Blinder (1992)). Although some studies find an increase in lending in the short-run (see e.g. Morgan (1998), Ivashina and Sharfstein (2010)), this can be traced back on the delayed response of the loan portfolio, as the negotiation process of credit extension is generally quite long. Furthermore, lenders could have concerns to access credit in the future, whereby they draw down on loan commitments and previously established lines of credit. But in the longer-run, the decrease in loan supply should outweigh demand reactions.

Banks who can respond to monetary policy tightening by raising non-reservable liabilities are less affected as other banks, and therefore do not shrink their loan portfolio as much (Kashyap et al. (1996)). Kashyap and Stein (2000) show that more liquid banks have easier access to external financing and can thus insulate their loan portfolio with more ease to a monetary tightening. Therefore, less liquid banks and banks with an inferior capital base have to shrink their loan portfolios to a greater extent (see also Kishan and Opiela (2000), Peek and Rosengreen (1995)). Also, smaller banks are less likely to find alternative sources of funding, if not affiliated to a large multibank holding company (see Campello (2002)).

Since it cannot easily be differentiated to which extent the change in the loan portfolio is attributed to supply or demand effects, recent studies try to draw on data on a micro level from detailed credit registers. These panel studies relate bank balance sheet data to other bank and firm specific characteristics. With regard to linking firm characteristics to loan supply, Jiménez et al. (2012b) find that short-term interest rates and loan approvals are negatively correlated, which is more pronounced with weaker bank health, especially in crisis times. Additionally, firm health also plays a restraining role in the supply of credit, as it has stronger effects on lending than bank balance sheet strength in crisis times. Ciccarelli et al. (2015) show that loan supply restraints are more pronounced than demand restraints following a negative monetary shock by using confidential bank surveys for the Euro area and the United States.

While micro level data linking firm to bank characteristics are not available for the whole Euro area, a different methodology of disentangling supply from demand effects is applied in this chapter. As credit supply and demand are determined contemporaneously on one market, a simultaneous equation model using two equations is estimated. Therefore, an instrumental variable approach similar to Carpenter et al. (2014) and Calani et al. (2010) is applied. By using only one equation models (like e.g. Bernanke and Blinder (1988)), it cannot be distinguished to which extent supply and demand factors react to changing economic conditions. Calani et al. (2010) for example are able to show that loan demand is negatively influenced and supply is positively associated with the loan rate, which is in line with conventional theory.

Generally, empirical research finds evidence in the importance of the credit—and especially the bank lending—channel in the transmission of monetary policy. In addition to effects on the liability side through the standard interest rate channel mechanisms, there are significant effects through a restructuring of the asset portfolio of banks in response to a monetary tightening. Moreover, there is empirical evidence that liquidity and capital constrained banks react more severely to monetary policy shocks, as well as the adverse impact on bank dependent borrowers, with a more pronounced effect of supply over demand constraints.

On the demand side, expectations of future returns on investment play a crucial role for the debtor. If these are positive, loans are more likely to be repaid, which leads to higher loan demand. These expectations are formed on the basis of past experiences, which are then updated into the future on the basis of recent data. Therefore economic growth is viable for the demand side decision to request loans (see e.g. Bernanke and Blinder (1988), Maddaloni and Peydro (2011)). Furthermore, inflation dynamics play a role in the credit demand decision, as with c.p. higher inflation debt looses its worth more quickly, therefore loans can be repaid quicker, which would lead to higher loan demand.

One problem with the empirical research, with an exception of recent studies using data from detailed credit registers, is that they still incorporate balance sheet data of loans, and the results are therefore prone to distortions due to the incorporation of factors in the change of the outstanding stock, which are not reflecting the underlying trends in credit extension. Chapter 3 already laid out a detailed analysis of this critique. The following empirical application of data on new lending tries to remedy this deficiency.

4.3 Empirical Model

4.3.1 Methodology

There is one particular issue with using aggregate data on lending, because of which the use of detailed data from explicit credit registers would be preferable. While applying aggregate lending data, only the amount of actual new lending is quantifiable. This final amount is therefore only the result of the minimum of supply and demand decisions on credit markets. But given the question of this chapter, that it shall be shown which are the determinants that influence loan supply and demand, one would have to apply more profound data of the notional plans, and not only on the final, realised amounts. As loan requests that were rejected are not visible in the aggregate credit data, it cannot be seen which market side was the constraining one. Although new lending data of the ECB, as well as data of the outstanding stock of credit, cannot account for this critique, data on credit extensions certainly represents the conditions on credit markets better than data of the outstanding stock of credit in an economy. Additionally, adding survey based data on perceived lending conditions, as done in this chapter, can mitigate this problem partially.

The empirical estimation in this chapter tries to account mainly for the identification issue prevalent in the literature. The bank specific internal adjustment cannot be analysed in this macro setting and is therefore left out.[1] Additionally, the critique of Chapter 3 is taken up again, where it is argued to use data on new lending activity in empirical estimations of determinants of lending activity. The strategy is to estimate the model twice. Once with the new lending variable and a second time with the change in the stock as the dependent variable, respectively, to examine to which extent empirical investigations might differ with a more precise variable for new lending activity. Therefore, a simultaneous equation panel model will be estimated for eight Euro area countries.[2]

Along the lines of recent literature (see e.g. Carpenter et al. (2014), Calani et al. (2010)), supply and demand equations are estimated separately in the panel model, due to the simultaneity of the formation of loan rates, functioning as the price for both supply and demand decisions on lending. Following the literature on bank credit determinants, specific variables, which are important for the supply and demand side, are controlled for, notably macroeconomic determinants, expectations of future economic performance, and financial market and bank specific determinants, like the policy rate, stress indicators, bank balance sheet determinants and survey based data on lending standards of banks (see e.g. Ciccarelli et al. (2015), Everaert et al. (2015), or Maddaloni and Peydro (2011)).[3]

[1] The reader shall be referred to the micro bank level literature like Abuka et al. (2015), Jiménez et al. (2012a), or Jiménez et al. (2014).

[2] The countries are Austria, Belgium, France, Germany, Italy, the Netherlands, Portugal and Spain. The sample had to be restricted to these eight countries because of data availability.

[3] Due to the nature of the aggregate data, this study cannot reveal the specific bank reactions in their loan supply to changing economic conditions, but merely shows a country wide aggregate, which is prone to outliers. Therefore, the estimates shall not be interpreted as a direct reaction function under which condition a specific bank grants a new loan application, but rather be seen as an industry wide response to changing conditions. Nevertheless, valuable information as to which extent market conditions affect bank lending can be drawn from this

4.3.2 Supply Factors

Commercial banks try to maximise their profits while taking into account several constraints, which are specifically funding, liquidity and capital constraints, while simultaneously managing their optimal asset structure given the macroeconomic environment (see Mishkin (2012)). In their supply decision of additional credit, banks have to weigh the revenues of an additional credit against the costs. The loan rate of extended credits is the determining revenue factor for a bank, and will be modelled on the supply side as the revenue factor. Higher loan rates would be expected to lead to higher credit supply, as—if one abstracts from any market frictions—there would be higher margins available, which would result in a better profit outlook.[4]

On the other hand, banks face costs for refinancing, and are subject to capital and reserve requirements. A proxy for the costs of refinancing can be the policy rate, for which banks have to refinance themselves to meet specific requirements. Higher policy rates should suppress loan supply, because of higher costs for refinancing. Additionally, the policy rate can also be seen as a proxy for future economic conditions, respectively expectations about the future path of the policy stance. Upward deviations would lead to expectations about a slower future growth path of the economy, which would also lead to lower credit extension.

Furthermore, bank balance sheet specific determinants are analysed. The literature shows that well capitalised and liquid banks are more likely to extend

method. Moreover, while the incorporation of the specific determinants are motivated by micro level considerations, they are also valid at the aggregate level.

[4] While an individual higher loan rate could also be the result of higher risks of loan extension for the bank, this might not be a big concern in the instrumental variable set-ups, because movements of the loan rate due to higher risk perceptions are removed in the first stage regression by incorporating risk measures.

loans. Therefore, capital ratios and liquidity measures are added to the estimation. Higher values on these should have a positive effect on bank lending. However, identification becomes difficult, since only aggregated data is applied in this study, which is therefore prone to outliers. Additionally, the capital ratio might also cause some problems in this estimation, since during the estimation period the Basel regulations were extended further, requiring banks to hold more capital. The capital ratio might therefore be vulnerable to estimation biases, and higher capital ratios might not directly be attributable to a higher capacity to extend loans. Although this problem might be mitigated while using a broad capital definition as applied here, since the requirements for total capital were already at 8% since the introduction of Basel I in 1992 and were not raised during the observation period.[5] While there is a markedly increase in (especially risk-weighted) capital visible after the Lehman crash in 2008, this is not per se due to the higher capital requirements of the Basel regulations. It is mostly due to market discipline effects and to self interests of the banks, as only the capital ratios with respect to risk weighted—and not total—assets increased after the Financial Crisis (see Brei and Gambacorta (2014)). Anyway, it can be that since during this period bank lending declined, the estimation could potentially show a negative relationship with regard to new lending.

Moreover, banks with higher credit exposure are less likely to extend further loans. Therefore, the loan ratio is added as an additional supply side variable, which should have a negative impact on loan supply. While these arguments mainly stem from micro level analyses, they are generalisable to the aggregate

[5] Nevertheless, it might be appropriate to apply a dummy for the Tier 1 capital requirements, but since the requirements for the Basel I and II were all risk weighted, it is difficult to ascribe a numerical value during the early observation period. Thus it is left out here.

level. A better capitalised and less leveraged banking system would lead to lower risk exposure for the individual institute, and would in general result in a higher capacity to extend loans for a specific bank.

Additionally to the individual banks' risks, market risks also play a determining factor in loan supply decisions. These risks lead to a reduction in loan supply, since average real returns shrink, and it becomes less attractive for banks to extend loans. The market risk is modelled by the Composite Indicator of Systematic Stress (CISS) of the ECB (see Holló et al. (2012) for an overview of this indicator). The general CISS is an aggregation of 15 indicators, which covers risks in 5 markets—money market, bond market, equity market, the foreign exchange market and risks for financial intermediaries. But due to data limitations, only the Sovereign CISS indicator can be used, as the general CISS is only available for the whole Euro area. The Sovereign CISS compiles spreads and volatilities from the short (2 year) and long (10 year) end of the yield curve.

It would be preferable to also incorporate data about the individual balance sheet risk of banks, and thereby applying the ratio of non-performing loans to total loans as an individual's risk variable. Unfortunately, such data is not available for individual Euro area countries and the time-frame considered in this chapter. NPL-ratios are therefore left out in this chapter. However, it can be expected, that the CISS and NPLs are highly correlated, since higher market risk would lead to more loan failures. Therefore, the CISS can also be seen as a noisy proxy for balance sheet risk.

As Lown and Morgan (2006) and Ciccarelli et al. (2015), among others, note, information from survey data can contain valuable information about changes in lending standards of banks. The ECB performs the Bank Lending Survey (BLS), where they ask senior loan officers about changes in their lending practices (see Ciccarelli et al. (2015) for a detailed explanation of the methodology). In this chapter, past developments are of interest. Therefore, backward looking questions for changes in the lending standards are taken. What can be expected is that with tighter lending standards, loan extension decreases, and vice versa.

4.3.3 Demand Factors

The loan rate constitutes the main determining factor on the demand side as well. It represents the cost of lending for borrowers. The decision to demand loans is based on the net return of investments with respect to the interest of loans on the one hand and, once the investment decision is made, on the costs of alternative financing (like bond issuance) on the other. A higher loan rate would suppress loan demand, as lending gets more costly with respect to other forms of financing, and thus becomes more unattractive.

Additionally, macroeconomic conditions need to be incorporated to adequately capture loan demand from the public. Borrowers look at previous economic conditions, from which they draw on expectations about the future. Furthermore, good economic conditions in the past imply that borrowers are more confident to request a loan, as their likelihood to repay a loan is stronger if they have faced better economic positions in the past.

On top of that, expectations about future economic conditions play an important role on credit demand. Better expectations for the future would also lead to more confidence to repay a loan and would therefore strengthen demand. Thus, lagged economic growth and lagged inflation dynamics are modelled as backward-looking variables, while survey data on the expected future path of economic growth and inflation expectations are used as forward-looking indicators. It can be expected that demand responds to all these variables in a positive way.

Information from the BLS are also modelled for the demand equation. Replies to the question of the change in the demand for loans and credit lines at banks are captured here. Higher demand visible at the banks should also translate into higher credit creation, absent supply constraints.

4.3.4 Data

To be in line with the literature, the logarithmic change in the amount of loans extended by MFIs vis-a-vis the Euro area (excluding ESCB) is taken as reference.[6] To account for the critique on the use of the stock variable, data from the MIR statistics of the ECB on new business volumes is applied for new lending. To not over-differentiate, the simple logarithmic change is used, as new lending is a flow variable in itself. To have the estimation technique correspondingly, the second order change in the log of the outstanding amount of bank credit is additionally applied in a further model (see Biggs and Meyer (2013), Huang (2010) for a reasoning on this).

The main independent variable is the loan rate on new business lending, as collected in the MIR framework. The loan rate is a determining factor for both market sides, as it is a revenue factor for the supply and a cost factor for the demand side. Since the loan rate is only collected for different sub-groups, these individual loan rates are multiplied by the proportion of the respective loan category with respect to the whole amount of new business loans.

To account for a varying monetary policy stance, the change in the policy rate is applied on the supply side, to cover the forward looking aspect of banks in their decision to extend loans. For this, the one quarter lagged change in the real EONIA rate, which is the average overnight rate for unsecured interbank lending,

[6] Data definitions, sources and the expected signs can be found in Table 4.5 in the Appendix A4 on page 138, while summary statistics are found in Table 4.6 in the Appendix A4 on page 139.

is used in the model. This is in line with standard macroeconom(etr)ic models (see Ciccarelli et al. (2015) for a reasoning as of why the EONIA rate might be an appropriate variable for the stance of the monetary policy even during the Financial Crisis). A tightening of monetary policy would lead to expectations about slower economic growth, which would then induce banks to cut back on lending. It can thus be expected that the change in the policy rate is negatively correlated with the growth of lending.

For the market risk, the Composite Indicator of Systemic Stress (CISS) of the ECB is taken. The sovereign index is applied in the panel model. In time of economic stress, this index rises. Therefore, the CISS is to be assumed to be related negatively to bank loan supply, as in time of stress it can be expected that credit extension falls due to uncertainty about the future path of the economy and due to possible arising balance sheet stress for banks, which would then depress bank loan supply.

Bank balance sheet specific determinants are added to the supply side equation. The amount of securities and cash to assets is used as a liquidity indicator (see Gambacorta and Marqués-Ibáñez (2011)).[7] It can be expected that higher liquidity in the banking sector leads to higher loan extension. The same applies for better capitalisation in the banking system. To capture bank capitalisation, a capital ratio is calculated, as the ratio of capital and reserves to total bank assets (see Gambacorta and Shin (2016)). As a risk variable for the loan portfolio, the

[7] It can also be argued to model excess reserves additionally to cash and securities, as these are also indicators for liquidity. Especially after the Financial Crisis the ECB used unconventional monetary policies to guarantee enough liquidity for banks by issuing more reserves than necessary for the maintenance of required reserves. Although specific effects of unconventional monetary policies associated with an expansion of the ECB's balance sheet will be analysed in more detail in Chapter 5, additional specifications will be estimated using also excess reserves due to this reasoning here.

outstanding stock of credit in relation to total bank assets is calculated. This loan ratio is expected to have a negative effect on bank lending, as higher leverage in the economy might induce banks to cut back on lending, because of internal balance sheet weakness and because of a possible over-leveraging in the private sector. Contrary, a positive sign may be the result of credit trends reinforcing themselves in the light of good or bad economic conditions.

In the demand equation, past and expected future economic activity is modelled. Annual GDP growth is taken as a proxy for past performance. The majority of other studies use the log difference of economic growth. But since the private sector is mainly focussed on annual growth rates, as being the most visible published source, it is taken here to reflect the decisions of private sector agents better (see also Ciccarelli et al. (2015)). Due to the delayed publication of the quarterly growth data and to account for the duration of the loan application process, GDP growth is modelled with a three quarter lag. This is in line with the literature (see Carpenter et al. (2014)). Additionally, the choice of the lag length is also confirmed by looking at the cross-correlations between GDP growth and new lending growth. For forward looking economic trends, business confidence is modelled. For this, the log change in the Economic Sentiment Index (ESI) is used, which is compiled through a survey undertaken by the European Commission to capture expectations for future economic activity in the private sector (see European Commission (2016)).

Inflation dynamics also play a role in the decision of loan demand. With higher inflation, nominal debt looses its worth more quickly and private sector agents can therefore delever faster. This might induce higher credit demand. For the backward-looking behaviour, the headline inflation rate is applied with a one quarter lag. The same rationale as with GDP growth also applies here. Inflation from the consumer survey of the European Commission are applied for the panel models, because data from the Survey of Professional Forecasters (SPF) is only publicly available for the Euro area as a whole. The European Commission gathers data about the one year ahead price dynamics.

For the survey data on bank lending standards, the changes in the demand for loans are captured in the demand equation (question 4 in the BLS), while taking the change in the credit standards of banks (question 1) for the supply side equation. The demand variable shows the difference between banks reporting an increase and a decrease in loan demand. Therefore, positive values indicate higher demand for loans. On the supply side, the BLS data is calculated as the net percentage of banks answering that they have tightened credit standards minus banks reporting an easing. Positive values therefore show a tightening in credit supply. Thus, for the demand side a positive sign would be expected with regard to loan demand, while a negative sign is expected for the supply side BLS variable.

The variables on the supply side (except for the policy rate) are captured without a lag, since banks have data about their balance sheet strength contemporaneously available while extending loans. However, there might be methodological problems, especially with regard to business loans. As the main question in this chapter is what determines the decision to request or extend a loan, respectively, one would need to apply the prevailing data at the time of the inquiry on the demand side and on the final decision by the bank on the supply side. Micro banking studies looking at applications from detailed credit registers can capture this due to the availability of the specific dates of the request more stringently. With aggregate data, this cannot be modelled specifically. In regard to the supply side, especially for established credit lines to businesses, one does not know when the underlying loan contract between the bank and the private sector agent was finalised. Since it can be that these loans sit idle for months and only get drawn in the future, the underlying economic trends might have changed in the meantime.[8] Additionally, there is a time gap between the application for a loan and the final decision of the bank, as the process often takes some time. These issues cannot be accounted sufficiently in model set-ups using aggregated data. But, by using quarterly data, they can be mitigated to a certain extend.

4.4 Empirical Analysis

4.4.1 Panel Model

Most empirical studies that try to determine factors for bank lending apply single equation autoregressive models with the logarithmic change in the outstanding stock as the dependent variable (see e.g. Bernanke and Blinder (1988), or Garcia-Escribano (2013), among others). In addition to several determining factors, as discussed in the last section, one lagged term is included on the right hand side equation, due to the autoregressive behaviour of the outstanding stock.

