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The Monetary Transmission Mechanism – an Analysis with Focus on German Banks

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Abstract

The present thesis investigates the impact of European Central Bank's (ECB) monetary policy measures on the lending behaviour of several German bank types by means of a structural vector autoregression (SVAR) analysis covering the past 19 years on a quarterly basis. Hence, the paper contributes to the ongoing discussion on the effectiveness of the monetary transmission mechanism's channels in times of unconventional monetary policy regimes.

The theoretical approach includes a thematic classification and presentation of the topic's relevance, while also money as such and the corresponding creation processes, including the money multiplier, are addressed. This is followed by a presentation of ECB's toolkit for monetary policy measures and how these are expected to influence the overall price level. The functioning of the transmission mechanism is analysed as well as the effectiveness of ECB's measures. Finally, SVAR is presented theoretically before the actual analysis and its results are displayed.

The analysis yields statistically significant models which assign only little importance to ECB's measures themselves. Rather, the lending behaviour of banks seems to be determined by them indirectly and additionally by other factors, such as the output and the demand for credit. Moreover, some distinct differences can be identified between the single bank types. In conclusion, the thesis provides further empirical evidence for the yet unsolved puzzle of how to motivate banks to increase their lending while showing various areas of possible further research.

Keywords: SVAR analysis, monetary policy, money creation, German banking sector

JEL classification: C32, E51, E52, E58, G21

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List of Abbreviations

ABSPP	Asset-backed securities purchase programme
ADF	Augmented Dickey-Fuller test
AIC	Akaike information criteria
APP	Asset purchase programme
BLA	Building and loan associations
CBPP	Covered bond purchase programme
CISS	Composite indicator of systemic stress
CPI	Consumer price index
CSPP	Corporate sector purchase programme
DSGE	Dynamic stochastic general equilibrium
BOE	Bank of England
ECB	European Central Bank
EONIA	Euro overnight index average
Fed	Federal Reserve System
FG	Forward guidance
GCEE	German Council of Economic Experts
GDP	Gross domestic product
HICP	Harmonised indices of consumer prices
ifo	ifo Institut – Leibniz-Institut für Wirtschaftsforschung an der Universität München e. V.
IMF	International Monetary Fund
IRF	Impulse response function
ISIN	International Securities Identification Number
LTRO	Longer-term refinancing operation
M1	Narrow money aggregate, base money
M2	Intermediate money aggregate
M3	Broad money (aggregate)
MFI	Monetary financial institution

MC	Monte Carlo simulation
MRO	Main refinancing operation
MRR	Minimum reserve requirements
NCB	National central bank
NFC	Non-financial corporation
OLS	Ordinary least squares
OMO	Open market operations
OMT	Outright monetary transaction
PSPP	Public sector purchase programme
QE	Quantitative easing
Repos	Repurchase agreements
SDW	Statistical Data Warehouse (ECB)
SHFMP	Securities held for monetary purposes
SMP	Securities markets programme
SVAR	Structural vector autoregression
TARGET2	Trans-European Automated Real-time Gross Settlement Express Transfer System, second generation
TLTRO	Targeted longer-term refinancing operation
VAR	Vector autoregression
VMA	Vector moving average

1 Introduction

1.1 Thematic Classification

The world, especially the euro area whose gross domestic product (GDP) has risen for 18 straight quarters (Draghi 2017), faces times of growing economies. The International Monetary Fund's (IMF) forecast on the world's as well as on many euro area economies' outputs has just recently been revised upwards (IMF 2018, p. 4), which is also reflected by the results of the current ifo[1] World Economic Survey: it shows that the respective countries' macroeconomic experts confirm these expectations and see most of the euro area experiencing a strong boom (ifo 2017, p. 31). In times of improving economic conditions, which normally lead to a rise in prices, central banks tend to tighten their stances towards monetary policy according to their goal of price stability. This can currently be obtained from looking at both U.S. Federal Reserve System (Fed) and Bank of England (BOE) which have raised their policy rates in December and November 2017, respectively (Fed 2017a and BOE 2017).

However, the highly anticipated first meeting of ECB's Governing Council in 2018 revealed that the policy rates will, for the moment, remain unchanged on their current, historic low level (ECB 2018b). In contrast to, e.g. Fed, the euro area does not face an inflation rate which meets the central bank's expectations, yet (Constâncio 2017). "There was a time, not too long ago, when central banking was considered to be a rather boring and unexciting occupation (…) Some thought that monetary policy could effectively be placed on auto-pilot. I can confidently say that this time has passed." With these words Mario Draghi, president of ECB, began his speech in front of students in Amsterdam University's Faculty of Business and Economics in 2013 (Draghi 2013). He refers to the various measures, ECB introduced after the outbreak of the subprime crisis. The collapse of Lehman Brothers in September 2008, fuelled by the afterwards forming European sovereign debt crisis, resulted in times of high uncertainty in financial markets and, ultimately, in a disrupted interbank market which "induced liquidity stress for the banking system" (Lewis et al. 2017, p. 1). Therefore, bank lending to the non-financial sector, which is one of the main drivers of inflation, decreased.

[1] Full name is ifo Institut – Leibniz-Institut für Wirtschaftsforschung an der Universität München e. V.

Moreover, the increased cautiousness in investments and uncertainty about the future affected the overall output which dropped sharply, as did the price level. These drastic economic developments in the markets threatened ECB's main goal of an inflation which is below, but close to, 2% p.a. (cf. Section 3.1). To address this issue, prevent the Eurosystem from collapsing, and enhance credit support (Trichet 2009a), ECB introduced measures which were of unprecedented amount and manner. Besides lowering the policy rate as much as ECB has done, they also include offering a fixed-rate tendering with full allotment, liquidity provision with an enlarged pool of collateral and at longer maturities. Foremost, ECB has processed large-scale asset purchases which are presently seen as the biggest bond-bubble in history, e.g. by David Folkerts-Landau who is current chief economist of Deutsche Bank AG (Fehr 2017).
Today, roughly five years after Draghi's speech, ECB still struggles with the offshoots of the two crises and some of the introduced measures are still in place, although they want to bring an end to the ultra-expansionary monetary policy in September this year. As will be later displayed in this paper, the so-called exit strategy is of major interest and importance for the markets.

Keeping the monetary policy as it is, on the other hand, does not reflect the conditions of all Eurosystem countries equally. ECB must cope with a distinct heterogeneity among euro area's member countries and especially Germany, as most influential country of the Eurosystem (cf. Section 3.4.2), experiences market conditions which would normally demand a change in the monetary policy stance. The business climate index has reached a new all-time high (ifo 2018), while the consumption index has reached the same spheres as in 2001 (GfK 2018), shortly before the burst of the dotcom bubble. Moreover, the unemployment rate is on an all-time low and according to the current annual report of the German Council of Economic Experts (GCEE), the consumer prices seem to normalise with expected values of 1.7% and 1.8% in 2017 and 2018, respectively (GCEE 2017, p. 137). Meanwhile, they even speak of an over-utilisation of the German economy, i.e. output gap, as its GDP is expected to rise by 2.3% and 2.2%, respectively, while its potential growth rate is estimated to be at approximately 1.4%. The main driver for this development is private consumption since it constitutes for roughly one half of this growth (ibid., pp. 117f).

With respect to the just made arguments, one could argue that ECB's unconventional measures managed to incentive German banks as well as consumers and non-financial corporations (NFC) to increase their use of credits to be able to invest. In fact, the current bank lending survey shows that German monetary financial institutions (MFIs) expect a growth in all types of credits in the upcoming three months which is associated to the favourable conditions they can offer, i.e. reduced collateral standards and interest rates due to low re-financing costs (Bundesbank 2018a). However, the actual link between monetary policy and its ability to influence banks is still unclear and has become of greater interest in research recently again (Bundesbank 2017a). The growth of the broad money aggregate M3, for instance, has been relatively small in comparison to the sharp increase in base money due to ECB's measures, here especially the reserves of commercial banks (cf. Section 2.3). Adding to this, M3 does not move in tandem with loans to NFCs anymore, as it has been in the past, but is mostly driven by the banks' exposure to sovereigns (Hüther et al. 2015, p. 5).

In general, the monetary transmission mechanism, i.e. the channels through which central banks influence market conditions, has been studied extensively both in times of standard and non-standard policy regimes. And while the effects of standard measures are well understood, yet "no consensus to what extent those [unconventional] measures are effective in bringing inflation and output back to their target level" (Lewis et al. 2017, p. 1) has been reached.

1.2 Research Objective and Course of Investigation

It is now the aim of this paper to analyse the impact of ECB's measures on German banks' lending as this is one of the main drivers for reaching their overall goal of price stability. The number of banks in Germany has decreased remarkably over the past two decades: in the beginning of 1999, there were 3,168 active MFIs, while today only 1,639 have remained (Bundesbank 2003, p. 104 and 2018c, p. 104).[2] Still, it is a very saturated and fragmented market with comparatively many participants. At the end of 2016, the German portion of less significant institutions within the European Single Supervisory Mechanism equalled crucial 53% (ECB Banking Supervision 2017, p. 4). Hence, it is worthwhile to analyse, whether these banks have behaved differently on

[2] As of October 2017.

ECB's measures and where this possible deviation may be rooted in. To provide empirical evidence, a structural vector autoregression (SVAR) is performed, using German data on GDP, consumer price index (CPI), different variables representing ECB's policy measures, a composite stress indicator, and, of course, data on German banks' lending. This selection is a combination of already suggested approaches by other authors (cf. Section 5.1.1) but for the first time, differences between the single bank types shall be identified. To reach this goal, the paper uses published Bundesbank data on quarterly basis from 1999Q1 to 2017Q3 in an aggregated form which differentiates between several bank types, such as commercial banks and Sparkassen, and, moreover, between two types of borrowers, i.e. NFCs and consumers.

The remainder of this paper is structured as follows. First, money as such is defined in Section 2. There are many possible definitions and it seems intuitive to define money as it builds one central aspect of this paper. Afterwards, the creation process is displayed. Here, both the creation of broad and base money is discussed as well as the corresponding discourse in the literature of the past decades. This includes, amongst others, a brief discussion of the money multiplier approach. The last part of this section is devoted to monetary aggregates, and their importance in ECB's monetary policy which is addressed in Section 3. After displaying the primary objective and the underlying motivation in detail, ECB's general approach of conducting monetary policy is presented. Next, both conventional and non-conventional measures are discussed. Section 4 concentrates on the monetary transmission mechanism. The theory behind its functioning is presented as well as discussed against the background of some theoretical re-interpretations and empirical evidence. Concluding this section, a literature review on the functioning of the transmission mechanism is presented which is, likewise, one on the effectiveness of ECB's monetary policy as such. The own empirical work is displayed in Section 5. First, the data is described, covering both the macroeconomic inputs and the aggregate bank level data on loans. Additionally, the four bank types under consideration are displayed with the focus lying on the commercial banks. Afterwards, the theoretical backgrounds of SVAR and the underlying characteristics are presented and applied on one data set to enhance comprehensibility. Furthermore, this section provides the results of the actual analysis, interpretations and the model's limitations. Section 6 concludes with providing various areas of further research as well as a summary of this paper's content.

2 Money – Definition and the Creation Process

2.1 Functions

The term money as such refers to various meanings and it is often defined by its functions.[3] Above all, it is the most liquid asset of an economy and, therefore, the most accepted vehicle of trade. With money, so-called barter trade, i.e. asset to asset, has become unnecessary because it is possible to trade directly (Belke et al. 2017, p. 503). Besides its trade function, money is also a unit of account, facilitating the comparability of two different goods. Without this function, both private households and corporations would have big troubles in comparing the good's value, especially due to the corresponding subjective perceptions (Conrad 2017a, p. 65). Another function is its ability to store value. Money holders can decide on their own, when to trade it into goods without having the fear of spoiling. Of course, one could immediately think of inflation as some kind of spoiling in the context of money. As a matter of fact, "inflation is always and everywhere a monetary phenomenon," as Milton Friedman wrote with great attention in 1963 (as quoted by Mishkin 1984, p. 2). However, this topic is not addressed at this point but in Section 3.1.

As last function of money, it transfers value into the future, as so-called standard of deferred payment (Belke et al. 2017, p. 504). Goods may be exchanged today, e.g. the resources for building a house, even though the monetary transaction is terminated at the end of the process. This agreement can only happen due to the trust of both sides in the value of money. In most economies today, money is the only legal tender, i.e. it needs to be accepted in case of any economic transaction. Yet, still nowadays there are also situations in which money is not used as medium of exchange anymore, e.g. in cases of extremely high inflation or volatility (see for feasible examples Doepke et al. 2013).

[3] These functions are closely linked to each other, leading to a different number of them in literature. However, this paper identifies four of them.

Besides the different functions of money, also different forms of it can be distinguished (following list based on Belke et al. 2017, pp. 505f.):[4]

- **Commodity money**: a raw material used as money, e.g. gold or silver, has an actual intrinsic value, even when it is not used as money
- **Token money**: coins whose face value exceeds the material value
- **Fiat money**: paper money without physical back-up, issued by a government which declares its value, i.e. non-redeemable money
- **Central bank money**: money issued by central banks, both through current accounts of commercial banks and currency, so-called high-powered money
- **Book money**: money issued by commercial banks through, for example, credits to non-banks on current accounts

Customers of commercial banks, looking at their current accounts, see book money which equals a receivable from their bank (Conrad 2017b, p. 363). This money is in most cases not backed by central bank money and banks do only have a small portion available to satisfy the expected need of their customers for cash, i.e. so-called working balances. How much they have in stock, depends on the single bank`s policy (McLeay et al. 2014, p. 11). To increase the confidence in these receivables, there are certain mechanisms in place which protect the depositor's money in case of bankruptcy of their bank.[5] At the very moment, customers withdraw money from their accounts to get cash, they change the receivable from their bank into one from the central bank because of its "position as the only issuer of (…) money" (ibid., p. 6). Today, this money is fiat money, meaning that customers cannot exchange it into something different than fiat money since it is not linked to any commodity anymore.[6] Likewise, this means that the central bank will always accept the money, even though there may be newly designed bank notes issued in the meantime (cf. ibid., p. 10). While there is no doubt about the monopoly of central banks to issue money, there is a persistent discussion in literature on the ability of commercial banks to create money. The following sections take a closer look at this issue.