In general, interpretation of the results using such a set-up is difficult, since both demand and supply determinants are modelled in one equation, where the specific effects for each market side cannot be analysed sufficiently. This would be especially vital for the interpretation of the coefficient for the lending rate. From a single equation model, it cannot be detected to which extent which market side is impacting the final results. Thus, to account for the simultaneity of credit supply and demand decisions, and for the simultaneous determination of the loan rate, a typical AR(1)-model set-up is not sufficient for a thorough estimation of credit determinants. Thus, a two equation model is analysed for eight Euro area

[8] Using U.S. data, it can be seen that the average length between the date when the terms are set and the date on which the loan is drawn is around 12 months for C&I loans.

countries from 2003Q3 till 2014Q2. Through this, it is possible to isolate supply from demand effects (see Greene (2012), chapter 15). The model is then specified as follows:

Demand Equation:

$$\begin{aligned}\Delta logLoans_{1it} = \; & \beta_0 + \beta_1 \cdot Loan\ Rate_{it} + \beta_3 \cdot Growth_{it-3} + \\ & \beta_4 \cdot Inflation_{it-1} + \beta_5 \cdot Economic\ Expectations_{it} + \\ & \beta_6 \cdot Inflation\ Expectations_{it} + \beta_7 \cdot BLS_{it} + \alpha_{1it} + u_{1it}\end{aligned} \tag{4.1}$$

Supply Equation:

$$\begin{aligned}\Delta logLoans_{2it} = \; & \gamma_0 + \gamma_1 \cdot Loan\ Rate_{it} + \gamma_2 \cdot \Delta rEONIA_{it-1} + \\ & \gamma_3 \cdot CISS_{it} + \gamma_4 \cdot Liquidity_{it} + \gamma_5 \cdot Loan\ Ratio_{it} + \\ & \gamma_6 \cdot Capital\ Ratio_{it} + \gamma_7 \cdot BLS_{it} + \alpha_{2it} + u_{2it}\end{aligned} \tag{4.2}$$

with β_i and γ_i as the to be estimated coefficients, α_{nit} as the country fixed effects and u_{nit} as the error terms.

Due to the simultaneity, an instrumental variable approach is applied using two stage least squares (2SLS), while treating the loan rate as the endogenous variable, and regressing it over the included exogenous variables and the instrumental variables from the equation of the other market side in the first stage, to obtain the fitted value for the loan rate:

First stage regression:

$$\widehat{LoanRate}_{it} = \pi_0 + \pi_1 \cdot Z_{it} + \pi_2 \cdot W_{it} + \upsilon_{it} \tag{4.3}$$

where π_i are the unknown regression coefficients, Z_{it} are the instruments (exogeneous variables from the equation of the other market side), W_{it} are the exogeneous variables from the equation to be estimated and υ_{it} is an error term.

In the second stage, the estimate of the loan rate from the first stage (Equation 4.3) is used as a regressor in each Equation (4.1 and 4.2 respectively) as the instrument, and performing an OLS regression of the specific equation together with the included exogenous variables W_{it} (see Wooldridge (2002), chapter 5). By doing this, the fitted value of the loan rate from the first-stage regression is net of influences from the other supply and demand variables, and reveals the movements of the amount of lending resulting from the simultaneously determined loan rate, and is therefore not correlated with the disturbances anymore.

Furthermore, a simultaneous system model using 3SLS is estimated, with Equation 4.4 as the equilibrium condition (see Greene (2012), chapter 10.6 for a discussion of simultaneous equation models). The logic behind this is that the amount of new lending is representing the quantity and the loan rate the price. The third equation is then equating supply with demand:

$$Credit\ Demand = Credit\ Supply. \tag{4.4}$$

The difference between the two instrumental variable approaches is that 3SLS contains an additional second step, where, after using the fitted values from the first stage (the same as in 2SLS), a consistent estimation for the covariance matrix of the equation disturbances is obtained, because of possible correlation of the disturbances across the two equations, thereby improving the efficiency of the estimator. The third stage then performs a GLS estimation instead of OLS estimation. A second difference is that while applying a 2SLS technique, not all exogeneous variables have to be used to obtain the instrumental values for the endogenous variables in the first stage, in contrast to the 3SLS set-up.

4.4.2 Panel Results for New Lending

The model analysed here is the one with the new lending variable. The results using the outstanding stock are discussed in the next section. The results from the main regressions using new lending are shown in Table 4.1 for the demand side and in Table 4.2 for the supply side.

For each equation several model set-ups are considered. Model (1) in each equation shows a simple panel OLS model without restrictions. In column (2) country-fixed effects (α_{it}) are added. For column (3), time-fixed effects are considered, in addition to the country fixed effects. Columns (4) to (6) depict the results for the 2SLS IV approach, with the respective instrumental variables shown below the table, using country-fixed effects. The approach is to first use all exogenous variables in the first stage, and then to sort out the weak instruments and check for over-identification, until the "final" estimation in (6) is reached. Column (7) depicts the estimation for the 3SLS model.

The results reveal that it is indeed appropriate to use the instrumental variable approach to account for the endogenous behaviour of the loan rate. For both equations the expected signs for the loan rate are obtained, which is not the case for the OLS and the fixed-effects models, as the demand side estimates are positive there.

For the demand side, the loan rate only shows the expected negative signs in the IV specifications, and only being significant in models (6) and (7). Previous economic growth and inflation have a positive, mostly significant impact on lending, as expected.[9] Expectations about future economic trends exhibit no significance in determining lending for the more sparsely instrumented specifications, although

[9] The results are robust even if the month-on-month change or different lags (1 or 2 quarters) for GDP growth are applied.

they still have a positive impact on lending. Inflation expectations on the other hand reveal an ambiguous picture, having small estimates and no significance, except for the 3SLS model. The BLS data is positive and significant at conventional level, except for model (3) with time-fixed effects. Positive values for the BLS demand question stipulate a net increase in demand. Therefore, signs are as expected.

Table 4.1: Demand side new lending models

	(1) OLS	(2) FE	(3) FE	(4) IV	(5) IV	(6) IV	(7) 3SLS
Loan Rate	0.129	0.407	0.763	-0.379	-2.168	-4.062*	-1.286**
	(0.40)	(0.94)	(0.71)	(-0.45)	(-1.61)	(-1.77)	(-2.47)
ΔGDP	0.404**	0.358*	0.390	0.453**	0.671***	0.901**	0.361**
	(2.25)	(1.86)	(1.10)	(2.14)	(2.63)	(2.57)	(3.09)
Inflation	0.638	0.931*	0.530	1.020*	1.221**	1.434**	0.323
	(1.28)	(1.68)	(0.67)	(1.81)	(2.04)	(2.10)	(1.16)
ΔESI	0.225***	0.246***	0.024	0.217**	0.149	0.078	-0.000
	(2.60)	(2.82)	(0.15)	(2.36)	(1.44)	(0.59)	(0.00)
Inflation	0.142	-0.031	0.083	-0.013	0.029	0.073	0.287*
Expectations	(0.63)	(-0.10)	(0.18)	(-0.04)	(0.09)	(0.20)	(2.16)
BLS Demand	0.504**	0.556**	0.430	0.563**	0.580**	0.597**	0.656***
	(2.38)	(2.49)	(1.56)	(2.51)	(2.46)	(2.32)	(3.91)
Constant	-2.529*	-3.637**	-4.079	-0.940	5.200	11.70	3.355*
	(-1.82)	(-2.14)	(-0.77)	(-0.32)	(1.10)	(1.48)	(1.72)
F-Statistic				20.97	14.51	16.80	
Sargan-Hansen				5.442	1.543		
p-Value				0.364	0.462		

t statistics in parentheses; * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$
Instruments:
(4): ΔrEONIA; CISS; Liquidity; Loan Ratio; Capital Ratio; BLS Supply
(5): CISS; Capital Ratio; BLS Supply
(6): CISS
The F-Statistic depicts values for the Sanderson-Windmeijer multivariate F test of weak instruments. Values below 10 would indicate that the applied instruments are weak (see Sanderson and Windmeijer (2016)). The Sargan-Hansen test checks for overidentification. The null hypothesis is that the excluded instruments are valid, which means that they are uncorrelated with the error term. A rejection would cast doubt on the validity of the instruments.

Turning to the supply side, the expected positive sign for the loan rate can be observed. Higher loan rates thus lead to higher credit supply, as profit opportunities for banks might rise. Looking at the IV models, a rise of the loan rate of one percentage point would induce higher loan supply of at least 3.5 percentage points, with higher coefficients than the respective estimates on the demand side. The policy rate also has the expected sign and is significant of at least 10% in almost all IV specifications. Furthermore, the coefficient is also in the range (around -1.5) of other studies which try to find out to which amount a change in the policy rate accounts to a change in lending (see e.g. Gambacorta and Marqués-Ibáñez (2011), Ehrmann et al. (2001)). An increase of the real EONIA rate of one percentage point would therefore lead to a 1.5 percentage point drop in the growth of new lending. The CISS also has the expected sign, with high significance of at least 10% in most IV estimations.

Table 4.2: Supply side new lending models

	(1) OLS	(2) FE	(3) FE	(4) IV	(5) IV	(6) IV	(7) 3SLS
Loan Rate	1.003***	1.030**	1.311	3.536**	3.453**	4.551*	3.469***
	(2.74)	(2.13)	(1.12)	(2.39)	(2.30)	(1.72)	(3.62)
ΔrEONIA	-0.591	-0.598	0.747	-1.554*	-1.522*	-1.941	-1.550***
	(-0.84)	(-0.83)	(0.71)	(-1.70)	(-1.66)	(-1.55)	(-2.98)
CISS	-3.847*	-3.820	-4.039	-8.084**	-7.942**	-9.810*	-3.663***
	(-1.78)	(-1.57)	(-1.18)	(-2.34)	(-2.28)	(-1.92)	(-2.70)
Liquidity	-0.093	-0.092	-0.073	0.165	0.156	0.268	0.059
	(-1.42)	(-0.79)	(-0.45)	(0.88)	(0.83)	(0.92)	(1.41)
Loan Ratio	-0.108**	-0.099	-0.150	-0.107	-0.107	-0.110	-0.182***
	(-2.38)	(-0.67)	(-0.92)	(-0.69)	(-0.69)	(-0.69)	(-4.03)
Capital Ratio	0.305	0.159	0.287	0.531	0.519	0.682	0.591***
	(1.44)	(0.44)	(0.62)	(1.24)	(1.21)	(1.25)	(3.48)
BLS Supply	-0.396*	-0.451*	-0.137	-0.729**	-0.720**	-0.841**	-1.010***
	(-1.72)	(-1.88)	(-0.47)	(-2.49)	(-2.45)	(-2.18)	(-4.09)
Constant	0.960	1.543	0.371	-15.05	-14.50	-21.77	-10.94**
	(0.35)	(0.27)	(0.05)	(-1.37)	(-1.30)	(-1.19)	(-2.94)
F-Statistic				8.66	10.45	13.57	
Sargan-Hansen				4.62	4.55		
p-Value				0.33	0.20		

t statistics in parentheses; * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$
Instruments:
(4): ΔGDP; Inflation; ΔESI; Inflation Expectations; BLS Demand
(5): ΔGDP; Inflation; ΔESI; BLS Demand
(6): BLS Demand
The F-Statistic depicts values for the Sanderson-Windmeijer multivariate F test of weak instruments. Values below 10 would indicate that the applied instruments are weak (see Sanderson and Windmeijer (2016)). The Sargan-Hansen test checks for overidentification. The null hypothesis is that the excluded instruments are valid, which means that they are uncorrelated with the error term. A rejection would cast doubt on the validity of the instruments.

The IV models also support the assumption that higher liquidity in the banking sector contributes positively to higher lending.[10] Higher loan ratios happen to be negatively correlated with lending, but only showing a significant impact in the 3SLS model. The same applies for the capital ratio, although with the expected positive sign. The supply side BLS variable also has the expected negative sign (higher values for the BLS supply variable indicate tighter lending standards) for all models, with high significance of at least 5% in the IV specifications.

Furthermore, it might be suspected that the models are prone to a regime change because of the Financial Crisis after 2008. This is not evident in the data. Although adding a dummy variable for the break in 2008 reveals the expected negative sign, it shows no significant effect on the results of the other variables. The reason may be that the CISS already accounts for most of the impacts of the Financial Crisis.

Additionally, using loans to non-financial corporations as the dependent variable in the new lending set-up does not change the results substantially, except that the loan rate on the demand side becomes less significant in specification (6) and is positive in specification (4) (see Tables 4.8 and 4.9 in the Appendix A4 on pages 141 and 142, respectively). This might be attributable to the more inelastic reaction of business lending towards loan rates, as the main rationale for credit demand lies in the immediacy of the investment decision, and possibly in the long duration between the loan application and the draw down of the credit line. Further, the negative impact of monetary policy through EONIA changes is not visible anymore, as the sign is positive, except for the 3SLS specification. A

[10] Adding excess reserves as an additional liquidity variable does not change the results. The estimation is robust with regard to the other variables, while excess reserves do not add any explanatory power to the estimation, as the coefficients are near zero with low significance.

possible reason might be the argument of Ivashina and Scharfstein (2010), already mentioned in Chapter 3, that in case of a monetary tightening, corporations draw down their pre-existing credit lines in fear of rising rates and/or a credit market cut-off. Additionally, different lags are considered as a further robustness check also for the previously not lagged variables, except the BLS data. Results do not vary significantly. Furthermore, what could also distort these results is the nature of corporate lending. Most short term loans are in the form of bridging loans, which are certainly very inelastic to the different determinants, as the immediacy of paying outstanding bills probably has higher priority and is very random. To eliminate these loans from the estimation would be preferable, but data about such loans is not available. Additionally, business loans can be seen to be more pro-cyclical, which could imply that while loan rates rise because of a rise in the policy rate, the economy is still on a sufficient growth path and economic agents might assume further robust growth, which would support credit extension.

As a preliminary conclusion, it can be assessed that the model with the new lending variable performs quite well, as signs and significances are predominantly in line with conventional theory.

4.4.3 Panel Results using the Stock

Because of the autoregressive behaviour of the stock variable dynamic panel techniques have to be considered, while using the change in the outstanding stock as the dependent variable in the panel set-up. Typically, a generalized method of moments (GMM) type estimation would be applied. Since these only lead to unbiased estimates for panels with a large number of individuals, several estimation techniques are considered here. A lagged term of the loan amount is included in the single differenced stock model, due to the autoregressive behaviour.

As a starting point, simple OLS regressions are considered. First without fixed effects (model (1), labelled OLS, while adding country fixed effects in model (2) (labelled FE) (see Equations 4.5 and 4.6):

Demand Equation:

$$\Delta logLoans_{1it} = \beta_1 \cdot \Delta logLoans_{1it-1} + \beta_2 \cdot X_{1it} + \alpha_{1i} + u_{1it} \tag{4.5}$$

Supply Equation:

$$\Delta logLoans_{2it} = \gamma_1 \cdot \Delta logLoans_{2it-1} + \gamma_2 \cdot X_{2it} + \alpha_{2i} + u_{2it} \tag{4.6}$$

with X_{nit} being a matrix containing the independent variables, α_{ni} as the country fixed effect, and u_{nit} again as an error term.

Additionally, due to the simultaneity of the determination of the loan rate, the fixed effects model is also extended using an instrumental variable setting. This is done similar to the new lending panel model in model (3) (labelled FEIV). The approach is the same as for the 2SLS models for new lending, with the loan rate as the endogenous variable, while using the exogenous variables from the other equation as instruments together with the exogenous variables of the same equation in the first stage.

Because of the lagged credit stock variable on the right-hand-side of the equation, OLS estimates can become inconsistent because of the correlation between the individual country effects and the lagged dependent variable. These should diminish with a higher panel length, but can nevertheless still be significant. The disturbances from country fixed effects can be eliminated using least square dummy variable estimates, but this estimation suffers from the small sample size (see Baltagi (2008)).

Due to this, dynamic panel techniques using GMM-type estimations are applied, to account for most of the shortcomings from the OLS estimations. However, they are designed for panels with many individuals, and therefore might still suffer from small-sample bias (see Judson and Owen (1999)). Nevertheless, two models using GMM estimation are considered here. First an Arrelano-Bond (AB) estimator is applied in model (4) (see Arellano and Bond (1991)). The first-differenced equation for this is given in Equation 4.7 in a generalised form:

$$\Delta Y_{it} = \beta_1 \cdot \Delta Y_{it-1} + \beta_2 \cdot \Delta X_{it} + \Delta u_{it} \tag{4.7}$$

with ΔY_{it} as $\Delta logLoans_{it} - \Delta logLoans_{it-1}$.

Through first differencing, the constant country fixed-effect (α) disappears. For the estimation, a GMM estimator with lagged-levels of the dependent and endogenous variables, and first-differences of the exogenous variables in the levels equation have to be applied as instruments, because OLS would be inconsistent otherwise due to the correlation between ΔY_{it} and Δu_{it}. The differenced dependent variable in the levels equation is then not correlated with the error term anymore, and can thus be used as an instrument.

But if the autoregressive process is too persistent, the lagged-levels instruments become weak. Therefore, a second GMM model (5) is estimated, using the modified Blundell-Bond (BB) GMM estimator. Here, a system GMM estimator with lagged first-differenced instruments of the dependent and endogenous variables in the levels equation in addition to the previously used lagged-levels instruments in the first-differenced equation is used (see Blundell and Bond (1998)). Both GMM models apply the same instrument set as the FEIV estimation.

To reduce the small sample bias, Kiviet (1999) proposes a least square dummy vector corrected (LSDVC) estimator (model (6)), which performs better in terms of the bias for models with a small number of individuals, than the GMM estimators for strictly exogenous regressors. For this estimation, the Anderson-Hsiao (see Anderson and Hsiao (1981)) estimator (AH) is applied to initialize the bias correction. This AH estimator lagges the dependent variable twice and uses it as an instrument for the first-differenced model with no intercept. Unfortunately, this estimation is not able to implement endogenous variables as instruments, which is a major drawback for the use in simultaneous model set-ups.

Although Monte Carlo tests reveal the most efficacy and accuracy for the LS-DVC estimation regarding the lagged dependent variable and exogenous regressors (see Kiviet (1995), Judson and Owen (1999), Bruno (2005)), it does not account for the simultaneity of the estimation of the loan rate. Flannery and Watson Hankins (2013) account for endogenous variables in such simulations, and reveal that some set-ups indeed exhibit significant errors. They show that fixed effects models have low errors for the endogenous variables, but not for the lagged dependent variable. On the contrary, the BB model is reliable regarding the endogenous and the lagged dependent variables. Due to the different drawbacks of each model for estimations with a small population, all six models are estimated and analysed (Table 4.7 in the Appendix A4 on page 140 depicts the specific drawbacks of each estimation more clearly). Arrelano-Bond tests for autocorrelation reveal a first-order autocorrelation structure throughout the GMM and LSDVC models, as expected. Tables 4.3 and 4.4 show the results for the stock estimations for the demand and supply equations, respectively.

The same variable set-up as in Equations 4.1 and 4.2 apply also for the stock model, with the added one period lagged credit variable on the right hand side of the equation. All instrumental variable approaches applied in the different stock models (FEIV, AB, BB) only use the smallest set of instruments, as in model (6) for the new lending variable, resulting in the use of the CISS for the demand side equation and the BLS Demand variable for the supply side equation. Results do not change significantly while applying different and/or more instruments, and are therefore omitted here.