[4] This list is without the claim to comprehensiveness.
[5] For further information see Compensation Scheme of German Private Banks and Einlagensicherungsfonds (only in German).
[6] In the past, there has been the possibility to exchange it, e.g. into gold. See the Bretton Woods system of 1973, addressed in, for instance, Bundesbank 2013.

2.2 Banks' Ability to Create Money

Sir Josiah C. Stamp, former director of BOE, wrote in 1927: "The general public economic mind is in a fair muddlement[7] at the present moment on the apparently simple question: 'Can banks create credit, and if so, how, and how much?'" (Stamp 1927, p. 424). Interestingly, this topic is still not settled today. According to Werner 2014, there are three core hypotheses on banks' ability to create money, all rooted mainly in the past century. Each was dominant for ca. three decades, but he also points out that still today, all three find application (p. 1). Furthermore, there are institutions such as the BOE which "manage to issue statements in support of all three theories" (ibid., p. 12). In the following, they are presented in short.

The first theory is called credit creation theory and it is assigned to the late 19th century and the twenties of the 20th century, respectively. Influential writers like Macload were convinced that banks can virtually create credit out of nothing, as can be seen with the following quote: "A bank is therefore not an office for 'borrowing' and 'lending' money, but it is a Manufactory of Credit" (Macload 1891, as quoted by Werner 2014, p. 3). Moreover, banks are not only not limited in their lending, but also "(…) able to grant at any moment any amount of loans at any, however diminutive, rate of interest" (Wicksell 1907, as quoted ibid.). A further development of this theory is the quantity theory of credit,[8] which separates productive and non-productive usages of credits (Werner 2014, p. 6).

The second theory is called fractional reserve theory and is assigned to the 1930s and late 1960s (ibid., p. 3). The main difference to the previous theory is the belief that banks cannot limitlessly create credit on their own, but instead the banking system as a whole can (ibid., p. 6). For instance, Keynes (1930) elaborates: "When a bank has a balance at the Bank of England in excess of its usual requirements, it can make an additional loan to the trading and manufacturing world, and this additional loan creates an additional deposit (…) on the other side of the balance sheet of this or some other bank" (as quoted ibid., p. 7). Another popular author of this conviction was Paul Samuelson (1948) whose dictum of the fountain pen is well-known: "According to these false explanations, the managers of an ordinary bank are able, by some use of their

[7] Muddlement is a term from 19th century and means confusion (Oxford Dictionary n.d.).
[8] For further reading on this topic, see Werner 2012.

fountain pens, to lend several dollars for each dollar left on deposit with them" (as quoted ibid.). In his much-attended text book *Economics*, Samuelson draws a causal chain which begins with deposits of customers and bases the bank's lending possibilities solely on these deposits afterwards. Still today, this is a public misunderstanding of how the banking sector works, as shown in McLeay et al. 2014, p. 15. The same emphasis on the contrary relationship can be found in Jakab et al. 2015: "(…) loans lead to deposit creation, not vice versa" (p. 6). Additionally, in modern textbooks, Samuelson's multiple deposit expansion theory finds application (see Section 2.3).

The third theory about money creation is called financial intermediation theory. It is rooted in the 70`s of the past century and differs from the others insofar as MFI are put on the same level as other financial institutions in the market. "Any differences between banks and non-bank financial institutions are seen as being due to regulation and effectively so minimal that they are immaterial for modelling or for policy-makers" (Werner 2014, p. 2). Following this somehow current thinking, more recent economic models, such as New-Keynesian mindset, define money supply by the demand for money and not by decisions from banks. In a popular text book, Krugmann et al. (2014) write: "Banks use borrowed funds to make loans" (p. 595), which is, likewise, only part of the truth.

Werner concludes his literature review with the statement that it is not possible to derive a single truth from his research. Therefore, he conducts an empirical test in which he examines the single accounting steps of a regional German bank from the beginning of the lending process to the end at which the borrower gets the money on his account. He displays that the bank did not match or check the amount of loan with any existing current balances (Werner 2014, pp. 12-16).[9] This supports, in the end, the first theory to some extent. Other authors have come to the same conclusion that commercial banks are only partly restricted in their ability to create money and associate it with a threat for financial stability. They plead for the Chicago plan (Wolf 2014) which is a concept that demands every loan to be secured by a 100% reserve in cash, i.e. so-called debt-free money (Benes et al. 2012). According to these authors, the plan would lead to a safer and more resistant banking sector. Nowadays,

[9] He even includes a confirmation statement from the respective director of the bank that this step was not processed (see Werner 2014, Appendix 2).

only 9.4% of the money supply are built of physical cash (see Figure 2),[10] i.e. issued by ECB, which is assessed as risky circumstance that will probably lead to banking failure in case of another crisis (Dyson et al. 2016). On the contrary, it is argued that thoroughly planned regulation can accomplish the same amount of safety in the banking sector.[11] Additionally, changing the current system bares the risk that banks cannot pursue their economic functions anymore which are of decisive importance for the well-being of the economy (Bundesbank 2017a, p. 15).

However, it seems like Sir Josiah Stamp's abovementioned quote is still of significance today. Since it is not the aim of this paper to analyse whether one of these theories can be rejected, it will now focus on the actual creation process as it is described in contemporary economic textbooks.

2.3 Creation Process of Money

As displayed earlier, there is no single conviction on this topic. Nevertheless, this paper tries to display the basic assumptions which are regarded as useful for the upcoming analysis. This section is divided into two parts, due to the single specific characteristics of central bank- and book money.

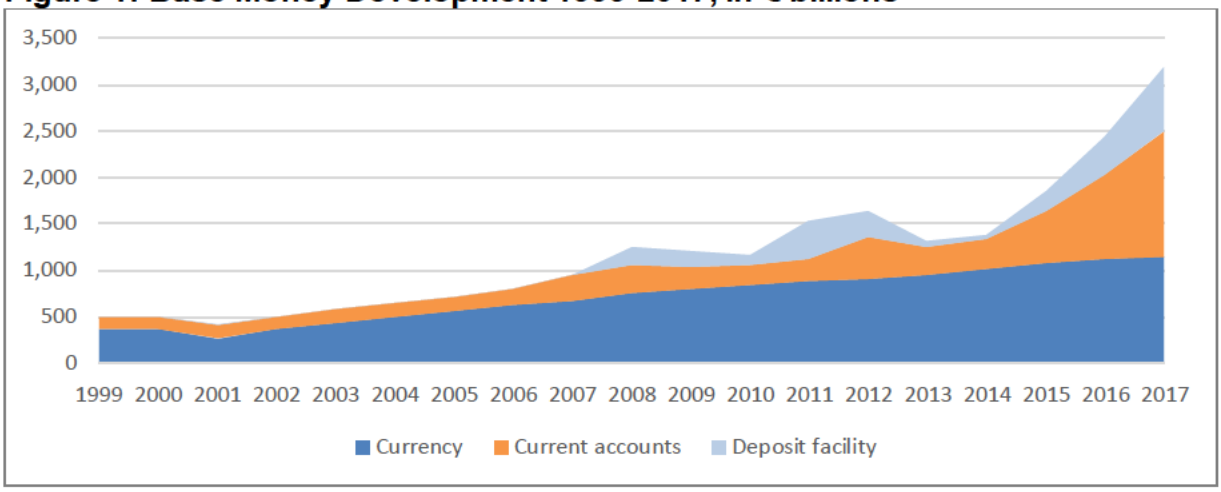
2.3.1 Creation of Base Money

Generally, central banks have the monopoly for printing money (Conrad 2017b, p. 363). Through issuance and destruction of money, respectively, they can influence the amount of outstanding currency. Figure 1 shows that the latter has been growing nearly constantly since 2002 and amounts to approximately €1.1 billion in 2017 (blue area). Together with currency, the overnight deposits that commercial banks maintain at their central banks (lighter blue and orange area), form the so-called base money (Belke et al. 2017, p. 509). Central banks influence base money not only through adjusting the amount of currency but also through policy decisions regarding the demand deposits of the banks. Section 3 takes a closer look at these deposits and how they are influenced. In addition to these minimum reserve requirements (MRR), commercial banks may also demand base money because of two other reasons. First,

[10] This number is taken from ECB. For example, in the United Kingdom it is even smaller with around 3%. Similar percentages hold true for nearly every other economy, as well (Dyson et al. 2016, p. 6).
[11] For a further discussion of the downsides of "100% Money" (Fisher 1935) see e.g. Bundesbank 2017a, pp. 33-36.

payments in the interbank market are processed with it and second, some non-banks have deposits at their banks in currency (cf. ibid., pp. 509f.).

Figure 1: Base Money Development 1999-2017, in € billions[12]



Own presentation, data taken from ECB Statistical Data Warehouse (SDW) 2017c.

Another way for central banks to create money is through open market operations (OMO). They are the main instrument for central banks to provide banks with liquidity or withdraw it from them and belong, hence, to the standard measures of monetary policy. They are illustrated in more detail in Section 3.3.1. In general, central banks buy different sorts of security from commercial banks, corporations, or governments and credit their demand deposits with the respective sum. Banks can then, for instance, use this money for reserve purposes. This process, of course, works the other way around, as well, reducing the liquidity of commercial banks when they buy securities from the central bank (Conrad 2017a, p. 123).

2.3.2 Creation of Broad Money

Under normal circumstances, central banks do not interact with market participants beyond MFIs directly to influence the amount of outstanding money.[13] Instead, commercial banks issue broad money through similar processes like the central bank does, i.e. giving loans to or buying securities from non-banks (Belke et al. 2017, pp. 516f.). The upper limit for these loans is then defined by three "main sets of constraints"

[12] As of December 2017.

[13] An exception is so-called helicopter money, as introduced by Milton Friedman in 1969, which stands for the distribution of central bank money directly to everybody. With this unconventional measure, for example, a recession or deflation shall be fought against and after outbreak of the subprime crisis, it has gained of public interest again. For further information see e.g. Buiter 2014 or Reichlin et al. 2013.

(McLeay et al. 2014, p. 17). First, the bank faces own limits, such as the MRR or the need to mitigate risk it faces with making loans. Here, also the so-called cash drain can be mentioned, referring to the individual amount, banks hold back to satisfy their customers' need for cash (Belke et al. 2017, p. 532). Second, it is constrained by the market, i.e. non-banks, and its behaviour. For example, when participants use the newly made loans to pay back other ones, they destroy broad money in the same instance and, thus, reduce the net growth in broad money. Lastly, loans are constrained by the central bank's monetary policy. With changing the circumstances at the market, such as the interest rate, it can influence the demand for borrowed capital (McLeay et al. 2014, pp. 17f.).

An important concept to think about within the money creation process for broad money is the money multiplier effect.[14] It is presented in many textbooks for economics (e.g. Conrad 2017a, Krugman et al. 2014, and Mishkin et al. 2011) and by some articles analysing the theory of money in banking (e.g. Diamond et al. 2006 and Friedmann et al. 2000). But nevertheless, it has been questioned many times which is partly due to the already stated fact that there is a public misunderstanding on how banks decide on their credit extension: "a common misconception is that the central bank determines the quantity of loans and deposits in the economy by controlling the quantity of central bank money – the so-called 'money multiplier' approach" (McLeay et al. 2014, p. 15). The basic assumption behind the money multiplier is presented by the following equation (Belke et al. 2017, p. 518):

Equation 1: Simple Money Multiplier

$$\frac{1}{r} = m$$

where r is the MRR and

m is the money multiplier

To illustrate how this misconception is understood, i.e. how it often is presented, it is assumed that a bank has a MRR of 5% and a customer deposits €100.- in cash. The bank credits his current account with this amount and generates an increase in its

[14] There are several money multipliers. Both for the different monetary aggerates (see Section 2.4) and for the ratio from broad- to base money (cf. ECB 2017c, p. 63).

central bank money. Due to the MRR, the bank must hold back €5.- which leaves it with remaining €95.-. It can now either let it this way, creating excess balances (see Section 3.3.3), or can make use of this money by lending it to another market participant. Inserting the 5% in Equation 1 leads to a money multiplier of 20. Therefore, the bank can make loans up to 20*95, equalling €1900.- in new money, without violating the MRR (example inspired by Belke et al. 2017, pp. 518-521). This concept is called multiple deposit expansion (Mishkin et al. 2011, p. 418) and is only a basic approach to think about the underlying process. As stated in Section 2.2, banks do not require deposits to grant loans, but create deposits by lending money.[15] Miskin et al. 2011 showed with further developments that the concept does not apply to currency (pp. 423f.). Furtherly, they identify the downside of the money multiplier model, being the intuition that central banks can, therefore, influence directly the amount of broad money by raising or lowering the MRR. If, for example, the ECB reduced the rate to 2%, there would be an increase in the money multiplier to 50, resulting in a possible lending of 50*95, equalling €4,750.-. This critique is not new; already in the late 1940s, famous economists like Paul Samuelson pointed out that "by lowering Member Bank legal reserve requirements, the Reserve Banks can encourage an increase in the supply of money and bank deposits. They can encourage but, without taking drastic action, they cannot *compel*" (emphasis in the original, Samuelson 1948, as quoted by Seidmann 2003, p. 216). He elaborates furtherly that banks cannot be forced to make loans and that they choose whether to do so on their own (cf. ibid.).

More recent and likewise important contribution has been published by Carpenter et al. in 2010. Using vector auto regression (VAR) analysis, they analyse both aggregate and bank-level U.S. data to identify, whether there is a causal relationship between the reserve balances and bank lending. They conclude "that the quantity of reserve balances itself is not likely to trigger a rapid increase in lending" (p. 29), while also OMO do not impact lending directly (p. 28).[16] Bundesbank writes in 2017a: the money multiplier "should not be broadly interpreted as causal relationship between reserves and the money supply" (p. 24). Here, the common metaphor is "pushing on a string" when trying to influence lending through adjusting base money. The halving of the

[15] For more details, see Bundesbank 2017a, pp. 18-20.
[16] A comparable analysis, focusing on Canada, can be found at Gianopoulos 2013. He draws similar conclusions concerning the money multiplier, although the results differ from those of Carpenter et al. concerning the analysed time frames.

reserve ratio (cf. Section 3.3.3) in 2012 showed clearly that the consequence is not a doubling of broad money through an expanded loan-making. "Overall, reserves play a marginal, if any, role" (Claeys et al. 2017, p. 8). Instead, the money multiplier should be used as a ratio and starting point for the analysis of the actual reasons behind the development of the so-called monetary aggregates (Bundesbank 2017a, p. 24).