Table 4.3: Demand side stock models

	(1) OLS	(2) FE	(3) FEIV	(4) AB	(5) BB	(6) LSDVC
Δ $Stock_{t-1}$	0.687***	0.652***	0.682***	0.653***	0.623***	0.688***
	(17.37)	(15.60)	(11.48)	(15.16)	(17.86)	(16.24)
Loan Rate	-0.009	-0.051	-1.265***	-0.051	-0.077	-0.082
	(-0.19)	(-0.74)	(-3.22)	(-0.73)	(-1.44)	(-0.99)
ΔGDP	0.172***	0.194***	0.327***	0.193***	0.204***	0.190***
	(5.20)	(5.49)	(5.05)	(5.31)	(6.91)	(4.96)
Inflation	-0.008	-0.035	0.111	-0.036	-0.014	-0.0228
	(-0.10)	(-0.40)	(0.85)	(-0.40)	(-0.19)	(-0.24)
ΔESI	0.052***	0.052***	0.005	0.051***	0.055***	0.052***
	(3.80)	(3.75)	(0.19)	(3.61)	(4.61)	(3.71)
Inflation Expectations	-0.005	0.030	0.057	0.032	0.049	0.037
	(-0.13)	(0.62)	(0.83)	(0.62)	(1.22)	(0.70)
BLS Demand	0.069**	0.077**	0.086*	0.077**	0.090***	0.076*
	(2.01)	(2.11)	(1.69)	(2.06)	(2.79)	(1.91)
Constant	0.021	0.155	4.305***	0.158	0.206	
	(0.10)	(0.58)	(3.18)	(0.58)	(0.97)	
Observations	344	344	344	336	344	344
Hansen test of over-identification (p-value)				0.686	0.214	0.533

t statistics in parentheses; * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$
Instruments in (3), (4), and (5): CISS
20 repetitions are used for the calculation of the bootstrapped variance-covariance matrix in model (6).

It is apparent that the results differ considerably with respect to the results for the new lending models. Especially for the Blundell-Bond model (5), which is deemed to be the most accurate regarding the endogenous variable, the loan rate estimate differs quite substantially. The significant impact of the loan rate, as seen in the new lending estimations, vanishes in the stock models, except for the FEIV model, which might perform with a low error in regard to the endogenous variable (see Flannery and Watson Hankins (2013)). Also, the negative impact of monetary policy decisions cannot be seen in the stock models, except for the FEIV model, but without being significant. This result might emerge because of the high inheritance in the stock, as new lending comprises only a fraction of the outstanding stock (see again Chapter 3).

Table 4.4: Supply side stock models

	(1) OLS	(2) FE	(3) FEIV	(4) AB	(5) BB	(6) LSDVC
Δ $Stock_{t-1}$	0.733***	0.607***	0.528***	0.607***	0.644***	0.638***
	(20.21)	(13.90)	(7.56)	(13.82)	(18.47)	(13.51)
Loan Rate	0.068	0.033	1.193**	0.032	-0.001	0.024
	(1.13)	(0.44)	(2.04)	(0.42)	(-0.02)	(0.26)
ΔrEONIA	0.072	0.114	-0.321	0.117	0.094	0.112
	(0.64)	(1.03)	(-1.23)	(1.05)	(1.03)	(0.75)
CISS	-1.325***	-1.181***	-3.247***	-1.186***	-0.884***	-1.137**
	(-3.73)	(-3.12)	(-2.85)	(-3.09)	(-2.66)	(-2.00)
Liquidity	-0.011	-0.021	0.092	-0.020	-0.048***	-0.012
	(-0.99)	(-1.10)	(1.51)	(-1.04)	(-3.24)	(-0.48)
Loan Ratio	-0.000	-0.060**	-0.074**	-0.061**	-0.009	-0.060*
	(-0.01)	(-2.51)	(-2.28)	(-2.49)	(-0.72)	(-1.91)
Capital Ratio	0.012	-0.158***	-0.026	-0.160***	-0.061	-0.174*
	(0.34)	(-2.69)	(-0.26)	(-2.67)	(-1.35)	(-1.78)
BLS Supply	-0.024	-0.031	-0.154**	-0.030	-0.028	-0.032
	(-0.67)	(-0.84)	(-1.97)	(-0.81)	(-0.85)	(-0.62)
Constant	0.468	4.139***	-2.686	4.174***	2.357***	
	(1.06)	(4.11)	(-0.74)	(4.09)	(3.95)	
Observations	344	344	344	336	344	344
Hansen test of over-identification (p-value)				0.495	0.038	0.554

t statistics in parentheses; * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$
Instruments in (3), (4), and (5): BLS Demand
20 repetitions are used for the calculation of the bootstrapped variance-covariance matrix in model (6).

Additionally, the capital ratio and liquidity estimates are negative in the stock model for almost all specifications, which is not the case for the new lending models, and is hardly explainable by theory. Furthermore, the supply side BLS indicator becomes insignificant, although still exhibiting a negative sign. This might be due to the high inheritance of the stock, as changes in credit standards do not show up immediately to a large extend in the change of the stock. Although the sign and significance for the BLS demand question is still as expected, the magnitude is exceedingly smaller.

Further, it is also evident that the economic sentiment is far more significant for the stock variable than for the richer models using the new lending variable. The stock is to a large extend driven by other factors, in this case especially revaluations and write-downs, which fluctuate highly with economic activity and future economic expectations. As a consequence, the stock variable might not be optimal for analysing models which try to depict the rationale for loan extension. This seems to underline the argumentation from Chapter 3.

The stock model is also estimated with the second differenced outstanding stock variable (see Tables 4.10 and 4.11 in the Appendix A4 on pages 143 and 144). Due to the stationarity of the variable, the same model set-ups as for the new lending variable are applied, with the respective instruments depicted below the table. What is apparent is that the models using the second differenced stock perform notably worse in regard to the underlying theory. Coefficients for the loan rate are negative in both equations, being even significant at the 5% level for the supply side IV models (5) and (6). The demand side variables (except inflation in the models (1), (2), (3) and (4)) are positive, albeit mostly insignificant (except GDP growth for models (5) and (6) at the 10% level). Expectations about the future path of economic growth are only significant in models (1), (2), (3) and (4). On the supply side, all other variables are insignificant, except the policy rate, which is positive throughout and significant at least at the 10% level in models (5) and (6), and the liquidity measure, which is negative throughout and significant at least at the 10% level in models (5) and (6). For the IV models, the capital ratio also has a negative sign, while the BLS supply variable turns positive. The estimations also do not improve by taking other variables as instruments.

The second differenced stock model does not only perform poorly from the point of view that many estimates have signs which are not in accord to theory, it has furthermore little explanatory power. This observation gives more validation to the observation that the stock, especially here the change in the growth trajectory, is not suited to estimate determinants for new lending behaviour. This may be due to the reason that the other factors comprising the change in the stock hide valuable information about the underlying trends in credit extensions.

4.5 Conclusion

This chapter takes the observations presented in Chapter 3 to the numbers. There, the observed differences between the behaviour of the outstanding stock of credit and data for new loans gave rise to the hypothesis that empirical estimations of credit determinants might differ. As the question of this chapter was to find out which variables determine loan extension to what extent, the conjecture from the observation of the stylised facts could be affirmed in the empirical part here.

Applying standard techniques using the change in the outstanding stock of loans as the dependent credit variable, past research found several determining factors to be important for credit extension. However, these estimations might be imprecise, given that the effect from the change in the outstanding stock may be distorted by repayments, write-downs, revaluations and securitisation. Therefore, a more thorough picture about what determines credit extension by applying data on new lending is given here.

For this, a comparison of empirical estimations using the outstanding stock on one hand and on the application of the new lending variable on the other is carried out. Although the estimations with the new lending estimate from the ECB MIR statistics suffer from a few shortcomings, they might give better insights into the factors influencing loan extensions.

Due to the simultaneous determination of the loan rate on both the supply and the demand side, single equation set-ups, as deemed reasonable in previous studies, seem not appropriate for such an estimation. Therefore, a simultaneous two equation panel model for eight Euro area countries is estimated, using an instrumental variables approach. For the stock variable, dynamic panel techniques are considered as well.

While the models for the new lending variable mainly reflect estimates according to theory, the regressions for the stock reveal ambiguous results for some variables. What is especially striking is that the loan rate, which is seen as one of the major determining factors, has no significant impact on lending in the stock models (except for the fixed effects model using instrumental variables), while it is highly significant in the new lending models, especially for the supply side.

These differences in the estimations might have vast implications for monetary policy. If the central bank wants to react to certain economic events to anticipate future credit market trends in a way which is based on the estimations of a stock model, it might react differently to these, than if it would base its policy on the estimates of a model using new lending. Reactions by the central bank could therefore become inaccurate.

If for example the economic outlook is getting better, the central bank might be inclined to tighten it's policy in an anticipation of higher inflation as a consequence of higher credit extensions. But since the stock is highly correlated with economic activity due to revaluations and write-downs, which are by itself highly dependent on the performance of the economy, credit trends might be overstated. In such a case, new lending might not react as vividly to the better economic outlook as the stock. This then overstates the effects on future economic activity, as upward revaluations in the stock should have a negligible impact on future economic activity.[11]

This overestimation, among potential other factors, might be a reason why the ECB raised policy rates in the summer of 2011 amid still falling new lending data in the Euro area. While giving high emphasis to the second pillar of the mandate, the monetary side, the ECB might have reacted too early with raising

[11] Clearly, the resulting better bank health would exert a positive impact on the ability to extend new loans, but there is no direct impact on real economic activity due to this, especially not in the magnitude as postulated by the rise in the stock.

rates, and had to unwind this rise later that year. Specifically, they based a part of their decision on a strengthening growth of loans, since this underlying pace of monetary expansion (together with ample liquidity) seemed to have "the potential to accommodate price pressures in the euro area" (ECB (2011a)). As Chapter 3 showed, new lending was still falling in the middle of 2011, albeit at a slower pace than before, and the growth of the stock was mainly due to the influences of higher upward revaluations and falling write-downs after the initial stages of the Financial Crisis.

The other important implication of the results is the feed-through of changes in the policy rate towards lending. While certain estimations show a negative effect of the change in the real policy rate of between -1% and -2% (see e.g. Gambacorta and Marqués-Ibáñez (2011)), the estimation here does not find any evidence to underpin this using stock data. Surprisingly, the coefficients for the policy rate in the new lending models are in the expected vicinity of those from other studies.

Additionally, the magnitudes of most coefficients are exceedingly smaller in the stock model, than in the new lending model. While this is expected because of the high inertia due to the incorporation of previously extended loans in the outstanding stock data, it can certainly affect monetary policy decisions. As shown in the estimation results, higher GDP growth of 1% would lead to an increase of new lending of around 0.4% and 0.9%, while the growth of the stock would only accelerate by around 0.2%. These two estimates probably have different feedback effects to real economic activity, and therefore to inflation dynamics. Other determinants are also suffering from this problem, as magnitudes, significances and even signs differ for certain variables.

This does not mean that the conduct of policy should change, but only that the rationale on which monetary policy decisions are based while looking at credit developments should be revised, as different determining factors are deemed crucial for credit developments while looking at new lending, rather than by only analysing stock data.

This chapter thus highlights the importance of the choice of the credit variable in empirical estimations of determinants for bank lending. Previous studies using the outstanding stock may have under- or overestimated the impact of certain variables for credit extension, due to the disturbing factors inherent in the stock.

Appendix A4

Table 4.5: Data definitions and sources

Variable	Description	Calculation Method	Exp. Sign	Source
New Lending	Loans to households and non-financial coorporations - bank new business volumes (MIR framework)	mom log change		ECB
ΔStock	Loans vis-a-vis euro area MFI excluding ESCB - outstanding amounts	mom log change		ECB
ΔΔStock	Loans vis-a-vis euro area MFI excluding ESCB - outstanding amounts	change of the mom log change		ECB
Loan Rate	Bank interest rates for new business loans (MIR) (annual agreed rate)	weighted average of the loan rate in relation to the amount of new business loans for each category	-/+	ECB
ΔGDP	Gross domestic product in mill. Euro	yoy change	+	Eurostat
Inflation	Harmonised index of consumer prices (overall index)	yoy change	+	ECB
ΔESI	Economic Sentiment Index	mom change	+	European Commission
Inflation Expectations	Price trends over next 12 months (Consumer Survey question)		+	European Commission
ΔrEONIA	change in the real EONIA rate	Inflation rate as reference value	-	ECB
CISS	Sovereign Systemic Stress Composite Indicator		-	ECB
Liquidity	Securities and cash in relation to total assets of MFIs		+	ECB
Loan Ratio	Outstanding amount of loans in relation to total assets of MFIs		-	ECB
Capital Ratio	Capital and reserves in relation to total assets of MFIs		+	ECB
BLS Demand	Bank Lending Survey question 4: change in demand for loans to enterprises - backward looking 3 months - Diffusion index		+	ECB
BLS Supply	Bank Lending Survey question 1: change in credit standards to enterprises - backward looking 3 months - Diffusion index		-	ECB

Table 4.6: Summary statistics for the panel model

Variable	Obs.	Mean	Std. Dev.	Min.	Max.
New Lending	352	-0.265	6.336	-21.952	19.161
ΔStock	352	0.905	1.721	-4.889	7.262
ΔΔStock	352	-0.034	1.048	-4.034	6.319
Loan Rate	352	3.855	1.11	1.93	6.958
ΔGDP	352	1.872	2.305	-5.764	6.156
Inflation	352	1.504	0.87	-1.573	4.404
ΔESI	352	0.205	4.911	-20.027	14.086
Inflation Expectations	352	1.703	1.642	-2.84	6.213
ΔrEONIA	352	-0.028	0.484	-1.727	1.34
CISS	352	0.235	0.227	0.011	0.96
Liquidity	352	23.086	6.438	12.737	38.316
Loan Ratio	352	34.711	10.744	18.305	60.264
Capital Ratio	352	6.637	2.055	3.435	13.829
BLS Demand	352	-0.476	1.658	-6.3	3.6
BLS Supply	352	0.820	1.793	-2.5	8

Table 4.7: Overview of the stock models

Model	**Explanation**	**Drawback**
(1) OLS	Ordinary Least Sqares Estimation	Upward bias for the coefficient of the lagged dependent variable due to the unobserved heterogeneity + only exogenous variables
(2) FE	Country fixed effects estimation	Downward bias for the coefficient of the lagged dependent variable due to the correlation between the lagged dependent variable and the error term + only exogenous variables
(3) FEIV	Country fixed effects estimation using instrumental variables	Downward bias for the coefficient of the lagged dependent variable due to the correlation between the lagged dependent variable and the error term
(4) ABIV	Arrelano-Bond GMM estimation using instrumental variables	small sample bias
(5) BBIV	Blundell-Bond GMM estimation using instrumental variables	small sample bias
(6) LSDVC	Least Squares Dummy Variable Correction	only exogenous variables

Table 4.8: Demand side new lending models for corporate loans

	(1) OLS	(2) FE	(3) FE	(4) IV	(5) IV	(6) IV	(7) 3SLS
Loan Rate	0.340	0.718	0.708	0.722	-0.680	-2.743	-0.506
	(0.94)	(1.44)	(0.51)	(0.78)	(-0.49)	(-1.28)	(-0.93)
ΔGDP	0.369*	0.291	0.315	0.317	0.483	0.765**	0.408***
	(1.67)	(1.22)	(0.71)	(1.21)	(1.61)	(2.00)	(2.95)
Inflation	1.040*	1.144*	0.547	1.136	1.293*	1.514**	0.391
	(1.69)	(1.68)	(0.56)	(1.63)	(1.84)	(1.99)	(1.29)
ΔESI	0.207*	0.229**	-0.0833	0.238**	0.169	0.0794	0.0109
	(1.95)	(2.13)	(-0.42)	(2.09)	(1.38)	(0.54)	(0.21)
Inflation	0.302	0.281	0.452	0.220	0.320	0.378	0.300**
Expectations	(1.10)	(0.74)	(0.82)	(0.57)	(0.83)	(0.92)	(2.08)
BLS Demand	0.537**	0.577**	0.375	0.559**	0.621**	0.686**	0.732***
	(2.06)	(2.09)	(1.11)	(1.98)	(2.20)	(2.27)	(3.67)
Constant	-4.163***	-5.485***	-6.735	-5.380*	-1.059	5.469	-0.0686
	(-2.74)	(-2.93)	(-1.05)	(-1.75)	(-0.23)	(0.80)	(-0.04)
F-Statistic				22.82	16.85	22.19	
Sargan-Hansen				4.15	1.99		
p-Value				0.53	0.37		

t statistics in parentheses; * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$
Instruments:
(4): ΔrEONIA; CISS; Liquidity; Loan Ratio; Capital Ratio; BLS Supply
(5): CISS; Loan Ratio; BLS Supply
(6): CISS

Table 4.9: Supply side new lending models for corporate loans

	(1) OLS	(2) FE	(3) FE	(4) IV	(5) IV	(6) IV	(7) 3SLS
Loan Rate	1.066**	1.096**	1.367	2.895**	2.550*	2.704	3.855***
	(2.55)	(1.97)	(0.83)	(1.98)	(1.69)	(1.44)	(4.02)
ΔrEONIA	1.131	1.145	1.028	0.447	0.581	0.521	-1.635***
	(1.30)	(1.29)	(0.79)	(0.43)	(0.55)	(0.46)	(-2.83)
CISS	-3.186	-3.307	-4.495	-6.896*	-6.209	-6.514	-4.279***
	(-1.17)	(-1.08)	(-1.01)	(-1.68)	(-1.49)	(-1.38)	(-2.62)
Liquidity	-0.103	-0.147	-0.0755	0.0819	0.0380	0.0575	0.0746
	(-1.25)	(-0.98)	(-0.36)	(0.36)	(0.16)	(0.21)	(1.58)
Loan Ratio	-0.132**	-0.0121	-0.0652	-0.0206	-0.0190	-0.0197	-0.175***
	(-2.33)	(-0.06)	(-0.31)	(-0.11)	(-0.10)	(-0.10)	(-3.65)
Capital Ratio	0.336	0.124	0.326	0.328	0.289	0.306	0.423***
	(1.28)	(0.28)	(0.56)	(0.68)	(0.60)	(0.62)	(2.70)
BLS Supply	-0.0941	-0.150	0.201	-0.349	-0.311	-0.328	-1.012***
	(-0.33)	(-0.50)	(0.55)	(-1.03)	(-0.92)	(-0.91)	(-3.67)
Constant	1.422	-0.336	-0.521	-12.19	-9.915	-10.92	-10.93***
	(0.44)	(-0.05)	(-0.05)	(-1.07)	(-0.85)	(-0.79)	(-3.23)
F-Statistic				11.46	13.13	16.14	
Sargan-Hansen				7.854	7.222	2.758	
p-Value				0.0971	0.0652	0.0968	

t statistics in parentheses; * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$
Instruments:
(4): ΔGDP; Inflation; ΔESI; Inflation Expectations; BLS Demand
(5): ΔGDP; Inflation; ΔESI; BLS Demand
(6): ΔESI; BLS Demand

Table 4.10: Demand side ΔΔ stock models

	(1) OLS	(2) FE	(3) FE	(4) IV	(5) IV	(6) IV	(7) 3SLS
Loan Rate	-0.047	-0.074	0.003	-0.126	-0.341	-0.492	-0.202**
	(-0.87)	(-1.01)	(0.02)	(-0.98)	(-1.54)	(-1.39)	(-2.43)
ΔGDP	0.032	0.039	0.050	0.046	0.072*	0.090*	0.011
	(1.06)	(1.21)	(0.82)	(1.30)	(1.72)	(1.67)	(0.93)
Inflation	-0.047	-0.042	0.005	-0.037	-0.012	0.005	0.007
	(-0.56)	(-0.45)	(0.03)	(-0.39)	(-0.13)	(0.04)	(0.38)
ΔESI	0.041***	0.041***	0.032	0.039**	0.031*	0.025	-0.000
	(2.83)	(2.78)	(1.17)	(2.55)	(1.82)	(1.25)	(-0.04)
Inflation	0.020	0.020	0.024	0.021	0.026	0.030	0.010
Expectations	(0.52)	(0.39)	(0.31)	(0.41)	(0.49)	(0.54)	(0.79)
BLS Demand	0.017	0.014	0.032	0.014	0.016	0.018	0.023
	(0.49)	(0.36)	(0.69)	(0.37)	(0.42)	(0.44)	(0.95)
Constant	0.125	0.207	-0.238	0.384	1.123	1.640	0.706**
	(0.54)	(0.72)	(-0.27)	(0.83)	(1.45)	(1.34)	(2.28)
F-Statistic				32.32	14.51	16.80	
Sargan-Hansen				1.971	0.347		
p-Value				0.7410	0.8407		

t statistics in parentheses; * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$
Instruments:
(4): ΔrEONIA; CISS; Liquidity; Loan Ratio; Capital Ratio; BLS Supply
(5): CISS; Loan Ratio; BLS Supply
(6): CISS