2.4 Monetary Aggregates

Monetary aggregates are used to summarise different forms of monetary assets of the Eurosystem's consolidated balance sheet. They will be of further importance in Section 3.2.2 and can be illustrated as follows:[17]

Table 1: Monetary Aggregates – ECB Definition

Component	M1	M2	M3
Currency in circulation	X	X	X
Overnight deposits	X	X	X
Deposits with agreed maturity up to 2 years		X	X
Deposits redeemable at notice up to 3 months		X	X
Repurchase agreements			X
Money market funds shares			X
Debt securities up to 2 years			X

Own presentation, based on ECB 1999a, p. 36.

Table 1 shows how the different money aggregates can be derived. M1 is the biggest portion of them, making up for 65.6% of the money supply (see Figure 2), and consists of currency and overnight deposits. The latter is so-called overnight money: counter-parties of the ECB make overnight deposits via TARGET2[18] and get the accrued interest on it (Garcia-de-Andoain et al. 2014, p. 3). This deposit facility is negative since June 2014 (ECB SDW 2017a), i.e. banks are charged for "parking" their money at ECB for the next business day. This includes the excess reserves of the banks and the current accounts of their customers, which motivated some MFI to charge them in case they hold too much liquidity (Seidenbiedel 2016).

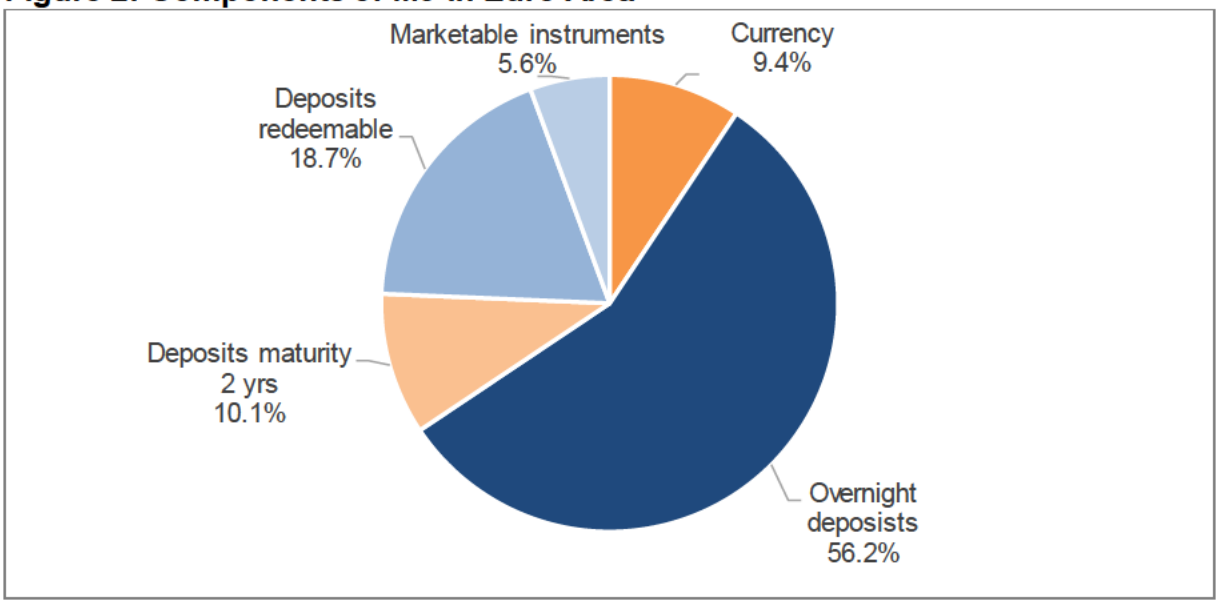
Next, M2 compromises M1 plus other short-term deposits which includes those that are not immediately redeemable or at least only redeemable under certain restrictions.

[17] This definition is taken from ECB. However, there are different definitions circulating, as well, see e.g. O'Brien 2006, p. 5.

[18] This abbreviation stands for Trans-European Automated Real-time Gross Settlement Express Transfer System and it is the real-time gross settlement system of the Eurozone to handle payments between banks and central banks of member states.

Converting them into narrow money may contain prior notification, fees, and penalty. For example, many private savings accounts in Germany have a three-month cancellation period (e.g. Commerzbank n.d.). In total, M2-M1 currently makes up for 28.7% of the money supply.

Figure 2: Components of M3 in Euro Area[19]



Own presentation, data taken from ECB 2018a, p. 1.

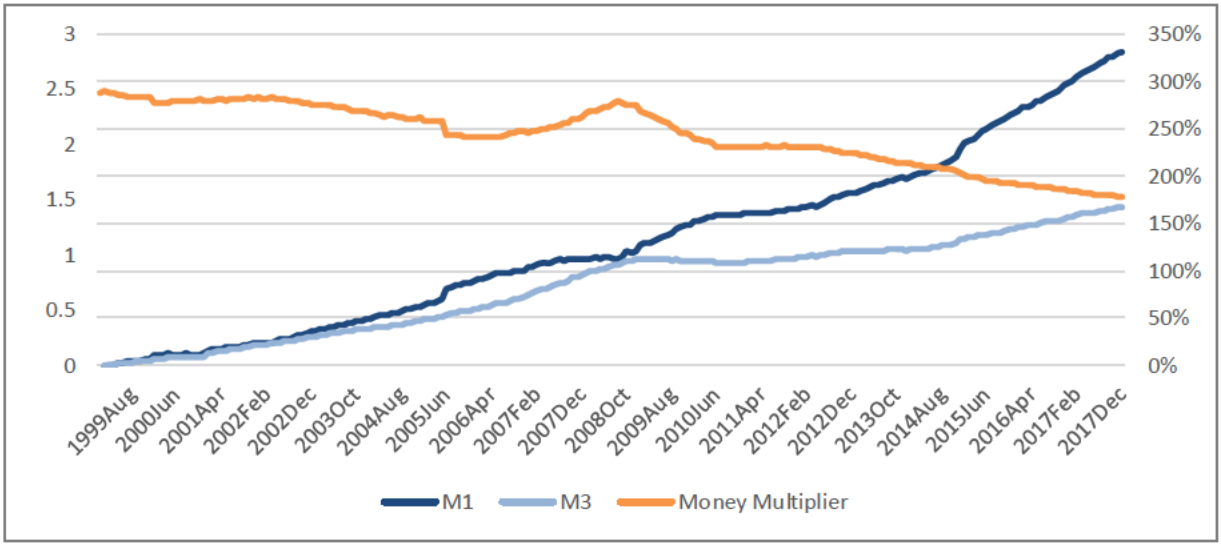
Lastly, M3 is the highest form of monetary aggregate. Especially here, central banks differ in the calculation or do not publish it separately at all (O`Brien 2006, p. 5). It includes M1, M2, and, in addition, some marketable instruments issued by resident MFI, such as repurchase agreements which are agreements between central- and commercial banks. They are concluded as monetary policy measure to reduce or increase the central bank money for a certain period of time (see Section 3.3.1). Furthermore, M3 includes money market funds shares which can be bought and sold by investors at any time. In return, those funds invest the money in short-term instruments, such as variable or fixed rate (up to twelve months) securities or bank deposits. The last position, the debt securities, consist of public bonds as well as bank debt- and corporate bonds. In December 2017, M3 equalled €11,870 billion, of which M3-M2 represented 5.6% (ECB 2018a, p. 1).

[19] As of December 2017.

Beyond M3, also other monetary assets find place on the consolidated balance sheet of the MFI sector, namely the so-called counterparts of M3.[20] They consist of MFI liabilities, i.e. holdings against central government and other longer-term financial liabilities, and MFI assets, i.e. credits to euro area residents, net external assets and residual counterparts of M3. Of the assets, the credits make up for the vast majority.

Figure 3 shows that prior to the subprime crisis, M1 and M3 grew relatively comparable. The money multiplier was rather constant at a rate between 2 and 2.5, i.e. M3 was more than twice as big as M1. However, with the outbreak of the crisis, this ratio experienced a feasible disentanglement: from then on, the base money has mainly been driven by ECB's monetary policy measures, instead of the demand-driven growth beforehand, here especially through the evolution of bank's reserve requirements (ECB 2017a, pp. 63f). M1 has grown remarkably, while M3 has grown considerably slower which reflects the worsened conditions at the financial markets, including, amongst others, a reduced loan making as one important counterpart of M3.

Figure 3: Monetary Aggregates and the Money Multiplier since 1999[21]



Own presentation, data taken from ECB SDW 2017d and ECB SDW 2018c.

It is clearly visible that the developments in monetary aggregates entails a lot of information for policy makers. And even though "[m]onetary economists had long recognized that central banks in practice treated the nominal interest rate rather than the

[20] A useful overview of the single components of M3 and its counterparts can, for example, be obtained in Bundesbank 1999, pp. 17-23.
[21] As of December 2017. Index = January 1999 for monetary aggregates (right hand scale), money multiplier as ratio from broad to base money (left hand scale).

monetary base or reserves aggregate as their policy instrument" (Nelson 2002, p. 1),[22] monetary analysis is seen as important measure, especially for longer-term horizons, to estimate the link between money and prices (Issing 2001a, p. 6). Monetary aggregates have been of significant interest for many researchers and several studies have provided evidence that the different aggregates bear predictive power and need to be analysed thoroughly. For instance, Brand et al. 2003 conclude (p. 321): "M1 outperforms (…) in terms of its predictive content for cyclical movements (…)". Masuch et al. 2003 add: "On empirical and practical grounds, we suggest that monetary developments contain information about the state of the economy which (…) should be integrated into the policy making process" (p. 219). In the following, ECB's toolkit for this process is presented.

3 ECB's Monetary Policy

3.1 Monetary Policy's Primary Objective

By now, ECB's dictum since 2003 to reach an inflation which is "below, but close to, 2% over the medium term," is its well-known main mandate (ECB 2003).[23] It is not the only objective, as ECB also wants to contribute to other economic goals, such as low unemployment and overall increased living standards. Yet, since monetary policy can, in the end, "only influence the price level in the economy, price stability is the best contribution that a central bank can make to economic welfare" (ECB 2011a, p. 57). Other central banks aim at approximately two percent, too, but in contrast to most of them, ECB does not perform inflation-targeting.[24] There is no widely agreed definition of the term inflation-targeting and what it implies for monetary policy. However, former president of the ECB, Wim F. Duisenberg, provided several arguments in 2001 why the ECB decided to not perform inflation-targeting. He named, amongst others, the

[22] Using reserve aggregates as policy instrument has become known as "reserve position doctrine", see for instance Bindseil (2004).

[23] This definition of price stability originally dates to five years earlier (ECB 1998a). However, in the prior definition, ECB only aimed at an inflation below 2% without any floor and the Governing Council clarified this number later for the named reasons.

[24] A difference between price-level-targeting and inflation-targeting can be seen with the following example. In case a period does not meet the set target rate, e.g. exceeds the two percent, ECB would ensure that the next period offsets this development while inflation-targeting allows such deviations without offsetting them (Mishkin et al. 1997, p. 10). Another difference lies in the circumstance that inflation-targeting also defines inflation as intermediate, i.e. shorter-term oriented, target (De Grauwe 2014, pp. 196f.).

circumstance that this approach does not give enough weight to monetary analysis which he saw crucial for an effective monetary policy (cf. Duisenberg 2001).
In 2012, BOE published an overview of inflation targets of different central banks around the world, showing that 27 "were considered fully-fledged inflation targeters" (Hammond 2012, p. 3), including Canada, New Zealand, Sweden, and United Kingdom aiming at approximately two percent each (cf. ibid., p. 9). Fed adapted this number later that year (Fed 2012) and Bank of Japan in the succeeding one (Bank of Japan 2013). In the following, some arguments of ECB for having set the primary objective as they did, are presented. First, a clear number (i.e. below 2%) is seen as better orientation than a range. In contrast, Canada sets its objective at 1 - 3%, under perfect conditions at 2% (Hammond 2012, p. 3). It is argued that a clear number provides a firm anchor for inflation expectations (Castelnuovo et al. 2003, p. 65) which increases the credibility and reliability both of the set price index and of the ECB itself, i.e. so-called "yardstick for accountability" for the public (Duisenberg 2001). In turn, those are important to equip market participants with the necessary confidence to pursue business in the euro area (Camba-Mendez 2003, p. 32f). As further reason to focus reliability, the time-orientation of "medium-term" can be named. It implies that there might be short-term deviations that ECB cannot fight against completely (ECB 2006, p. 2) and, furthermore, it has been shown that focusing the short-term is exacerbating boom-bust behaviours driven by expectations of productivity developments (Fahr et al. 2011, p. 38). Lastly, a clear number does not have the same thresholds, as a possible range has, which leaves the central bank with more freedom to act – unlike the thresholds of a range which imply automatic action in case they are exceeded (Castelnuovo et al. 2003, p. 44).

Additionally, the 2% should be "an adequate margin to avoid the risks of deflation" (ECB 2006, p. 2). This is important because, with monetary policy measures, deflation is harder to fight than inflation and it should, thus, be prevented resolutely (Bundesbank 2017b, p. 157).[25] On the other side, 2% seem to be just the right amount of inflation. Klaeffing et al. 2003 conclude that "2 percent would be the inflation target that would maximise the expected utility of the representative consumer" (p. 30). There are

[25] An interesting article on this topic was published by Ito et al. in 2006 on the stagnation in Japan, the so-called lost decade, which is a feasible example of an economy in deflation and the corresponding restricted possibilities of the central bank.

several arguments, why this seems to be true. For instance, resources can be used more efficiently, as the changes in prices reflect the respective scarcity of the product and not just a change of the monetary base. Moreover, stable prices ensure that there is no need for holistic hedging measures which, amongst others, decreases interest rates because these do not need to include inflation risk premia (ECB 2011a, pp. 56f.). Adding to this, Issing 2001 (p. 200) ends his analysis on price stability with: "Above all we must avoid the possibility that society reacquires a significant 'habitual' rate of inflation. (…) If inflation is allowed to rise then either society has to accept a situation which is clearly second best in the long-run or endure a painful period of reversion to price stability. (…) As Nicolaus Oresme, Bischof of Lisieux (1325–1382) noted, allowing the purchasing power of money to fall represents a betrayal of the people."