Table 4.11: Supply side ΔΔ stock models

	(1) OLS	(2) FE	(3) FE	(4) IV	(5) IV	(6) IV	(7) 3SLS
Loan Rate	-0.049	-0.102	-0.042	-0.230	-0.455**	-0.658**	-0.043
	(-0.80)	(-1.26)	(-0.21)	(-1.32)	(-2.02)	(-2.36)	(-0.28)
ΔrEONIA	0.097	0.111	0.365**	0.160	0.248*	0.326**	-0.050
	(0.81)	(0.91)	(2.05)	(1.18)	(1.66)	(1.97)	(-0.84)
CISS	-0.537*	-0.499	-0.648	-0.383	-0.178	0.006	-0.121
	(-1.72)	(-1.39)	(-1.13)	(-0.99)	(-0.43)	(0.01)	(-0.94)
Liquidity	-0.005	-0.019	0.030	-0.034	-0.061*	-0.084**	0.002
	(-0.36)	(-0.81)	(1.10)	(-1.15)	(-1.76)	(-2.11)	(0.71)
Loan Ratio	0.001	0.003	-0.006	-0.002	-0.009	-0.015	-0.006
	(0.19)	(0.11)	(-0.24)	(-0.06)	(-0.35)	(-0.57)	(-0.89)
Capital Ratio	0.015	0.014	0.057	-0.011	-0.056	-0.095	0.020
	(0.42)	(0.23)	(0.73)	(-0.17)	(-0.75)	(-1.16)	(0.90)
BLS Supply	-0.043	-0.042	-0.032	-0.023	0.012	0.043	-0.035
	(-1.13)	(-1.04)	(-0.66)	(-0.48)	(0.22)	(0.72)	(-0.95)
Constant	0.214	0.496	-0.511	1.384	2.951*	4.356**	0.206
	(0.59)	(0.50)	(-0.38)	(0.94)	(1.66)	(2.05)	(0.39)
F-Statistic				21.61	25.60	30.37	
Sargan-Hansen				4.961	4.046	1.101	
p-Value				0.291	0.257	0.294	

t statistics in parentheses; * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$
Instruments:
(4): ΔGDP; Inflation; ΔESI; Inflation Expectations; BLS Demand
(5): ΔGDP; Inflation; ΔESI; BLS Demand
(6): ΔESI; BLS Demand

Chapter 5

Unconventional Monetary Policy Effects on Bank Lending

This chapter employs a structural VAR framework with sign restrictions to estimate the effects of unconventional monetary policies of the European Central Bank since the Global Financial Crisis, mainly in their effectiveness towards bank lending. Using a variable for newly issued credit instead of the outstanding stock of credit, the effects on bank lending are smaller than found in previous similar studies for the Euro area. The results of this chapter have been previously published as Behrendt (2017b).

5.1 Introduction

Since the Global Financial Crisis of 2007/2008 central banks in many advanced economies have resorted to unconventional monetary policies, as traditional monetary policy of steering market interest rates by calibrating the policy rate have become less effective due to the zero lower bound. Central banks have since then relied more and more on policies like asset purchases, credit easing and forward guidance, to try to maintain working transmission mechanisms. The primary intention of these policies is to boost economic activity, through, amongst other channels, elevating bank lending.

Similar to other central banks, non-standard monetary policies by the European Central Bank were mainly aimed at reviving bank lending in the aftermath of the Global Financial Crisis through more favourable lending conditions, especially for non-financial corporations (see Draghi (2011)). As bank lending is the main source of external finance for non-financial corporations in the Euro area (see ECB (2008), Trichet (2009)), a functioning transmission mechanism through the bank lending channel is vital for working credit markets.

Central banks try to affect bank lending through unconventional monetary policies by lowering market yields to make refinancing cheaper and by strengthening commercial banks' balance sheets through additional provision of further liquidity. While there is an extensive literature on the effects of unconventional monetary policies towards financial market yields and prices (see e.g. Borio and Zabai (2016) for an overview), less is known about the pass-through of non-standard policies towards bank lending. Bank lending is supposed to be stimulated through such policies by providing commercial banks with more liquidity than needed for reserve requirement reasons. Additionally, central banks might engage in outright purchases of securities (*quantitative easing*), to reduce impairments in specific financial market segments.

There are several theories, as to how these policies work through the bank lending channel. Most central bankers and more Keynesian-leaning economists see this channel working because the increased supply of reserves offers banks a cheap form of refinancing, and therefore enables banks to supply more loans because of lower riskiness and higher liquidity of their balance sheets, and better capital positions (see e.g. Borio and Disyatat (2009), Joyce et al. (2012)).

In contrast, more monetaristic-leaning scholars postulate that through the provision of central bank reserves, bank lending and hence inflation must consequently rise, given the static money multiplier theory and the quantity theory of money. This argumentation is frequently brought forward in macroeconomic textbooks and the literature (see e.g. Freeman and Kydland (2000), Meltzer (2010)).

Previous studies are inconclusive to which extent UMPs in the aftermath of the Financial Crisis were able to spur bank lending. Some studies find a clearly positive impact of UMPs on bank lending, as for example Peersman (2011), Gambacorta et al. (2014), or Hachula (2016) for the Euro area, while others, like Butt et al. (2015), and Goodhart and Ashworth (2012) for the UK, find no clear cut positive impact of UMPs on bank lending and broader macroeconomic variables. But, what all of these mentioned studies have in common is that they consider the outstanding stock of credit or the change of it as the relevant credit variable. As this variable is consisting of several other factors besides newly issued loans, results of these studies might be distorted (see again Chapter 3 for a discussion of this issue).

This insight shall be reviewed in this chapter, while simultaneously attempting to answer two main questions. The first deals with the effectiveness of the unconventional monetary policy actions of the ECB since the beginning of the Global Financial Crisis of 2007/2008 towards stimulating bank lending to non-financial corporations. A main focus there is on policies which affect the size of the ECB's balance sheet. The second question picks up the critique of Chapter 3, namely if it makes a difference which lending variable is applied. Typically, empirical studies use a variant of the outstanding stock of credit as the bank lending indicator. But to quantify the transmission mechanism of monetary policy, the exact amount of new bank lending volumes is more important. To answer both questions, different structural vector autoregressive (SVAR) models for the Euro area are estimated using monthly data since the Financial Crisis on both credit variables.

Furthermore, this chapter tries to account for another shortcoming in the literature. Most empirical studies which estimate effects of non-standard monetary policies that affect central banks' balance sheets, apply a measure of the size of the unconventional monetary policies which either corresponds to the total amount of the central bank's balance sheet or the monetary base. This has important effects on the estimation results, due to the inclusion of more than the amount of unconventional monetary policies into these series. Estimations of the effects of unconventional monetary policies which aim at the size of the central bank's balance sheet should only be concerned with the excess amount of liquidity provided by the central bank. Taking for example the monetary base—which consists of currency in circulation, required reserves and excess reserves—as an UMP indicator, has several drawbacks. For one, the central bank does not have full control over the amount of currency in circulation, which the public wants to hold. Additionally, there are possible cointegration issues between currency in circulation and economic output variables. Further, required reserves can hardly serve as an indicator of the amount of additional liquidity, and there exist crucial feedback effects between required reserves and bank lending. Beyond that, the total balance sheet size of the central bank is influenced by even more factors, which have no link to UMPs. Revaluations of for example gold reserves on the central bank's balance sheet certainly have no immediate effects on bank lending by commercial banks. The same can be said for provisions and non-distributed profits. All such examples have an effect on the size of the balance sheet, which would be incorporated into the UMP series and thus distorting the variable, but can hardly be ascribed to have an effect on lending decisions by commercial banks.

While analysing the effects of unconventional monetary policies, it needs to be accounted for that unconventional monetary policies were overlapping with interest rate decisions, at least in the beginning of the crisis. The crucial task is therefore to identify exogenous monetary policy shocks to quantify the effects on economic variables. To guarantee orthogonality of both conventional and unconventional monetary policy shocks, this chapter resorts to estimation specifications within SVAR frameworks, which incorporate standard and unconventional monetary policy shocks via sign restrictions. Therefore, a model set-up similar to Peersman (2011) and Gambacorta et al. (2014) is estimated in this chapter. This approach has the advantage that it imposes less rigid constraints on the underlying economic theory in contrast to a Cholesky decomposition. By applying a classical Cholesky decomposition, which orders the variables from fast to slow reacting (see e.g. Christiano et al. (1998)), it would be postulated that the unconventional monetary policy variable is not influencing most other variables contemporaneously within the shock period. Using sign restrictions on the other hand, specific effects, also of contemporaneous nature, can be modelled more stringently to the underlying economic theory (see Uhlig (2005)).

The chapter highlights two important results. First, unconventional as well as conventional monetary policies during the Financial Crisis were not able to stimulate bank lending in the Euro area to a large extent, while on the other hand not leading to unintended consequences, especially on resulting in greatly elevated inflation rates, as postulated by some monetarist models.[1] While several previous studies found significantly positive reactions of bank lending to unconventional monetary policy shocks, these findings cannot be confirmed here, as reactions of

[1] See also IMF (2013a), White (2012) for a discussion on unintended consequences from UMPs.

bank lending—specifically on newly extended loans—to unconventional monetary policy shocks are only showing a positive, significant response in the short-run, which dies out fast. Furthermore, there are slight differences between the reactions of the new lending and the stock variable towards (unconventional) monetary policy shocks, highlighting the relevance of the insights from Chapter 3. It can also not be confirmed either that the unconventional monetary policies have a clear-cut positive effect on output and inflation, as several previous studies found.

The chapter is structured as follows. Section 5.2 gives a theoretical overview of the transmission process of unconventional monetary policies towards bank lending. The effects of such policies on bank lending shall be analysed on the basis of a SVAR model in Sections 5.3 and 5.4. Section 5.5 draws several conclusions from the empirical estimations.

5.2 Transmission of Unconventional Monetary Policies towards Bank Lending

Traditionally, monetarists see unconventional monetary policies as working through the supply of central bank reserves. This *money view* postulates that monetary policy decisions result in changes of bank lending through open market operations, which change the available amount of central bank reserves. Through unconventional monetary policies, which increase the amount of reserves, commercial banks are equipped with more reserves than required. The money view now postulates that banks put these reserves "to work". It is assumed that banks increase their lending activity as a consequence of the excess reserve provision. This will be done as long as there are excess reserves. The reserve provision by the central bank would therefore lead to a likewise increase in lending. This argumentation rests on the notion of a static money multiplier theory, which postulates that central banks set an amount for the high-powered monetary base and then the stock of money is only a multiple of that (see for example Freeman and Kydland (2000), Friedman and Schwartz (1963), or Meltzer (2010)).

With excess reserves rising by a multiple, which by definition expands M0, M1 needs to rise simultaneously, according to this static view. From the rise in the money stock through higher lending, this theory is then being expanded through the quantity theory of money to a consequent rise in inflation, as the static quantity theory requires a rise in the price level if the money stock increases (at least in the long run). Taking the equation of exchange and the money multiplier in their static form seriously, one can only conclude that an over-allotment of reserves by the central bank leads to higher bank lending and consequently to a higher price level. Asness et al. (2010) for example certainly base their critique of the first quantitative easing programme of the Fed on these grounds.

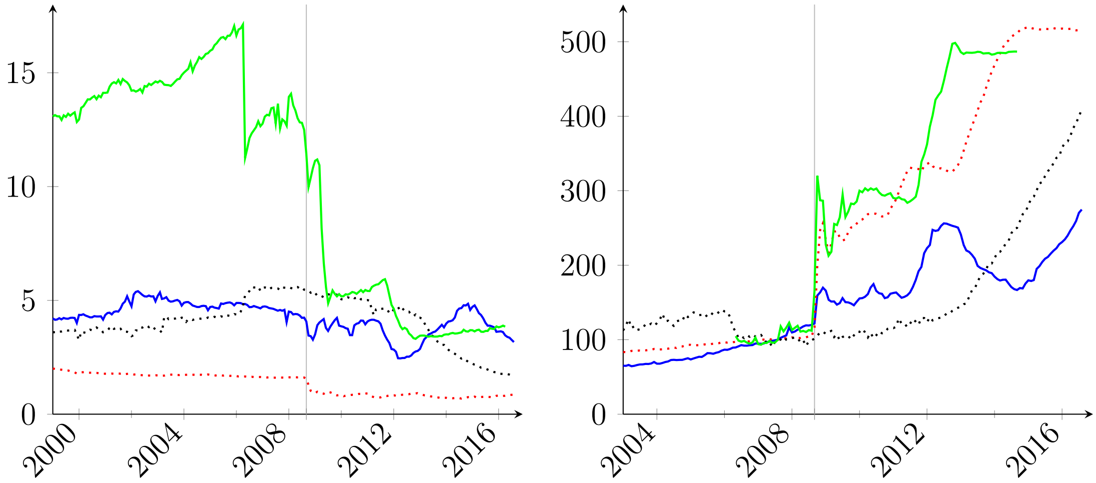
But what this theory overlooks is the fact that there is no causality in these equations. These are merely ex-post identities. In a fractional reserve banking system, as existing today, the causation does not go from the creation of bank reserves to credit expansion, but the other way around (see Werner (2014) for a real-world experiment and subsequent validation of this notion). If a bank extends a credit it acquires reserves afterwards, either on the interbank money market or through the standing facilities at the penalty rate, whenever there is a shortage in the money market (see Carpenter and Demiralp (2012)). As Dudley (2009) notes: "If banks want to expand credit and that drives up the demand for reserves, the Fed automatically meets that demand in its conduct of monetary policy. In terms of the ability to expand loans rapidly, it makes no difference whether the banks have lots of excess reserves or not." Hence, banks extend loans and acquire reserves afterwards to fulfil the average reserve requirement over the maintenance period. With abundant reserves, additional loans are only matched by extra deposits (the amount of reserves does not necessarily have to change). They are not mechanically multiplied into new loans, as predicted by the money multiplier theory. Additionally, as central banks will always allot enough reserves, commercial banks can therefore never be reserve constrained over the maintenance period, at least by amount. So there is no bottleneck on reserves, which would suddenly be lifted by higher reserve allotment.[2]

A sudden increase in reserves does therefore not induce commercial banks to increase their lending for no apparent reason, although excess reserves might induce slightly more lending at the margin, as reserves become cheaper for banks, since interbank market rates most likely fall down to near the deposit facility with abundant reserves (at least in the Euro area, where there is an interest rate corridor). Additionally, banks do not need to pay the penalty rate, if they are not able to acquire reserves on the interbank market, as most central banks have resorted to a full allotment policy after the Financial Crisis. However, this slightly cheaper financing is not sufficiently large to make any lending reasonable. Banks still face an internal risk-return calculus on their lending decisions, which is based on the credit worthiness of the borrower, the cost of funding and capital requirements (see e.g. Georg and Pasche (2008), Jakab and Kumhof (2015), or Singh and Stella (2012)). Additionally, they have to find willing borrowers for their potential credit supply. It is therefore not reasonable to assume that the additional provision of reserves by the central bank drastically affects the incentives of commercial banks to lend to the public. Hence, the money multiplier is to be seen as an ex-post identity and not as a rigid ex-ante relationship (see also McLeay et al. (2014), Tobin (1963), von Hagen (2009)).

[2] If the central bank would shut down the reserve window, this could potentially lead to unwanted bankruptcies and market turmoil, as reserve allotment is no longer guaranteed.

This is also confirmed by the fall of money multipliers in the aftermath of the Global Financial Crisis, as shown in Figure 5.1. Money multipliers have fallen distinctly since then in many economies, as broad money aggregates have not held up with the rise in the monetary base due to the over-supply of central bank reserves.

Figure 5.1: Money multipliers and central bank assets



(a) M1 money multipliers

(b) CB total assets

Note: Data for the Euro area (——), Federal Reserve (⋯⋯), Bank of England (——), Bank of Japan (⋯⋯)). The vertical lines indicate the time of the Lehman crash in 9/2008. Sources: ECB, Fed, BoE, BoJ.

If central banks are not able to directly support lending and therefore economic activity through the transmission postulated by the money view, how might unconventional monetary policies work then? To answer this question, this chapter predominantly concentrates on two policies that affect liquidity in the banking sector through the supply of additional reserves by the central bank, namely bank reserves policy and quantitative easing. These are the two unconventional policies on which the ECB laid its focus in the aftermath of the Financial Crisis.

Bank reserves policies are directly aimed at providing banks with large amounts of excess reserves via longer-term reverse-repurchase operations. After the Financial Crisis interbank markets experienced a drastic decline in overnight lending activity, because of mutual doubt of commercial banks about their financial health (see e.g. Frutos et al. (2016)). This led to a reserve shortage of some banks, who had to borrow these at the ECB with a penalty, while others built up large amounts of reserves without providing them on the interbank market. This in turn led to an increase in the interbank market rate, which made refinancing for reserve constrained banks more expensive. In order to lower market rates, the ECB supported liquidity in the interbank market by switching to a fixed-rate, full-allotment strategy. Furthermore, the ECB offered longer-term refinancing on several occasions and under different conditions to mitigate bottlenecks in the interbank market and give banks balance sheet relieve (see e.g. Rogers et al. (2014) for a short overview). The expansion of the ECB's balance sheet through these policies is due to an increased demand for liquidity, as banks requested higher amounts of additional reserves, while providing the ECB with the required collateral in exchange. The effects on commercial banks' and the central bank's balance sheets from reserve policies are illustrated in Table 5.1:

Table 5.1: Impact of reserves policy on balance sheets

Commercial Bank			
Assets		Liabilities	
+	Reserves		
-	Securities		

Central Bank			
Assets		Liabilities	
+	Securities	+	Reserves

On the other hand, *quantitative easing* (QE) policies are purposefully supply driven by the central bank. Through such outright asset purchases, specific securities from banks and the non-bank public are bought and taken onto the central bank's balance sheet, via open market operations. Such purchases can consist of government bonds, covered bonds or asset backed securities, for example. Central banks aim to purchase these securities mainly from the non-bank public, such as insurance companies or pension funds. But since these are not eligible to transact with the central bank directly, such purchases have to be intermediated through depository institutions. The bank of the non-bank public credits them with a deposit in exchange for the asset. Then the central bank swaps this asset for newly created reserves with the depository institution. Banks therefore not only gain central bank reserves, but also a corresponding increase in customer deposits (see Table 5.2 for a schematic illustration, and Benford et al. (2009), McLeay et al. (2014), or Joyce et al. (2012) for a more in depth discussion). Thus, the difference is that through the intermediation activity of the banking sector, their balance sheets expand, while this is not the case for direct purchases or reserves policy. But in both scenarios, the private sector's net worth remains unchanged. QE can therefore merely be seen as an asset swap, which changes the composition of outstanding private sector assets. So, the aim of these purchases is to support liquidity in specific financial market segments, and not to add net financial assets, as often-times assumed by using the term *money printing* equivalently to QE purchases. Thus, QE is mostly aimed to provide liquidity to lower interest rates in specific financial market segments.[3] Additionally, by buying securities from the private through the banking sector, central banks take risks off the balance sheets of the public onto their own balance sheet. The higher liquidity and lower risk in turn might *indirectly* induce banks and the public to engage in more lending activity.[4]

[3] Further, through higher liquidity, non-banks shall be incentivised to invest their newly received deposits in higher yielding assets, such as bonds and shares. This in turn will raise the values of these assets and thus lower funding costs of corporations. This might then induce the private sector to spend more through wealth effects.

[4] Whereas, bank lending could also potentially shrink due to QE measures, if companies issue more alternative funding (bonds and equity), to pay back bank credits (see McLeay (2014)).

Table 5.2: Impact of QE on balance sheets

Non-Bank

Assets		Liabilities
-	Securities	
+	Deposits	

Commercial Bank

Assets		Liabilities	
+	Reserves	+	Deposits
+	Securities		
-	Securities		

Central Bank

Assets		Liabilities	
+	Securities	+	Reserves

So, while QE policies are designed to expand the liability side of the central bank balance sheet by a pre-defined amount, reserves policies are demand driven and (in the case of the ECB) are virtually without a limit.[5] While differing in their implementation, both policies are supposed to affect the economy through similar transmission channels (see also Altavilla et al. (2016a)). In essence, both are designed to give balance sheet relief to banks and the public through lower interest rates and higher asset prices.

The following section shall empirically evaluate to which extend the UMPs by the ECB were able to revive the transmission of monetary policy, with a special focus of these balance sheet policies towards bank lending.

[5] Although there is an implicit limit by the amounts of credible collateral held by the public, which the central bank deems worthy for the operations.

5.3 A SVAR Model for the Euro Area

5.3.1 Baseline Specification

Structural VAR models typically try to estimate effects of standard monetary policies towards economic variables (see e.g. Christiano et al. (1998), or Peersman and Smets (2001)). In contrast to classical monetary policy SVARs using a Cholesky decomposition on the ordering, SVARs with sign restrictions are able to impose very little economic theory to the structure of the data, and are therefore more flexible in regard to the concrete research question.

SVAR models with sign restrictions estimate a simple reduced-form VAR model and then define a set of sign restrictions on specific variables in the impulse response functions (IRFs) to identify one particular shock. For the shock in question, a random draw of a given number (at least enough to be necessary to identify the model) of IRFs satisfying these restrictions is realised. If enough IRFs are estimated, the median response and the confidence bands can then be obtained through inference in a typical fashion (see Rubio-Ramirez et al. (2010), Uhlig (2005)).

The baseline reduced-form VAR model has the following representation (see Lütkepohl (2005), Kilian (2013) for the following):

$$y_t = \nu + A_1 y_{t-1} + \ldots + A_p y_{t-p} + u_t \tag{5.1}$$

with y_t as a $k \times 1$ vector of the endogenous variables, $A(L)$ as the autoregressive lag order polynominal, $\nu = A(L)\mu_0$ as the vector of the intercepts, and u_t as the one-step ahead prediction error of the disturbances, with a zero mean, zero autocorrelation, and variance covariance matrix

$$\sum = E(u_t u_t'). \tag{5.2}$$

But as the elements of u_t might still be correlated across the equations, there is, in principle, no structural interpretation out of this system possible. This is accounted for in structural models, where the structural innovations are assumed to be mutually uncorrelated. A structural VAR model can then be represented by:

$$B_0 y_t = \nu + B_1 y_{t-1} + ... + B_p y_{t-p} + \varepsilon_t, \tag{5.3}$$

with B_i, i=0,...,p, as a $k \times k$ matrix of parameters and ε_t as the structural, mutually uncorrelated shocks following a standard-Normal distribution with zero mean and unit variance. Without loss of generality and to keep the notation simple, let's assume that y_t is zero mean. Thus, the shocks are uniquely identified and can be interpreted in an economic context.

The reduced form Equation 5.1 and the structural model Equation 5.3 are linked by the matrix B_0, which describes the contemporaneous relation between the variables. The link between both expressions is given by:

$$A_p = B_0^{-1} B_p. \tag{5.4}$$

The estimation of B_0 requires restrictions on some parameters, given that without these only $k(k+1)/2$ parameters can be uniquely identified. This is done by applying identifying assumptions on specific relations, so that the innovations and the IRFs are just-identified (see Lütkepohl (2005), Uhlig (2005)). Doing this, the mutually correlated reduced form innovations u_t are weighted averages of the structural innovations ε_t, with B_0^{-1} serving as the weights:

$$u_t = B_0^{-1} \varepsilon_t. \tag{5.5}$$

The structural innovations ε_t, which are obtained from Equation 5.5, are assumed to be orthonormal, i.e. its covariance matrix is an identity matrix

$$E(\varepsilon_t \varepsilon_t') = I. \tag{5.6}$$

The baseline model at hand contains six variables: the log of the industrial production index (IPI), the log of the consumer price inflation index (HICP), lothe g of bank lending (new lending and the outstanding stock, respectively) (Lending), MFI lending rates (MIR), the EONIA rate (EONIA) and the level of excess reserves (monetary base minus currency in circulation and required reserves (Reserves)).[6] The model is estimated in log levels, since all variables are integrated of order one, and thus the estimators remain consistent and the marginal asymptotic distributions remain asymptotically normal (see Sims et al. (1990)).

Variable choices are mainly following the model of Peersman (2011), whose main interest is also on the effects of unconventional monetary policy on lending volumes. The frequency of the main model is monthly from 2007M08 to 2016M07. The start of the estimation period is restricted to the beginning of the liquidity-providing longer-term refinancing operations (LTRO) up to three months by the ECB in August 2007. Several robustness checks on different indicators for the UMPs are performed (specifically with the *shadow rate* proposed by Wu and Xia (2016), as well as monetary policy announcement effects on bond yields and on term spreads), although the main focus is on operations that affect the excess amount of liquidity through reserve accommodation and QE. The lag length is set to 2, according to the Schwarz Information Criterium (SIC), and is also in line with

[6] Data sources and details can be found in Table 5.6 in the Appendix A5 on page 182.

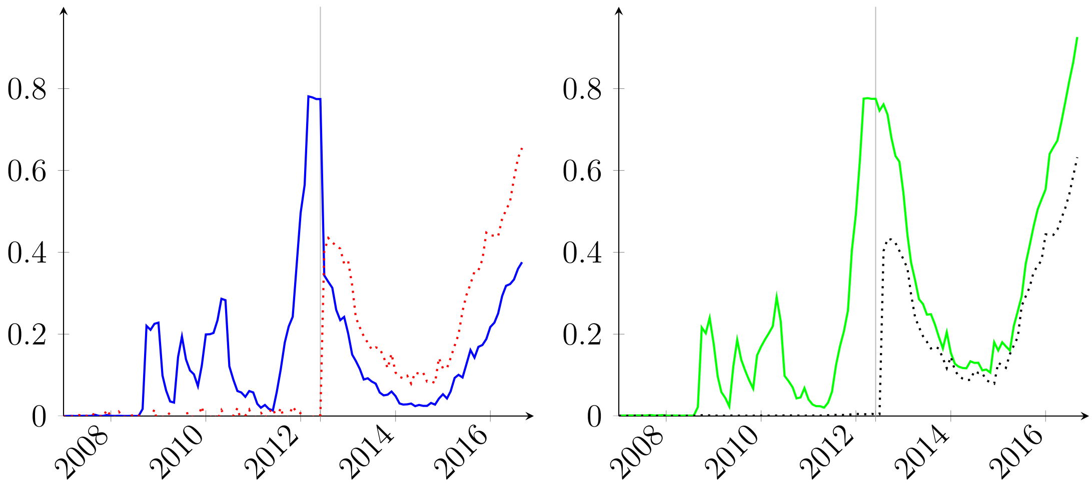
the majority of the related literature. The Akaike Information Criterium (AIC) proposes a longer lag length. Therefore, longer lag lengths are also considered as a robustness check.

For the output variable, industrial production (IPI) is applied, as the focus is on lending activity to the non-financial corporate sector. Prices are proxied by the Harmonised Index of Consumer Prices (HICP). The estimations contain bank lending and interest rates on lending to non-financial corporations. Two lending variables are applied for each specification and ultimately compared, to account for the insights of Chapter 3. For new lending, new business volumes of loans to non-financial corporations from the MIR statistics are taken. The stock amount of credit is the outstanding volume of MFI loans to the private sector. Lending rates are also from the MIR statistics and cover new business loans other than revolving loans and overdrafts, convenience and extended credit card debt. The policy rate is proxied by the EONIA rate, as the ECB conducts its policy by steering interest rates around the overnight money market rate. The EONIA thus captures standard monetary policy decisions (see also Ciccarelli et al. (2015) for example). It is justifiable to apply the EONIA rate instead of only the rate for main refinance operations of the ECB, as the ECB policy rate virtually approached the zero lower bound in 2014 and there would be no movement visible afterwards. Contrary, the ZLB is not binding for the EONIA rate. There was still sufficient movement in the EONIA down to almost the deposit facility rate since 2014, which further reflects the more expansionary stance of the ECB on its policy rate decisions to additionally lower the deposit facility while keeping the main refinancing operations rate constant—as for example done in December 2015. The movement in the EONIA can also be accounted through the extended forward guidance policies by the ECB, which were able to further suppress market rates, despite little movements in the policy rate (see Altavilla et al. (2016a)).

As the unconventional monetary policy indicator, excess reserves are taken in the baseline estimation. These are calculated as the monetary base less currency in circulation and required reserves. This stands in contrast to similar studies estimating the effects of unconventional monetary policies on bank lending. Peersman (2011) for example applies the monetary base as the UMP variable, while Gambacorta et al. (2014) and Boeckx et al. (2014) apply total assets of the central bank. The application of these broader definitions has several drawbacks. Firstly, the monetary base includes currency in circulation, which leads to a co-movement of the lending and UMP indicator before the Financial Crisis, as both grow similarly with economic activity. Further, as decisions of the private sector to hold cash are not really influenceable by monetary policy, it is not quite clear as to why to incorporate them into the UMP variable. Additionally, the monetary base also includes required reserves. As they need to increase with loan extension, because a certain percentage of each new loan needs to be underwritten with reserves, there is a feedback loop between lending and reserves, which further contributes to the co-movement of the stock of outstanding credit with the monetary base. A positive movement of the UMP variable induced by higher required reserves would have therefore by definition already increased lending, absent all other influences. Thus, by excluding required reserves from the estimation, the true unconventional monetary policy decisions, which affect additional liquidity provision, are reflected more compellingly. With regard to total assets, they include even more operations by the central bank, which have if any, then only a loose effect on additional intra-Euro area bank lending, as mentioned before in Section 5.1.

For the calculation of the excess reserves, the method as mentioned above is applied, which is the monetary base minus currency in circulation minus required reserves. Since the monetary base at the ECB is including reserves parked in the deposit facility and the current accounts, taking the excess reserves data directly from the ECB would be incomplete, as this statistic only incorporates amounts parked in the current accounts (less minimum reserves). With the reduction of the penalty rate to zero on the 11th of July 2012, banks transferred a large amount of excess reserves into the current accounts, to not have to book it anew into the deposit facility on each working day (see Figure 5.2 (a)). But as the amounts in the deposit facility do not appear in the excess reserves series of the ECB, this would then be reflected as an unconventional monetary policy easening, due to the sudden rise in the official excess reserves statistic. This would give an incomplete picture, as the amounts in the deposit facility are still representing excess liquidity which banks hold (and are also counting towards the monetary base). The transfer into the current accounts can therefore not be seen as an unconventional monetary policy decision, but was only done by banks to avoid a re-booking of excess liquidity into the deposit facility at the end of each working day. Because of the zero penalty rate, this need vanished. By only taking the excess reserve statistic as provided by the ECB, this series would effectively be zero until July 2012 (see Figure 5.2 (b)), which does not reflect the expansive monetary stance by the ECB directly after the Financial Crisis adequately. Thus, the amounts in the deposit facility are also considered for the excess reserves variable in the estimation, to better cover the ample liquidity in the banking sector.

Figure 5.2: Excess reserves in the Euro area



(a) **(b)** Excess Reserves

Note: Figure 5.2 (a) depicts the deposit facility (——) and current accounts less minimum reserve requirements (⋯⋯). Figure 5.2 (b) compares the excess reserves statistics as calculated in this chapter (——) and provided by the ECB (⋯⋯)). The vertical lines depict the month when the ECB lowered the penalty rate to zero, thus inducing a large transfer of funds from the deposit facility into current accounts. All data are in trillion Euro. Source: ECB.

5.3.2 Identification Strategy

In recent years, SVARs using sign restrictions have become increasingly popular in response to some critical points about simple Cholesky orderings (see e.g. Rudebusch (1998), or Kilian (2013)). Sign restrictions are seen as superior to Cholesky decompositions, as they do not impose as rigid constraints on the underlying economic theory. With the added flexibility, it is possible to reflect the feedback effects more rigorously in comparison to the recursiveness assumption. To accomplish this, qualitative restrictions on certain shocks for some variables are used as an identification scheme. Most notably is the restriction method proposed in a monetary policy setting by Uhlig (2005).

Due to the identifying assumptions, it is possible to isolate exogenous UMP shocks. To identify these exogenous innovations to excess liquidity, a mixture of sign and zero restrictions on a specific set of shocks in the contemporaneous matrix B_0, as depicted in Table 5.3, is applied. These restrictions are similar to those in Peersman (2011).

Table 5.3: Sign restrictions for the shocks in the baseline estimation

	IPI	HICP	Lending	MIR	EONIA	Reserves
UMP/Reserves shock	0	0	≥0	≤0	0	≥0
Standard MP shock	0	0	≥0	≤0	≤0	

It is assumed that an unconventional monetary policy shock only impacts output and consumer prices with a lag. The contemporaneous impact is therefore set to zero for both variables. This assumption can be validated using monthly data in order to disentangle monetary policy shocks from disturbances originating in the real economy (see e.g. Christiano et al. (1998), or Peersman and Smets (2001)). On the other hand, innovations of output and prices can impose an immediate effect on excess reserves. Shocks in the real economy can therefore exert a contemporaneous impact on the credit market.

In the baseline specification, there is a non-negative restriction on the sign for bank lending in response to an UMP shock. Peersman (2011) restricts the response of bank lending to only the third and fourth lag after the disturbance. He validates this by the notion that lending to non-financial firms can potentially react positively to a policy rate hike in the short-run due to drawdowns of pre-existing credit lines in a worry of rising lending rates in the medium term. Giannone et al. (2012) confirm this by showing that lending to firms responds negatively only with a lag. But, for the estimation here, the specific lag restriction does not make a difference, as the immediate response is in line with the responses of the subsequent periods in the estimations. As only unconventional monetary policies which influence the volume of new lending in a positive way are of importance for this study, the imposing non-negative sign in only the first period can be validated. Negative innovations to lending are therefore captured by the other variables and shocks in the system. For example, if a fall in lending is due to a fall in output, these reactions should be visible in the data.

UMP shocks are further assumed to have a non-positive impact on bank lending rates, as looser monetary policies should lead to lower lending rates, because of cheaper refinancing and lower financial risks (see Woodford (2003)).

To clearly identify non-monetary policy innovations, orthogonality between UMP and standard interest rate disturbances have to be ensured. By imposing a non-contemporaneous response of the EONIA rate (zero sign), orthogonality of both types of monetary policies can be guaranteed.

While looking at unconventional monetary policy shocks during the estimation period after the Financial Crisis and their effects on bank lending is helpful to understand the transmission mechanism of these policies, it might also be helpful to analyse if standard monetary policies were able to influence bank lending. Especially for the Euro area, where the zero lower bound on the policy rate was not reached until 2014, there were still enough movements in the policy rate to potentially have an effect on lending and economic activity in the earlier stages after the Financial Crisis. Such standard interest rate innovations—labelled *Standard MP shock* in Table 5.3—are represented by a fall in the EONIA rate, to have the signs corresponding to the easing of monetary policy by expanding excess reserves. The standard monetary policy shock is assumed to have a negative effect on lending rates, meaning a fall in the EONIA is identified with a likewise fall in lending rates. Conversely, credit volumes are assumed to not fall on impact. Responses to output and inflation are, like for the UMP shock, assumed to not react contemporaneously. These restrictions are also in line with those in Peersman (2011).

5.4 Estimation Results

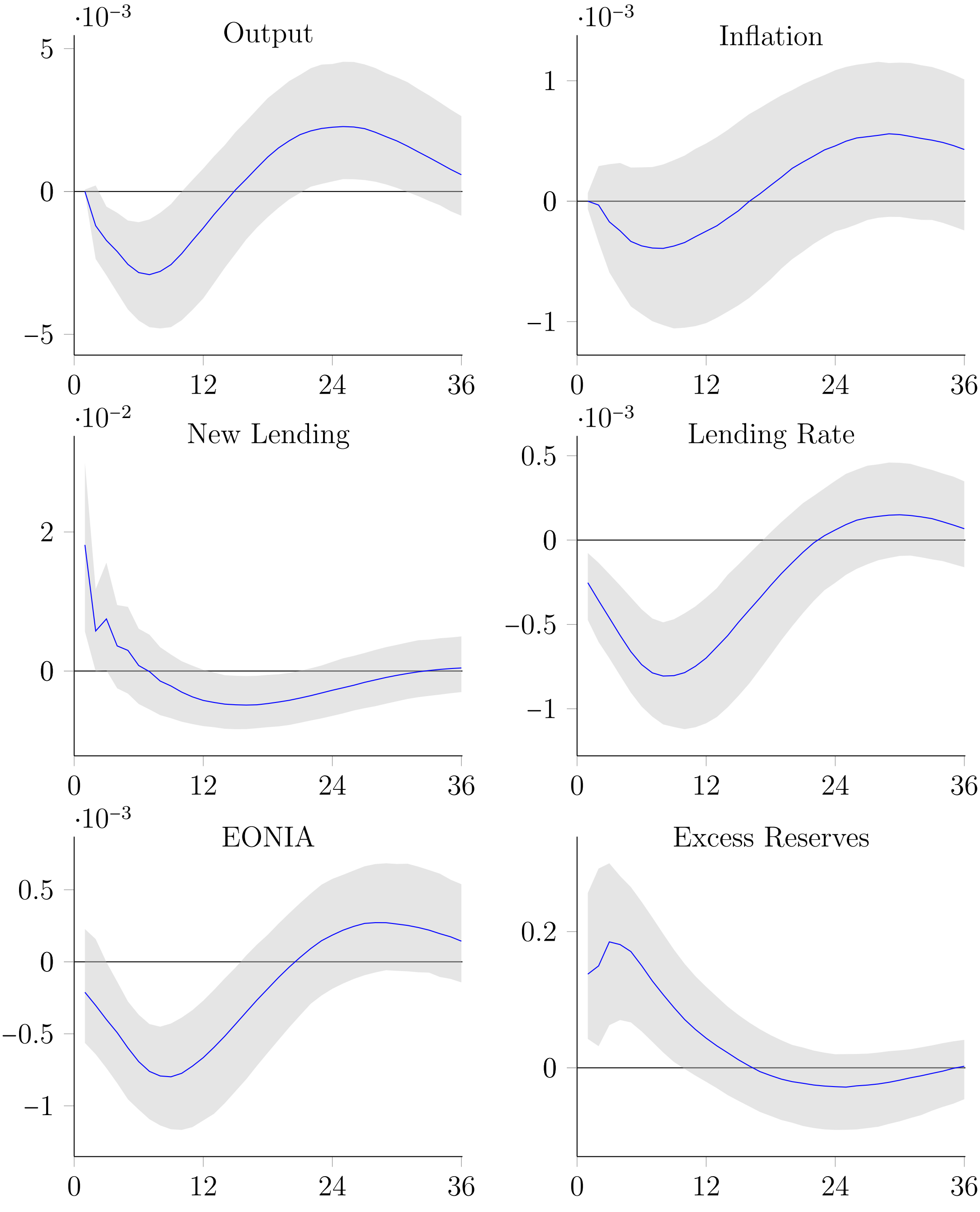
5.4.1 Baseline Estimation

The benchmark VAR model is estimated from 2007M8 to 2016M7 using two lags on the endogenous variables. A Bayesian approach, as proposed by Uhlig (2005) and applied in a similar setting by Peersman (2011), is used for estimation and inference. Normal-Wishart prior and posterior distributions of the reduced form VAR are applied, as well as a random possible decomposition B of the variance-covariance matrix (see Baumeister and Hamilton (2015)). If the IRF of the specific draw satisfies the restrictions, it is kept. Otherwise, the draw is rejected. In total, 2000 successful draws from the posterior are applied to produce the IRFs, which show the median values, while also depicting the 68 percent posterior probability bands.