3.2 The Two-Pillar Approach

While trying to reach its primary objective and corresponding goals, ECB faces several uncertainties. Besides the possibly existing errors and insufficiencies in both data and applied models, also time lags play an important role (Belke et al. 2017, pp. 614-618, see also Section 4.1). These uncertainties are met with use of the so-called two-pillar-approach to gather as much information as possible. With the conduction of economic and monetary analyses, of which the latter is the longer-term-oriented one, ECB wants to identify the necessary steps that need to be undertaken (Issing 2001b, p. 25). "Furthermore, the possibility of imperfections in the data and the uncertainty associated with the reliability of the economic information available (…), call for a continuous cross-checking of information and analyses" (ECB 2000, p. 44). It is a further argument for an approach that bases on more than one information source.

3.2.1 Economic Analysis

Economic analysis is a short- to medium-term oriented assessment of determinants of risk to price stability. It focuses on actual financial and economic conditions in the euro area with a broad view on, especially, supply and demand. This is due to their influence on the goods, services, and factor markets in shorter time horizons (ECB 2006, p. 5).

To gain this knowledge, ECB regularly performs macroeconomic projections and inflation expectations of the market participants are derived by the analysis of asset prices and financial yields. For instance, different techniques, such as surveys, are in place

to find out what market participants imply with their buying or selling behaviour of state bonds. Moreover, ECB regularly reviews progresses of (ECB 2000, p. 42f.):

- The economic output in general
- Conditions at the demand and labour market
- The member states' fiscal policies, and
- Euro area's balance of payments.

Economic analysis is also called the second pillar and with it, "due attention is paid to the need to identify shocks hitting the economy" (Issing 2001b, p. 24). Also, since the goodness of the available data has recently increased, the broad economic analysis gives high-frequented indications for policy decisions which are based on evaluating non-monetary developments (cf. ibid., p. 25). Yet it is only the second pillar, because "forecasts can hardly incorporate all the information in a timely manner and can quickly become out of date. (…) [Additionally], models used to produce forecasts do not usually give an important role to monetary developments. In the euro area context, however, all evidence tells us that money should be an essential piece of information in the context of a forward-looking monetary policy" (Duisenberg 2001).

3.2.2 Monetary Analysis

With the previous quote, this paper has repeatedly emphasised the high value, ECB contributes to monetary analysis. It is the first pillar and the most important measure to gather the necessary information for monetary policy decisions.

ECB's monetary analysis relies on the relation between monetary growth and inflation in the medium- to long-term, while analysing also credit- and liquidity conditions. Hereby, the results of economic analysis can be cross-checked. ECB's commitment to monetary analysis can also be seen from looking at the benchmarking through the above-mentioned monetary aggregates (ECB 2006, p. 6). An annual growth rate of 4.5% of M3 was set as reference value and is reviewed on a yearly basis (ECB 1998b). This calculation is based on first, the desired inflation rate of closely below 2%, second, assumptions for real GDP growth of 2 - 2.5% p.a., and, third, the development of M3 income velocity,[26] declining 0.5 – 1% p.a. (ECB 2000, p. 41). However, it is not taken

[26] M3 income velocity refers to the circulation pace of money which is a key concept in monetary theory. For further information on the calculation see e.g. Brand et al. 2002.

as a target of monetary growth but, instead, "the reference value is intended to help the Governing Council analyse and present the information contained in monetary developments in a coherent manner" (Brand et al. 2002). Therefore, it can be taken as measure to assess the monetary developments through, for example, closely monitoring the different components of M3 as well as its counterparts to identify possible financial imbalances which might lead to destabilising effects on the price level (ECB 2006, p. 6).

In 2000, ECB organised a seminar on the tools and applications of monetary analysis. In the resulting report, one of the editors wrote that it "continues to be 'en vogue' among central bankers. (…) [T]he world's main central banks conduct some form of monetary analysis, with an increasing degree of depth and sophistication" (Klöckers et al. 2000, p. 9). However, the degree of importance still differs among central bankers: especially supporters of newer forms of Keynesianism argue that money is neutral in the long run and the analysis of the same is, hence, not necessary. In the end, it seems like the importance of monetary analysis is of subjective conviction. "As the experience of major central banks in the world has shown, there is no unique way for a successful conduct of monetary policy. Different traditions, practices or frameworks have different merits and also depend on historical circumstances and institutional environments" (Duisenberg 2001).

3.3 Conventional Measures

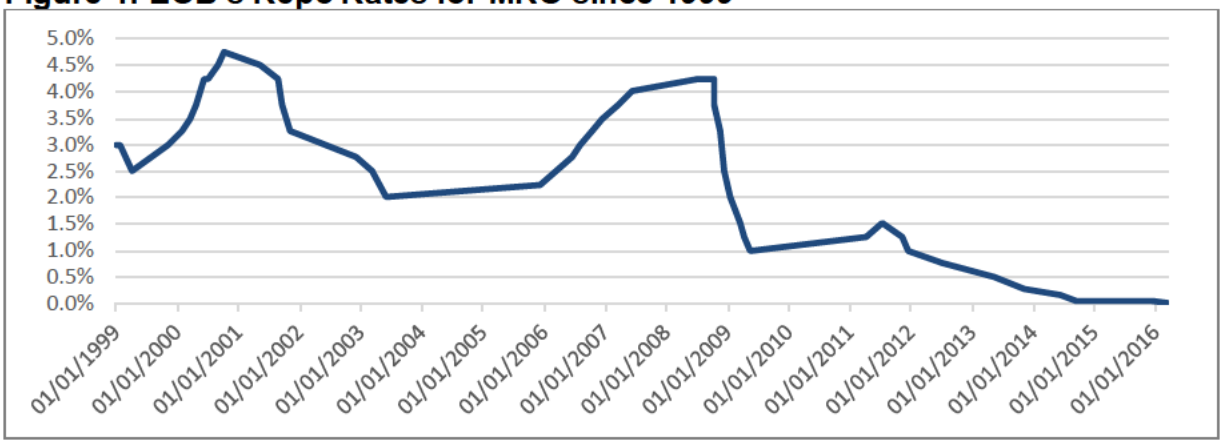
After displaying the mindset behind ECB's monetary policy, the actual measures are presented in this and the following section. It starts off with conventional, also called standard, measures. It needs to be mentioned that most of the measures are processsed in a decentralised manner, i.e. by the single national central banks (NCB). However, this paper does not distinguish between the Eurosystem and the ECB in this context.

3.3.1 Open Market Operations

ECB's most important measures are OMO which provide the banking sector with liquidity or withdraw it from them, respectively (Conrad 2017a, p. 123). There are five possible ways to conduct OMO, namely reverse transactions, outright transactions, issuance of debt certificates, foreign exchange swaps, and collection of fixed-term

deposits. Only the first one is presented because it is the most commonly used one due to its applicability to all four upcoming categories.[27] Reverse transactions refer to operations in which ECB buys or sells eligible assets under repurchase agreements, hereafter repos, or conducts credit operations against eligible assets as collateral (ECB 2002, p. 14). The eligibility of these assets is assessed by ECB. It differentiates between tier one and tier two assets, i.e. of secondary goodness, and has repeatedly relaxed these definitions after the outbreak of the subprime crisis to "facilitate the provision of increased credit by the Eurosystem" (Bindseil et al. 2017, p. 24).