Figure 5.3 shows the impulse response functions for the unconventional monetary policy shock using the new lending variable. The blue straight lines show the median responses to an unconventional monetary policy shock, while the grey areas around it represent the 16th and 84th percentiles of the posterior distribution of the estimated responses.

The UMP shock is characterised by an increase of excess reserves between 0.5 and 2.5 percent. The shock is positively significant for up to about nine months, with a peak in the median response after three months. Output and prices are restricted to have a zero contemporaneous response for the first month after the shock. For the following months, this restriction is lifted. Instead of immediately positively contributing to economic activity, output falls for the first ten months after the shock, although turning positive in the medium term.

Figure 5.3: UMP shock on new lending



Note: Impulse responses from an UMP easing shock. 68% confidence intervals (2000 replications).

Additionally, there is no significant impact on prices visible.[7] For both variables, the results stand in contrast to estimations of similar studies for shorter time horizons after the Financial Crisis, as for example found by Boeckx et al. (2014) or Gambacorta et al. (2014).

Further, bank lending rates are falling for about one year and a half after an UMP shock. The response of the EONIA rate is characterised by a medium term fall after an UMP shock, with a low after about nine months.

More interestingly for the aim of the chapter is the response of lending to an UMP shock. Imposing a non-negative contemporaneous restriction, the new lending IRF shows a positive response for the first three months after the shock. While having no sign restriction for the new lending variable, the response becomes insignificant, although the median response is still positive for the first three periods after the shock.

Constraining the estimation period to the first few years after the Financial Crisis (until December 2012), the results qualitatively stay the same, only with a more pronounced negative median response of prices. The effect on all other variables, especially bank lending, stay qualitatively the same. Also, using longer lag lengths does not alter the general results of the estimation.

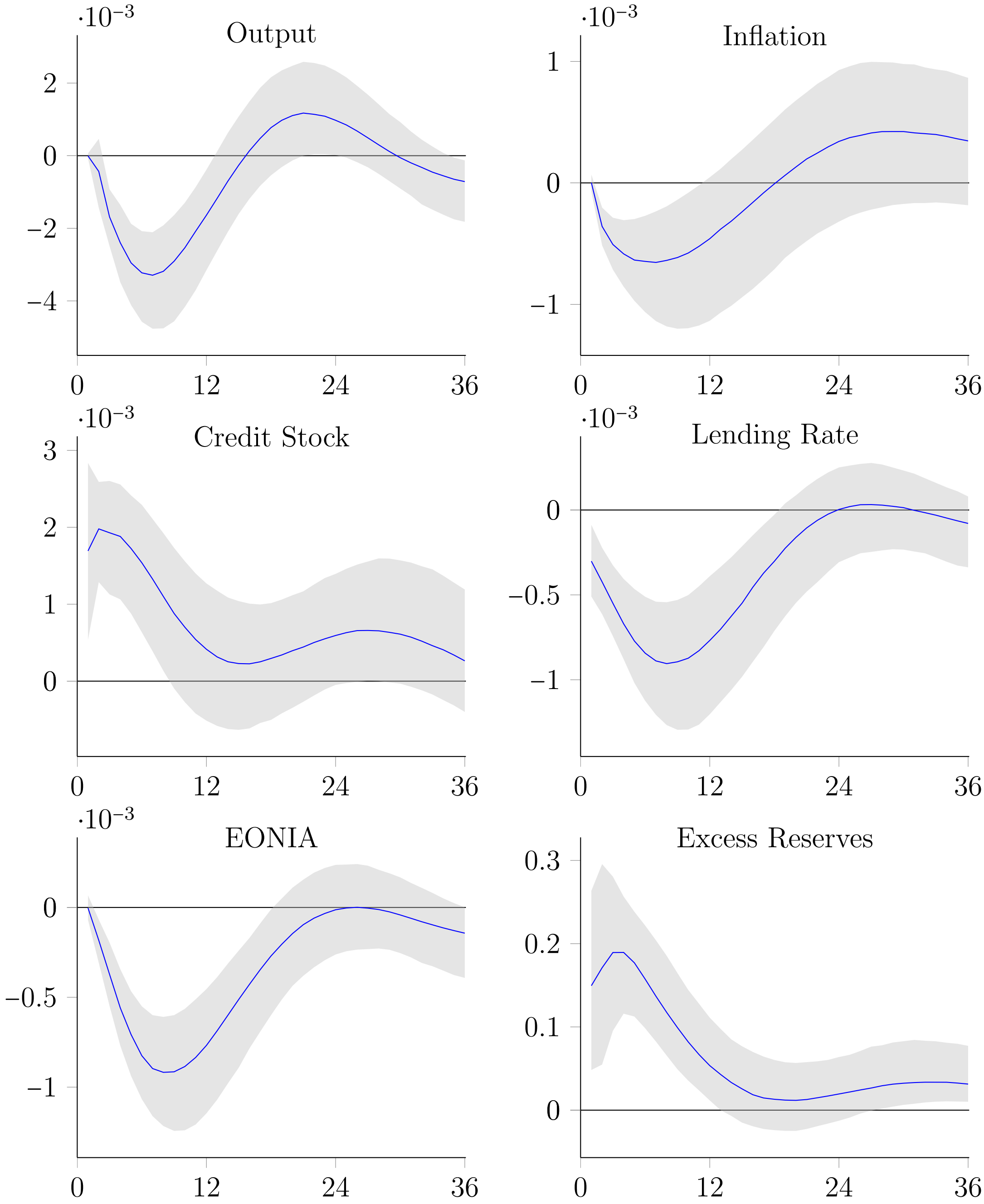
The IRF analysis here is able to show that the provision of excess liquidity by the ECB after the Financial Crisis has no significant long-term impact on lending activity. Although these policies might have contributed to lower lending rates and higher liquidity on bank's balance sheets, they did not induce banks to significantly increase lending. This might be explainable by the high uncertainty after the Financial Crisis, as well as bad economic conditions constraining credit supply

[7] This holds also true if instead of consumer prices producer prices are applied.

and demand. As shown by the ECB in their Bank Lending Survey (BLS), banks increased their credit standards significantly after the crisis, thus constraining the availability of bank loans. This was mainly due to worsening capital positions, as well as negative impacts of reduced general economic activity (see ECB (2014a)). Additionally, credit demand receded simultaneously after the crisis. The main factor for reduced credit demand was—as mentioned by enterprises in the survey of Access to Finance of Enterprises (SAFE)—given by concerns of finding customers and the subdued general economic outlook, while access to finance played an elevated role only in the beginning of the Financial Crisis. These constraints were especially pronounced in crisis hit countries. Respondents in these countries (mainly Greece, Italy, Portugal and Spain) were also discouraged to demand credit by too high interest rates, as this was the main reason for enterprises to not demand loans in these countries (see ECB (2014c)). Real economic impacts thus might have offset the positive effects of the UMPs by the ECB, resulting in only small short-run positive impacts of these policies on bank lending.

While using the outstanding stock as the lending variable, the response of the bank lending indicator is markedly more positive and for a longer horizon significant (for about eight months), with the median response being positive throughout (see Figure 5.4). Previous similar studies found a strictly positive response of the credit stock. But this result can also not be validated with this study. All other responses are qualitatively the same as for the specification with the new lending variable. Without a restriction on the credit variable, the response of the outstanding stock of credit to an UMP shock also becomes insignificant (although the median response is still distinctly more positive than for the new lending specification).

Figure 5.4: UMP shock on the credit stock



Note: Impulse responses from an UMP easing shock. 68% confidence intervals (2000 replications).

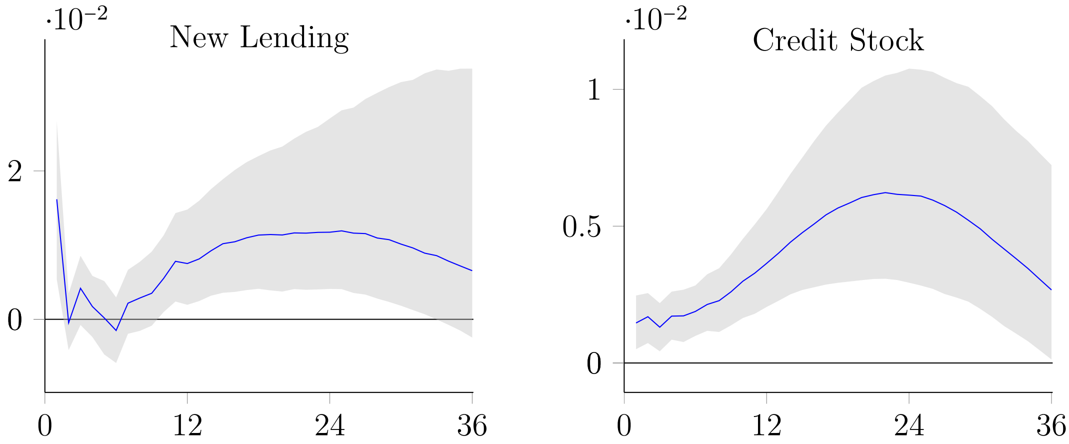
Comparing the responses of both credit variables, it is visible that the positive impact of an UMP shock on new lending dies out much quicker than for the stock variable. Analysing the effects of UMPs on bank lending using the stock might therefore overstate its impact, as the positive effect on new lending is not that long-lasting as the stock variable might indicate. Taking the same variable and lag restriction approach as Peersman (2011), i.e. the policy rate (MP Rate) instead of the EONIA and the monetary base instead of excess reserves, the reaction of the stock would be positively significant for an even longer time (eleven months).

The responses to the conventional monetary policy shock are qualitatively the same for both lending variable set-ups (see Figure 5.11 and 5.12 in the Appendix A5 on page 183 and 184). As for the QE shock, new lending responds positively for a significantly shorter period of time, in comparison to the credit stock. Likewise, output and inflation does also not react positively to a standard monetary policy shock.

Three main insights come out of the IRF analysis. First, the clearly positive and increasing impact of UMPs on bank lending visible in other studies cannot be confirmed here. The positive reactions die out fairly quickly after the UMP shocks for the period after the Financial Crisis. Second, the positive reaction is even less pronounced while using the new lending variable instead of the stock variable. And lastly, monetary policy shocks after the Financial Crisis seem not to be able to stimulate output and elevate prices.

Taking the model set-up as in Peersman (2011) for the time-frame before the Financial Crisis (2003M01 to 2009M12; earlier data is not available for the new lending variable), but with new lending, the response of new lending is only positively significant in the third and fourth period, those where the restrictions apply. Taking the restrictions as in the baseline representation in this chapter, the positive response already becomes insignificant in the second period, although lending recovers after about a year and becomes positive again for about another year and a half (see Figure 5.5). Applying the stock for this period yields quite the same results as in Peersman (2011). The positive credit response, especially in the short run, is thus mainly driven by the stock variable, mostly irrespective of before or after the crisis. Applying the new lending variable leads to a breakdown of this strictly positive result for lending to an UMP shock.

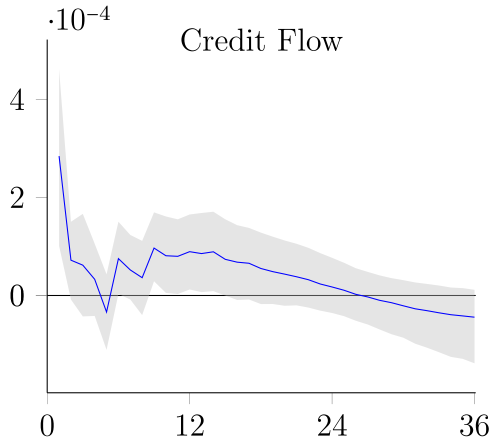
Figure 5.5: UMP shock on bank lending for the period 2003-2009



Note: Impulse responses from an UMP easing shock. 68% confidence intervals (2000 replications).

Consequently, using the flow of the credit stock yields similar results as for the new lending variable, as shown in Figure 5.6 (see Chapter 3 for a reasoning on this). The flow variable here only contains new loans, repayments and revaluations. Securitised and written-off loans do not fall into the estimation (see ECB (2012)). Thus, a large amount of the disturbances are already out of the estimation. Furthermore, repayments are probably distributed fairly evenly in the short-run, so they do not distort the flow too much. Additionally, revaluations might not even be that large in relation to new lending, thus probably also not distorting the flow variable that heavily.

Figure 5.6: UMP shock on the credit flow for the period 2003-2009



Note: Impulse responses from an UMP easing shock. 68% confidence intervals (2000 replications).

In essence, the positive response of lending in response to UMPs found in other studies is due to the choice of the credit variable. Taking new lending instead of the stock leads to a partial breakdown of these findings. Several reasons are responsible for this. For one, the use of the outstanding stock of credit might lead to stock-flow inconsistencies (see Biggs and Meyer (2013), or Huang (2010) for a discussion of this problem). This notion is validated by the fact that the response of the flow variable of the credit stock is showing similar results as the new lending variable. Further, results are also likely to be skewed by the other factors except new lending comprising the change of the credit stock variable. And lastly, the high inertia in the stock, as newly issued credits make up only about 15 to 23% of the outstanding stock of loans to non-financial corporations in the Euro area, is contributing to the higher positive response of the stock IRF in the later periods after the shock.

5.4.2 Further Specifications

Effects of UMPs on bank lending only defining by the size of the amount of excess reserves might miss out on important central bank policies, which go further than interest rate decisions and manipulations of provided liquidity. In addition to these tools, central banks have also resorted to enhanced communication policies, better known as *forward guidance*. Their aim is to lower market rates on the longer end of the yield curve through credible communication strategies (see Filardo and Hofmann (2014)). The ECB for example resorted to forward guidance in a way as to promise to keep rates low for a long period of time, to reduce inflation premia on long-lasting contracts. This in turn should lead to higher credit demand, as lending becomes relatively cheaper.

Typically, announcement effects of monetary policy are accounted for by using high frequency financial market data and employing them on lower frequency data (see e.g. Rogers et al. (2014)). Such studies identify surprise components of monetary policy announcements, using changes in money market future rates around the days of ECB policy meetings. Due to the lack of market futures data to the author, a more simplified approach is taken here. The assumption here is that surprise announcements by the ECB of either unconventional monetary policies or enhanced forward guidance lead to a fall in risk free interest rates (Altavilla et al. (2016b)). Typically the prices of financial indicators who are associated with the policy rate already incorporate expected responses of the policy rate. But as above mentioned announcements are typically unforeseen, market rates typically do not incorporate such information. Variations on these surprise policy announcement days can therefore be seen as the response to these. They can then be treated as exogenous with respect to other economic events (see Gürkaynak et al. (2005)). According to Altavilla et al. (2016b), changes in two-year government bond yields can be seen as a reasonable proxy to reflect such announcements, as the target horizon of these announcements lies in the medium-term. Here, only two-year German Bund yields are considered, as they can be seen as relatively risk free (see also Hachula et al. (2016)). Subsequently, the change of the yield of the closing date before the announcement day to the closing yield on the announcement day is considered to be the effect due to the policy announcement.[8] Decreasing yields are seen to be associated with a further monetary easing. Therefore, signs are as for the UMP shock in the baseline specification, except that the announcement here has a non-positive sign.

Alternatively, Meinusch and Tillmann (2014) take another approach, in which they determine the policy announcements as a binary system. In a month with a further easing announcement, the variable takes the value 1, in all other months it is set to zero.[9] The reason for such a strategy is that announcements of unconventional monetary policies might have already been incorporated into yields before the announcement, if market participants expect such announcements, even though most announcements can still be seen as surprising. A movement on the day of the announcement can thus not represent a surprise response to such an event. On some announcement days yields rose, even if a fall would have to be anticipated. This might be because market participants expected further easing than ultimately announced, and therefore revised their expectations. Only taking this simple approach can mitigate such anticipated movements before the announcements. The same dates as in the above mentioned methodology are taken here, too. The sign for the announcement is non-negative, meaning a positive response is associated with a policy easing.

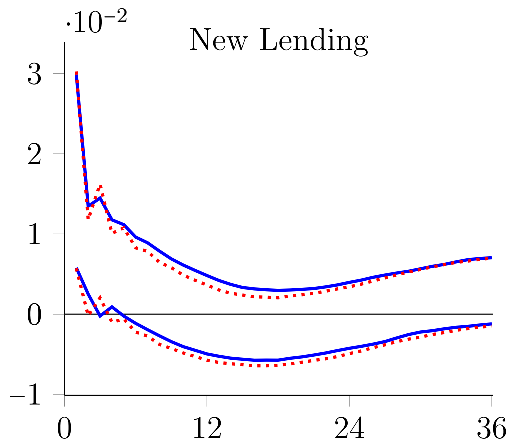
Results for new lending to both announcement shocks can be seen in Figure 5.7. The blue straight lines depict the 68% probability bands for the first announcement variable (daily changes), while the red dotted lines show the bands for the second

[8] The dates are taken from Rogers et al. (2014) and Hachula et al. (2016). Until August 2016 there were no further announcements, which would validate the addition of another event.

[9] There are no contractionary announcements. Thus no event has been identified with a value of -1.

announcement methodology (binary values). Both estimations show a similar pattern as the baseline specification for the reserves shock. For the first three months, responses are significantly positive, while dying out quickly. Responses to the other variables are also similar (not being reported here).

Figure 5.7: Announcement shocks on new lending



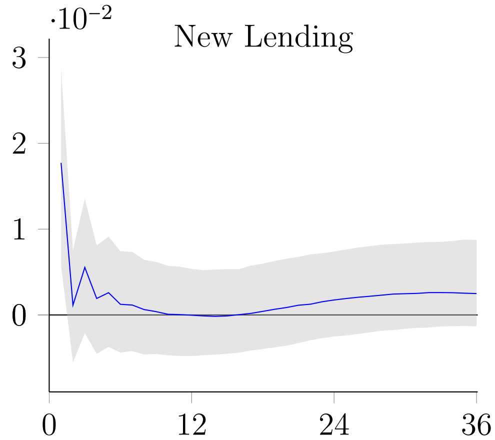
Note: Impulse responses from an UMP easing shock. 68% confidence intervals (2000 replications). Shock 1 (——) and Shock 2 (⋯⋯).

An alternative methodology applies spreads between long- and short-run interest rates. Here, specifically the difference between the 12-month and 1-month Euribor rate is considered. This term spread is supposed to decline with enhanced forward guidance policies, as longer rates react considerably stronger to announcements to keep interest rates low for a longer period of time, than short-run rates (see ECB (2014b)). The term spread is added into the system instead of the reserves variable and is restricted with a non-positive sign. All other signs are as in the baseline specification (see Table 5.4). New lending is reacting to this shock only in the impact period positively, which is due to the restriction (see Figure 5.8). Without the restriction, new lending is insignificant throughout all lags. All other variables are again similar in their response, instead that the output variable is not reacting negatively significant all throughout.

Table 5.4: Sign restrictions for the shocks in the term spread estimation

	IPI	HICP	Lending	MIR	EONIA	Spread
UMP shock	0	0	≥0	≤0	0	≤0

Figure 5.8: UMP shock using the term spread

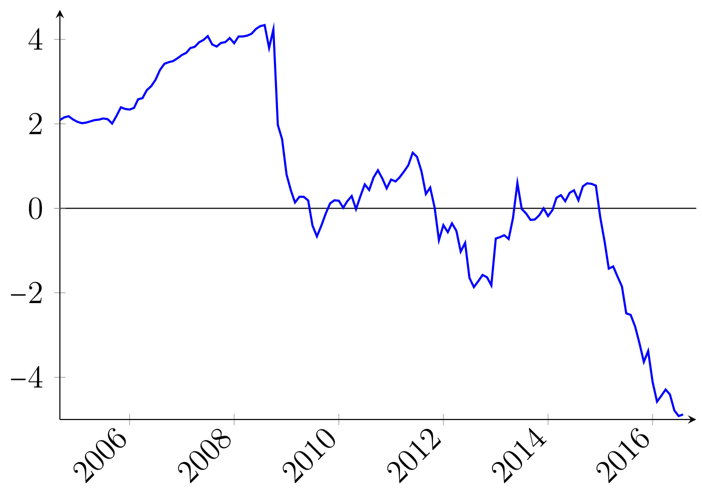


Note: Impulse responses from an UMP easing shock. 68% confidence intervals (2000 replications).

Furthermore, a different approach of modelling UMPs is added. Generally, there is the challenge of modelling standard and unconventional monetary policies together. With policy rates approaching the zero lower bound, they no longer contain information about the monetary policy stance. Thus, typically two separate indicators have been applied to capture additional monetary policy actions. One way, which is presented in the models before, is to use an indicator for standard policy rate decisions (e.g. the EONIA rate) and to add another indicator for unconventional measures (e.g. excess reserves).

Wu and Xia (2016) try to combine both policy measures by constructing a single indicator which captures both kinds of monetary policies. It subscribes amounts of quantitative and qualitative easing policies in a way to add them to the policy rate once they reach the ZLB via a shadow rate term structure model (SRTSM)—first proposed by Black (1995). Since the UMPs provide the economy with further monetary easing, their indicator can fall below the ZLB, to allow for this structural break. They call their indicator the *shadow rate*. This indicator can then better capture the more expansionary monetary policy stance than only taking the central bank refinancing rate, which is constrained by the zero lower bound (see Figure 5.9).

Figure 5.9: Shadow rate for the Euro area

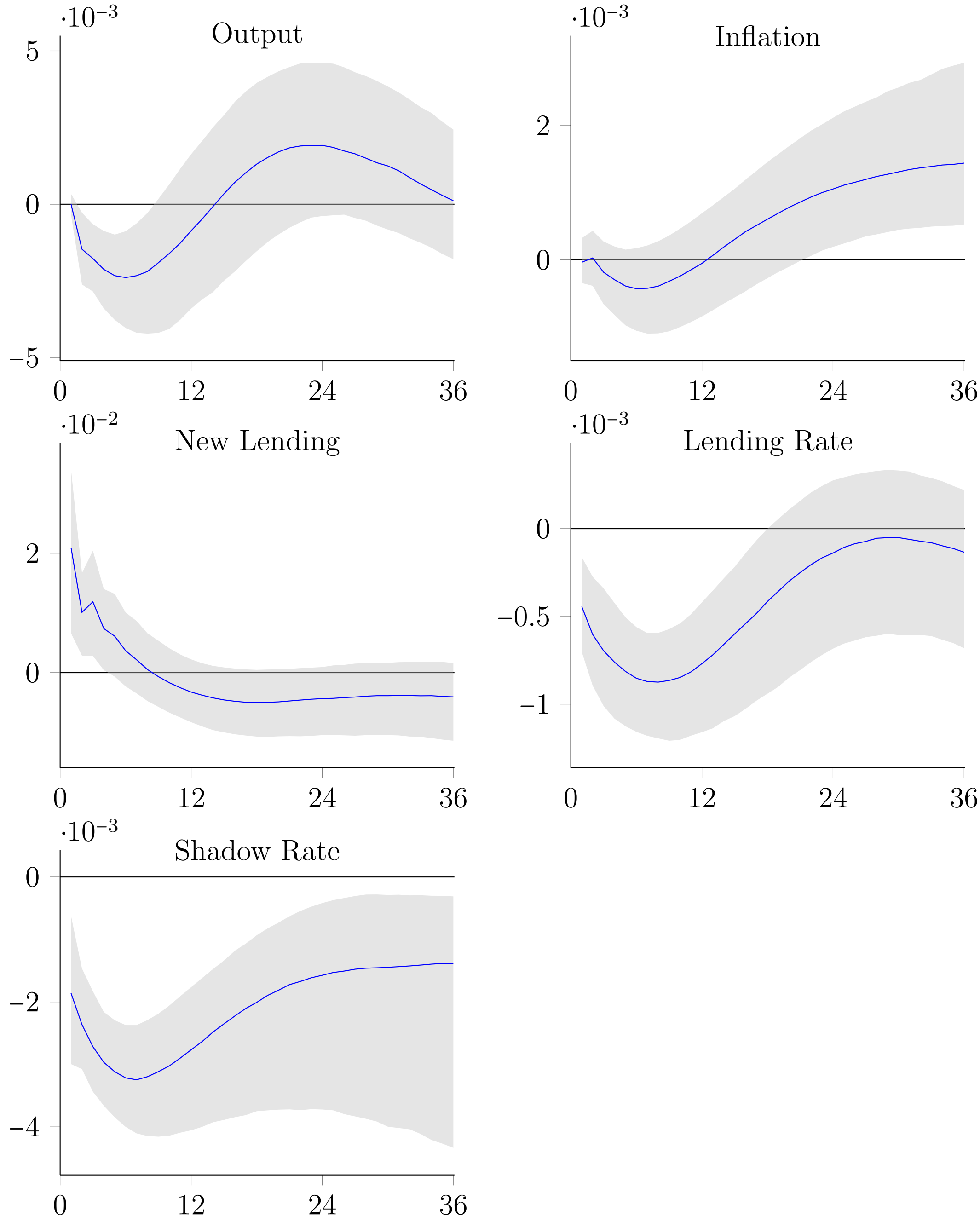


The benchmark model here is then estimated with the shadow rate as the only policy tool, leading to a SVAR model with five variables. The sign restrictions are the same as in the baseline model for the other four variables. The sign for the shadow rate is assumed to be non-positive, to also estimate a policy easing (see Table 5.5). Results are again almost the same as for the other specifications. New lending reacts positively for the first three periods and is insignificant afterwards (see Figure 5.10). Output shrinks for the first eight periods after the shock, while inflation is not reacting significantly for the first two years after the shock, and becoming positive afterwards. Further, the lending and shadow rate are reacting negatively, which is in line with the further monetary easing.

Table 5.5: Sign restrictions for the shocks in the shadow rate estimation

	IPI	HICP	Lending	MIR	Shadow
UMP shock	0	0	≥0	≤0	≤0

Figure 5.10: UMP Shock using the shadow rate as the policy indicator



Note: Impulse responses from an UMP easing shock. 68% confidence intervals (2000 replications).

Irrespective of the specific unconventional policy variable applied in this section, lending reacts similarly to all of them. All responses of the other variables are also qualitatively the same in comparison to the baseline specification.

5.5 Discussion

This chapter identifies effects of the unconventional policy measures taken by the European Central Bank after the Financial Crisis on bank lending on the basis of a structural vector autoregressive model using sign restrictions. While taking some improvements to the estimation set-up in contrast to the existing literature, it is shown that the impact of the UMPs on bank lending had no significant long-term impact on new credit issuance. One reason is given by the application of the credit variable. By taking a measure of the outstanding stock of credit, as previous studies did, the response of lending to UMP shocks is significantly greater, than for the new lending variable. Furthermore, it is demonstrated that taking an indicator as the monetary base or total central bank assets for unconventional monetary policies could lead to distorted results.

Additionally, the mechanical money multiplier perspective could be refuted from a theoretical standpoint and is also not confirmed by the empirical findings. The notion that bank lending can be driven by an over-allotment of reserves can thus not be affirmed. Rather, the propositions as postulated by the endogenous money view, that lenders still have to find willing borrowers, even though they might be excessively equipped with reserves, is endorsed in this chapter. There is still a certain risk-reward analysis prior to loan extension at banks, to which the cost of further acquisition of reserves plays only a minor role. Thus, by lowering the price and increasing the availability of bank reserves, central banks are not able to mechanically control private credit issuance.

Although the unconventional monetary policies taken by the ECB were able to lower market yields and provided balance sheet relieve, they did not significantly boost economic activity (at least in the short-run; see also Mallick (2017) for similar findings for the US) and bank lending. They probably had a stabilising effect directly after the Financial Crisis, but were not really able to sustainably affect economic activity in the long-run. This argument is also similarly stressed by Goodhart and Ashworth (2012), for example.

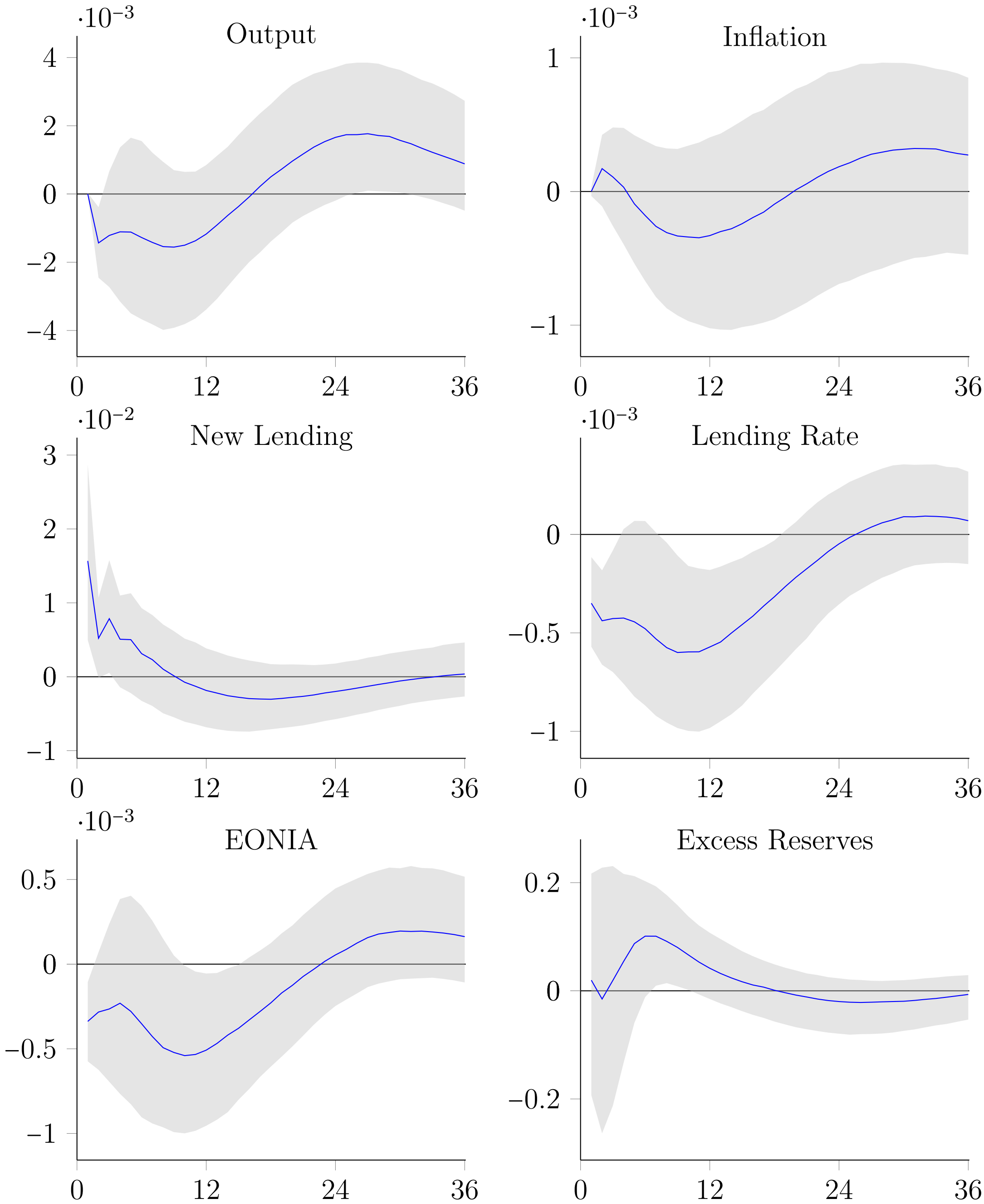
Furthermore, bank lending in the Euro area remains subdued due to the fallouts of the Financial Crisis. While the UMPs of the ECB have given banks some balance sheet relief, they were not able to lift economic expectations sufficiently to induce significantly more bank lending. One major problem for banks after the Financial Crisis was to find willing borrowers. A reason for the lacking credit demand can be seen in the deleveraging activities by many private and also public sector agents, as they were still highly indebted for the most part. This observation is also similar to the one Koo (2009) made for Japan and also stressed for the Euro area in Koo (2011, 2013), that after a debt-induced recession, loan origination cannot be jump-started by monetary policy to a large extent, since many economic agents still try to pay down their debts (a so called *Balance Sheet Recession*). Additionally, uncertainty about the recovery prevailed during the first years after the Financial Crisis subsequently constrained bank lending.

Appendix A5

Table 5.6: Summary statistics for the baseline SVAR model

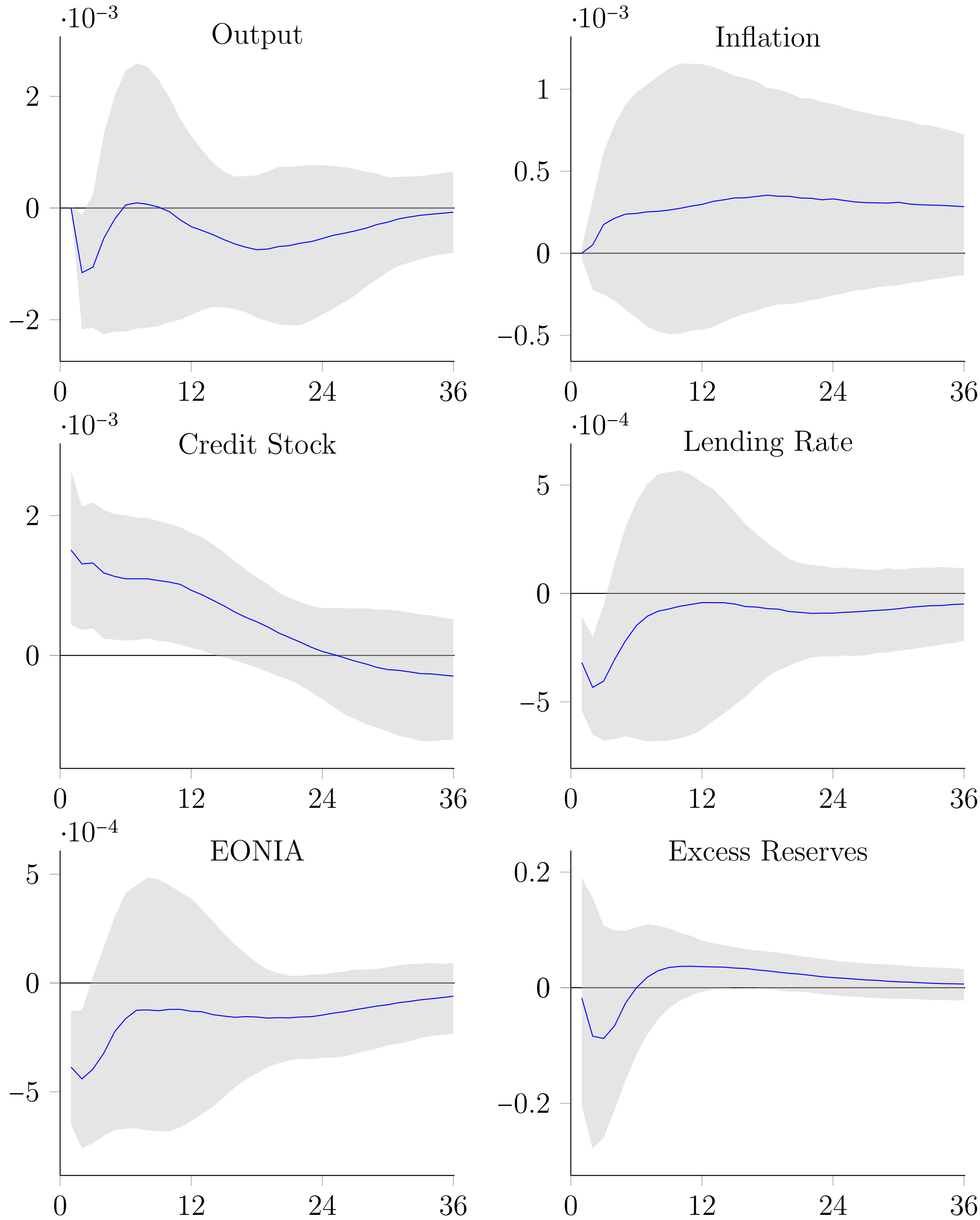
Variable	Obs.	Mean	Std. Dev.	Min.	Max.
IPI	108	4.618	0.050	4.539	4.754
HICP	108	4.566	0.039	4.486	4.609
New Lending	108	4.420	0.207	4.143	4.900
Credit Stock	108	4.772	0.045	4.690	4.844
MFI Rate	108	0.030	0.011	0.017	0.057
EONIA	108	0.009	0.014	-0.003	0.043
Reserves	108	11.560	1.871	6.837	13.614
Monetary Base	108	14.093	0.250	13.637	14.569
MP Rate	108	0.012	0.013	0.001	0.043
Shadow Rate	108	0.001	0.022	-0.049	0.043
Spread	108	0.551	0.253	0.082	1.052
Announcement	108	-0.003	0.032	-0.219	0.144
Announcement2	108	0.250	0.435	0	1
2-yr Bund Rate	108	0.020	0.024	-0.004	0.136

Figure 5.11: Standard monetary policy shock on new lending



Note: Impulse responses from a standard monetary policy easing shock. 68% confidence intervals (2000 replications).

Figure 5.12: Standard monetary policy shock on the credit stock



Note: Impulse responses from a standard monetary policy easing shock. 68% confidence intervals (2000 replications).

Deutsche Zusammenfassung

Während der als *Great Moderation* benannten Phase der späten 1980er bis zu den frühen 2000er Jahren setzte sich in weiten Teilen der akademischen Literatur die Meinung durch, dass die Zeit von großen Wirtschaftskrisen überwunden sei. Die Zentralbanken hatten es scheinbar durch ihre geldpolitischen Maßnahmen geschafft, die Wirtschaft auf einen stabilen Wachstumspfad nahe dem Potentialwachstum zu führen. Niedrige und stabile Inflationsraten sowie weit weniger und schwächere Rezessionsphasen schienen ein Indiz dafür zu sein.

Seit den späten 1980er Jahren wurde den Zentralbanken die Hauptaufgabe zugeschrieben für eine niedrige und stabile Inflationsrate zu sorgen. Diese Stabilisierung allein, so schien es, würde ausreichen, um für ein schwankungsfreies und dadurch nachhaltigeres Wirtschaftswachstum zu sorgen (siehe zum Beispiel Bernanke (2004), oder Blanchard et al. (2013)).

Typischerweise nehmen Zentralbanken heutzutage über die Steuerung kurzfristiger Refinanzierungszinssätze der Banken Einfluss auf das Wirtschaftsgeschehen. Diese Refinanzierungszinssätze dienen den Finanzmarktteilnehmern als Leitlinie, nach der sich wiederum ihre Zinsen richten. Eine Erhöhung oder Senkung dieser Leitzinsen wirkt dabei dämpfend beziehungsweise belebend auf das Wirtschaftsgeschehen, und beeinflusst somit wiederum die Inflationsrate.

Die gewonnenen Erkenntnisse im Bezug auf die Wirkungskanäle von Zentralbankmaßnahmen bedürfen jedoch einer Neubewertung im Zuge der Auswirkungen der *Globalen Finanzkrise* der Jahre 2007/2008 (siehe zum Beispiel Boivin et al.

(2010), oder Ramey (2016)). Notenbanken war es nach der Finanzkrise kaum noch möglich durch ihre primäre Politikmaßnahme Einfluss auf den Konjunkturverlauf zu nehmen, da die Leitzinsen in vielen Ländern nahe, oder an die Nullzinsgrenze gesenkt wurden. Die typische Transmission geldpolitischer Maßnahmen über den Zinskanal konnte somit nicht mehr gewährleistet werden.

Durch das Zurückgreifen auf gezielte Sondermaßnahmen, wie dem Bereitstellen zusätzlicher Liquidität, gezielten Wertpapieraufkäufen und/oder erweiterten Kommunikationspolitiken, erhofften sich die Zentralbanken zusätzliche Stimuli für die Wirtschaft zu erzeugen, um die negativen Auswirkungen der Finanzkrise abzumildern. Die primären Ziele lagen dabei auf einer Stabilisierung der Finanzmärkte in der kurzen Frist sowie dem Setzen zusätzlicher Impulse in der mittleren Frist, um die Kreditvergabe und somit das Wirtschaftswachstum wieder zu beleben.

Die vorliegende Dissertationsschrift setzt es sich, vor dem Hintergrund dieses veränderten Maßnahmenkatalogs der Zentralbanken, zum Ziel, ein besseres Verständnis von Zentralbankpolitiken auf den Einfluss der Wirtschaftssteuerung, und hier vor allem auf die Kreditvergabe von Banken, zu vermitteln. So wird der Frage nachgegangen, warum und wie sich Zentralbankmaßnahmen nach der Finanzkrise in Bezug auf die Wirkungen der Neukreditvergabe verändert haben.

Zunächst wird in Kapitel (1) der Transmissionsprozess von Zentralbankmaßnahmen beschrieben. Hier liegt der Fokus, wie auch im Rest der Arbeit, auf der geldpolitischen Transmission über das Bankensystem. Bestimmte Zentralbankpolitiken werden auf ihre Wirkungsweisen im Hinblick auf die Kreditvergabe der Banken an die Privatwirtschaft untersucht. Dabei wird das Hauptaugenmerk auf die veränderten Bedingungen nach der Globalen Finanzkrise gelegt.

Kapitel (2) unternimmt danach einen Erklärungsversuch, worin die Ursachen des langfristigen Rückgangs des allgemeinen Zinsniveaus in den entwickelten Volkswirtschaften in den letzten vierzig Jahren begründet liegen. Aufgrund dieses säkularen Rückgangs waren die Zinsen bereits vor der Finanzkrise auf einem relativ niedrigen Niveau, welches den Zentralbanken nur noch begrenzte Zinssenkungsspielräume zubilligte. Durch rasche Zinssenkungen nach dem Ausbruch der Finanzkrise wurden die Notenbanken vor die Herausforderung der Nullzinsgrenze gestellt und sahen sich dadurch gezwungen ungewohnte Politikmaßnahmen durchzuführen.

In der Literatur finden sich diverse Gründe, warum das allgemeine Zinsniveau bereits vor der Krise einen historisch fallenden Trend aufwies. Jedoch haben bisherige Studien (siehe zum Beispiel IMF (2014), oder Rachel und Smith (2015) für einen Überblick) den ausstehenden Kreditbestand einer Volkswirtschaft und die daraus resultierende geringere Fähigkeit für Zinszahlungen außer Acht gelassen. Diese Lücke soll durch das Kapitel (2) geschlossen werden.

Die grundlegende Hypothese dieses Kapitels liegt in der Erkenntnis, dass das Einlösen von Zinsversprechen an die Gläubiger von der angebotsseitigen Fähigkeit abhängt, Zinszahlungen Erwirtschaften zu können. In der langen Frist kann dies nachhaltig lediglich nur aus dem pro Periode erwirtschafteten Mehrwert geschehen. Durch die gestiegene Verschuldung in den meisten Volkswirtschaften in den letzten vier Jahrzehnten ist die Kapazität, Zinszahlungen aus dem aktuell erwirtschafteten Mehrwert zu leisten, jedoch deutlich zurückgegangen. Da die weiteren Faktoreinkommen—Gewinne und Dividenden aus unternehmerischer Tätigkeit sowie Lohneinkommen—in den meisten entwickelten Volkswirtschaften in den letzten vierzig Jahren nicht in dem Umfang zurückgegangen sind, um die gestiegenen Zinsforderungen durch die erhöhte Menge an Schuldkontrakten zu kompensieren, muss sich zwangsweise die durchschnittliche Zinszahlung pro

Schuldkontrakt, sprich der durchschnittliche Zinssatz, verringern. Dies hat im Umkehrschluss die Auswirkung, dass, solange die Wirtschaftssubjekte weder von der Substanz leben, noch alte durch neue Schulden ablösen, noch die Schuldenhöhe im Vergleich zur Wirtschaftsleistung senken, die durchschnittliche Zinszahlung pro Schuldkontrakt nicht steigen kann, ohne das andere Wirtschaftssubjekte, im speziellen Unternehmer und Lohnarbeiter, auf ihren Teil des Mehrwertes verzichten müssten. Zentralbanken sehen sich somit einer gewissen Restriktion im Bezug auf ihrer Fähigkeit Leitzinsen zu erhöhen, ohne potentiell ungewünschte negative Nebenwirkungen zu verursachen, gegenüber.

Die theoretischen Erkenntnisse aus Kapitel (2) werden im zweiten Teil der Arbeit, den Kapiteln (3) bis (5), aufgegriffen, um anschließend der Frage nachzugehen, wie und ob es die Zentralbanken geschafft haben, die Wirtschaft nach der Finanzkrise durch ihre zusätzlichen Maßnahmen zu stabilisieren. Das Hauptaugenmerk liegt dabei auf empirischen Schätzungen des Einflusses der Geldpolitik auf die Neukreditvergabe der Banken an die Realwirtschaft in der Eurozone.

Eine besondere Beachtung findet dabei die Verwendung von Kreditgrößen in empirischen Untersuchungen zentralbankpolitischer Transmissionen über das Bankensystem. Die überwiegende Mehrheit der empirischen Arbeiten zur Frage des Einflusses der Zentralbankpolitiken auf die Kreditvergabe verwendet als Entscheidungsvariable die Bestandsgröße ausstehender Bankkredite. Bei Fragestellungen, die sich mit dem Einfluss der Zentralbankpolitik auf die Kreditvergabe beschäftigen, ist die Änderung der Bestandsgröße jedoch nur mit Einschränkungen geeignet, da sie nicht den genauen Betrag der neu ausgegeben Kredite angibt. Neben der Neukreditvergabe beinhaltet die Veränderung des Kreditbestands noch Informationen über abgeschriebene und wertberichtigte Kredite, Rückzahlungen sowie Verbriefungen. Für Zentralbanken ist es bei der

Beurteilung der Transmission ihrer Politiken auf die Kreditvergabe aber von Interesse, wie sich die heutige und zukünftige Neukreditvergabe entwickeln wird, denn diese bewirkt unmittelbare Änderungen im realwirtschaftlichen Sektor. Wie sich der Bestand bereits ausgereichter Kredite verändert, ist dabei von nachrangigem Interesse.

Das Kapitel (3) geht dieser Erkenntnis aus einer theoretischen Sichtweise nach. Die einzelnen Posten der Änderung des Kreditbestands werden einer kritischen Analyse zu ihrer Aussagekraft für den Entscheidungsraum von Zentralbanken sowie privaten Nachfragern und Anbietern auf Kreditmärkten unterzogen. Das Hauptergebnis liegt dabei in der Erkenntnis, dass die weiteren Faktoren in der Änderung des Kreditbestandes sich zum überwiegenden Teil den Steuerungsmöglichkeiten von Zentralbanken entziehen. Zwar kann eine Zentralbank in gewissem Maße Einfluss auf die Schaffung neuer Kredite ausüben, jedoch entzieht sich die weitere Verwendung bereits geschaffener Kredite überwiegend ihrer Kontrolle. Aus empirischer Sicht besteht zudem das Problem, dass diese weiteren Faktoren nur bedingt mit der Neukreditvergabe korreliert sind. Dies impliziert, dass empirische Untersuchungen über die Wirkungsweise der Zentralbankpolitik auf die Kreditvergabe diese deutlich über- oder unterschätzen könnte, wenn die Änderung des Kreditbestandes als relevante Kreditgröße Anwendung findet.

Ein Blick auf die stilisierten Fakten untermauert die theoretischen Überlegungen. Für die USA ergibt sich im Zeitraum von 1998 bis 2015 zwischen der Neukreditvergabe und der Änderung des Kreditbestands an kommerziellen und industriellen Krediten an Unternehmen lediglich eine Korrelation von 0.30. Das hat zur Folge, dass 70% der Änderung des Bestands nicht durch die Kreditneuvergabe erklärt werden können. Für die Eurozone ergibt sich im Zeitraum zwischen

2003 und 2015 eine Korrelation von 0.46 für Bankkredite an nichtfinanzielle Unternehmen. Insbesondere in hoch volatilen Zeiten, weicht die Änderung des Kreditbestands noch deutlicher von der Höhe der Kreditneuvergabe ab.

Ein weiteres Problem in diesem Zusammenhang betrifft das Timing. So könnten Zentralbanken zu divergierenden Entscheidungen kommen, falls sie nur auf die Änderung der Bestandsgröße bei ihren Politikentscheidungen schauen. So entwickelte sich die Kreditvergabe in der Eurozone laut EZB Monatsbericht vom Juni 2011 wie folgt: "Die Jahreswachstumsrate der MFI-Buchkredite an den privaten Sektor ... folgte weiterhin einem moderaten Aufwärtstrend; sie stieg ... auf 2,6% im April" (ECB (2011b)). Obwohl die Bestandsgröße wuchs, schrumpften die vergebenen Neukredite annualisiert um 11,2% im April 2011. Diese Unterschiede liegen in einer Verlangsamung des Rückgangs der Neukreditvergabe sowie in niedrigeren Abschreibungen und geringeren Wertminderungen bzw. gestiegenen Werterhöhungen des Kreditbestandes begründet. Von den beiden letztgenannten Einflussfaktoren werden jedoch kaum größere Impulse auf das Wirtschaftsgeschehen zu erwarten sein. Aufgrund der Betrachtung des wachsenden Kreditbestands stellte die EZB im Juli 2011 fest, dass sich, unter anderem aufgrund der gestiegenen Kreditvergabe, ein Preisdruck in der Eurozone ergeben könnte (EZB (2011a)). Zum Teil gestützt auf diese Feststellung sah sich die EZB veranlasst den Leitzins im Juli 2011 um 0,25 Basispunkte zu erhöhen. Die Zentralbank hätte eventuell andere Schlussfolgerungen gezogen, wenn sie im Gegensatz zum Anstieg des Kreditbestands den Fokus auf die weiter fallende Neukreditvergabe gelegt hätte.

Das Kapitel (4) greift die in Kapitel (3) gewonnenen Erkenntnisse auf und stellt eine empirische Untersuchung über Einflussgrößen für die Kreditvergabe an. Hierbei werden Unterschiede in empirischen Schätzungen zwischen der Benutzung der Bestandskredite und der Kreditneuvergabe aufgezeigt. Das Ziel dieses Kapitels ist es, Determinanten herauszuarbeiten, welche Kreditnehmer dazu bewegen einen Kredit nachzufragen sowie Kreditgeber veranlassen einen Kredit auszugeben.

Hierfür werden verschiedene empirische Zeitreihenmodelle, ähnlich der bereits vorhandenen Literatur, angewendet. Die überwiegende Mehrheit der Untersuchungen in der Literatur zieht den ausstehenden Bestand an Bankkrediten als zu erklärende Variable heran (so zum Beispiel Bernanke und Blinder (1988, 1992), Kashyap und Stein (2000), Kishan und Opiela (2000), oder Lown und Morgan (2006)). Die empirischen Untersuchungen anhand eines Panelmodells von acht Ländern der Eurozone innerhalb dieses Kapitels können aber zeigen, dass es sowohl auf der Angebots-, wie auch auf der Nachfrageseite zu teilweise erheblichen Abweichungen der Einflussfaktoren für die Kreditvergabe je nach angewendeter Kreditvariable kommen kann. Zusätzlich können die Spezifikationen mit der Neukreditvergabe als abhängige Variable die zugrundeliegende Theorie besser darstellen, als die Spezifikationen mit der Bestandsgröße. Diese Ergebnisse haben weitreichende Konsequenzen für die Beurteilung der spezifischen Einflussfaktoren der Neukreditvergabe sowie für die Wirkungsweise des Transmissionsmechanismus von Zentralbankpolitiken über das Bankensystem.

Ein Hauptziel der nach der Finanzkrise von der EZB durchgeführten Sondermaßnahmen war die Förderung der Kreditvergabe in der Eurozone. Aus diesem Grund wird in Kapitel (5) eine Untersuchung der Wirksamkeit dieser *unkonventionellen Maßnahmen* auf die Neukreditvergabe der nichtfinanziellen Unternehmen im Euroraum anhand eines strukturellen vektorautoregressiven Modells vorgenommen. Der überwiegende Teil der bisherigen Literatur konnte herausfinden, dass diese Maßnahmen einen positiv, signifikanten Einfluss auf die Kreditvergabe haben (siehe zum Beispiel Peersman (2011) und Gambacorta et al. (2014)). Jedoch benutzen diese Studien den Kreditbestand als relevante Kreditgröße. Wie in Kapitel (3) ausgeführt, kann diese Variable nur unzureichend die Höhe der tatsächlichen Neukreditvergabe wiedergeben. Dies kann bei der in diesem Kapitel bearbeiteten Fragestellung zu divergierenden Ergebnissen führen.

Durch die Verwendung der Neukreditvergabe als relevante Kreditgröße kann gezeigt werden, dass die unkonventionellen Maßnahmen nicht die wie in bisherigen Studien gezeigte strikt positive Wirkung auf die Kreditvergabe entfalten konnten. Zwar steigt die Neukreditvergabe auf einen unkonventionellen Politikschock, diese positive Wirkung hält aber nur in der kurzen Frist an.

Zusammenfassend zeigt die vorliegende Dissertationsschrift auf, dass Zentralbankmaßnahmen in den Jahren nach der Globalen Finanzkrise nicht in dem Umfang auf die Kreditvergabe wirken, wie sie noch vor der Krise zu beobachten waren. Eine Ursache wird in einer zu starken Verschuldung der Wirtschaftsakteure gesehen, welche wesentlich zum vorherrschenden Niedrigzinsumfeld beigetragen hat. Zusätzlich ist es bei der Betrachtung des Einflusses von Zentralbankmaßnnahmen auf die Kreditvergabe geboten, den tatsächlichen Betrag der Neukreditvergabe, anstatt die Änderung des Kreditbestandes als Entscheidungsvariable heranzuziehen.

Auf eine Diskussion über potentielle Nebeneffekte der unkonventionellen Maßnahmen, wie zum Beispiel eines möglichen Verlustes der politischen Unabhängigkeit von Zentralbanken, den Einfluss auf Vermögenspreisinflation, oder Vermögens- und Einkommensverteilungen, sowie einer Problemanalyse bestimmter Ausstiegsstrategien aus den unkonventionellen Maßnahmen, wird dabei bewusst verzichtet, da diese über das Ziel der Arbeit, nämlich dem aufzeigen der Wirkungen von Zentralbankpolitiken auf die Neukreditvergabe, deutlich hinaus gehen würde.

Lebenslauf

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Aug. 2009 - Jan. 2010	**Universität Aarhus, Dänemark** Auslandsstudium
Okt. 2005 – Juni 2012	**Friedrich-Schiller-Universität Jena** Studium der Volkswirtschaftslehre Schwerpunktfach: Innovationsökonomik Abschluss: Diplom-Volkswirt
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Behrendt, Stefan (2017) – *Unconventional Monetary Policy Effects on Bank Lending in the Euro Area.* Jena Economic Research Papers, 2017-002, Friedrich-Schiller-Universität Jena.

Behrendt, Stefan (2017) – *Low Long-Term Interest Rates - An alternative View.* Jena Economic Research Papers, 2017-001, Friedrich-Schiller-Universität Jena.

Behrendt, Stefan (2016) – *Determinants of lending activity in the Euro area.* Jena Economic Research Papers, 2016-017, Friedrich-Schiller-Universität Jena.

Behrendt, Stefan (2016) – *Taking Stock – Credit Measures in Monetary Transmission.* Jena Economic Research Papers, 2016-002, Friedrich-Schiller-Universität Jena.

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Behrendt, Stefan (2013) - *Monetary Transmission via the Central Bank Balance Sheet.* Working Papers on Global Financial Markets Nr. 49/11-2013

Wissenschaftliche Vorträge

November 2016 — *Low long-term interest rates - An alternative explanation*
Doktorandenseminar (Prof. Dr. Hans-Walter Lorenz)

Februar 2016 — *Measuring the Bank Lending Channel wirth New Credit Creation in the Euro Area*
CGDE – Doctoral Workshop Magdeburg

Dezember 2013 — *Central Bank Balance Sheet Policies as a Risk to Financial Stability - Theory and Evidence*
Doktorandenseminar (Prof. Dr. Hans-Walter Lorenz)

Sprachkenntnisse

Deutsch:	Muttersprache
Englisch:	Verhandlungssicher
Französisch:	Grundkenntnisse
Spanisch:	Grundkenntnisse
Dänisch:	Grundkenntnisse

Software Kenntnisse

Fortgeschrittene Kenntnisse:	MS Office, Stata, Eviews, R, Latex
Grundkenntnisse:	Matlab, SPSS

Promotionserklärung

Erklärung gemäß §4 Abs. 1 Pkt. 3 PromO

Hiermit erkläre ich,

- dass mir die geltende Promotionsordnung bekannt ist;
- dass ich die Dissertation selbst angefertigt, keine Textabschnitte eines Dritten oder eigener Prüfungsarbeiten ohne Kennzeichnung übernommen und alle von mir benutzten Hilfsmittel, persönlichen Mitteilungen und Quellen in meiner Arbeit angegeben habe;
- dass ich bei der Auswahl und Auswertung des Materials sowie bei der Herstellung des Manuskriptes keine unzulässige Hilfe in Anspruch genommen habe;
- dass ich nicht die Hilfe eines Promotionsberaters in Anspruch genommen habe und dass Dritte weder unmittelbar noch mittelbar geldwerte Leistungen von mir für Arbeiten erhalten haben, die im Zusammenhang mit dem Inhalt der vorgelegten Dissertation stehen;
- dass ich die Dissertation noch nicht als Prüfungsarbeit für eine staatliche oder andere wissenschaftliche Prüfung eingereicht habe;
- dass ich nicht die gleiche, eine in wesentlichen Teilen ähnliche oder eine andere Abhandlung bei einer anderen Hochschule bzw. anderen Fakultät als Dissertation eingereicht habe.

Berlin, den 17. Februar 2017

Stefan Behrendt

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