Figure 4: ECB's Repo Rates for MRO since 1999



Own presentation, data taken from ECB SDW 2017a.

There are four categories of OMO of which the main refinancing operations (MRO) build the clear majority as approximately 70% of refinancing to the financial sector is executed with them (Conrad 2017a, p. 123). Figure 4 shows the repo rates at which banks can operate, equalling 0.0% since March 16th, 2016.[28]

Furthermore, MROs are "playing a pivotal role in (…) managing the liquidity situation in the market and signalling the stance of monetary policy" (ECB 2002, p. 14). These operations provide liquidity with a standard tender procedure with a maturity of, regularly, two weeks and an execution on weekly basis (cf. ibid.). In the past, there have been both fixed and variable tendering procedures, the first prescribing the banks the rate at which they may borrow and the second including a bidding procedure in

[27] The other four refer to: First, transactions in which ECB buys or sells eligible assets outright on the market, i.e. with full transfer of ownership. Second, the issuance of debt certificates to increase liquidity shortage, i.e. these certificates absorb liquidity. Third, swaps combining spot- and future transactions of euro against foreign currency to both reduce or increase liquidity, i.e. a non-standardised measure. And fourth, MFI are invited to store deposits for a fixed term at their respective central bank and get remunerated for it, i.e. another measure to reduce liquidity at the market (ECB 2002, pp. 16-19).

[28] Before the year 2000 and since 2008, MRO's have been performed with a fixed tender, however, from 2000 – 2008 there was a variable tendering.

which those MFI get the liquidity pro rata, which bid the most. Subsequently, not all banks received the desired liquidity. After the subprime crisis, ECB complemented the fixed tender with so-called full allotment, meaning that since then, the banks have always received the full amount of requested liquidity (De Grauwe 2014, pp. 198f.).[29] The figure in Appendix 1 shows the daily developments of OMO throughout the years. It is clearly visible that the number of operations increased significantly on path to the subprime crisis and became comparatively volatile in the years after the outbreak of the same which is also associated to the sharp increase in the number of bidders who made use of the full allotment policy (Eser et al. 2012, p. 21). In general, the usages of OMO, i.e. the demand for liquidity, closely mirrors the condition at the market. For instance, the decrease in 2012 is regarded as response on Draghi's famous speech in 2012 (see below) which relaxed the existing tensions and motivated the banks to pay back the operations at the first opportunity (Alvarez et al. 2017, p. 25).

In addition to MRO, there are also other maturities both shorter and longer. The short-term-oriented measures are called fine-tuning operations and are ad-hoc measures to react flexibly on changes in the market (ECB 2002, pp. 15f.). The longer-term refinancing operations (LTRO) with a standard maturity of three months[30] constitute for approximately 20% of MFI's refinancing under normal conditions (cf. Conrad 2017a, p. 123).

As last mean of OMO, ECB can execute structural reverse operations. They are used as solution in case, for instance, ECB wants to reduce liquidity permanently. It would then buy assets without any repo (ECB 2002, p. 16).

3.3.2 Standing Facilities

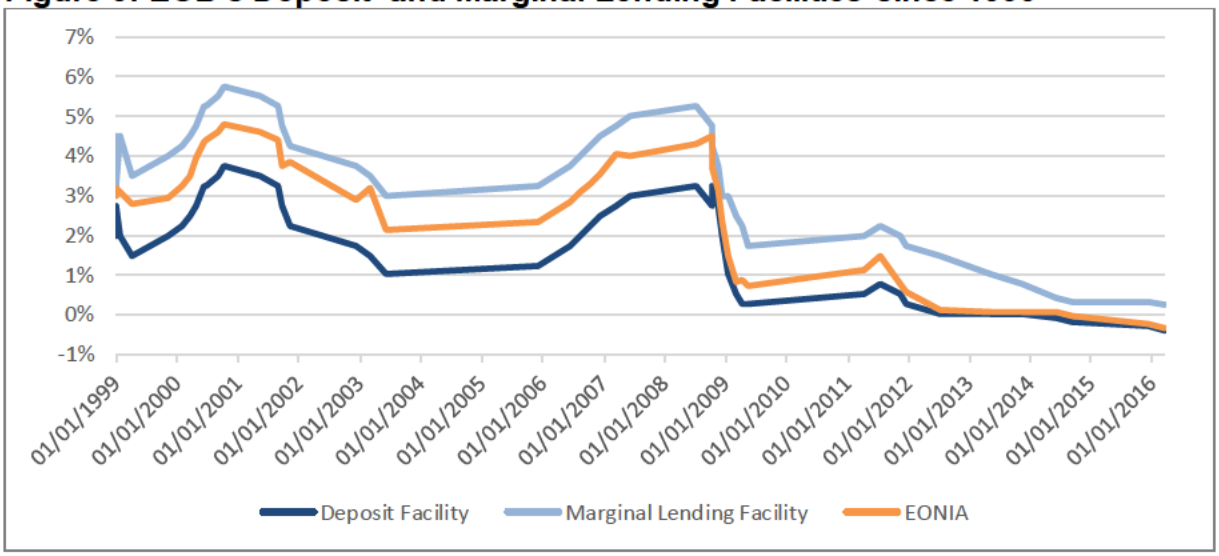
The next standard measure of monetary policy is standing facilities. They aim at absorbing and providing overnight liquidity, available for the counterparties on their own initiative and without limitation as long as they can provide adequate collateral assets (Conrad 2017a, pp. 123f.). Counterparties can either deposit their surplus liquidity with the Eurosystem and, under normal circumstances, get remunerated for it

[29] In addition to the full allotment, there were also operations issued in US-dollars and Swiss francs to counter difficulties of internationally acting banks (ECB 2011b, p. 60).

[30] There are also LTRO's of other maturity, e.g. one month or three years (Alvarez et al. 2017, p. 25). Additionally, in 2014 and 2016, respectively, ECB introduced targeted longer-term refinancing operations (TLTRO) in two series with a maturity of up to four years. The aim was the same: providing banks with incentives to lend money (ECB 2017c, p. 42).

(see Figure 5). Or, on the other hand, they can lend from the Eurosystem at the marginal lending facility. Since the deposit facility provides a floor, and the marginal lending facility a ceiling, "the two facilities together determine a corridor for the overnight market rate" (ECB 1999b, p. 51). This corridor shows under which conditions counterparties lend money from each other in the interbank market. It is measured by the weighted average of all overnight interbank market transactions, the euro overnight index average (EONIA). The width of the corridor varied over the years and experienced a sharp decline after the subprime crisis. Since the introduction of the euro, the width between standing facilities equalled ± 100 basis points from either side. Due to the subprime crisis, this corridor was narrowed to ± 75 basis points in 2009 (Eser et al. 2012, p. 36). However, ECB's upcoming unconventional measures created high volumes of liquidity which let the short-term money market rates converge towards the rate of deposit facility as this amount of excess liquidity exceeds the actual demand for it (Alvarez et al. 2017, p. 59). This can easily be obtained from Figure 5, as well.

Figure 5: ECB's Deposit- and Marginal Lending Facilities since 1999



Own presentation, data taken from ECB SDW 2017a.

Since June 11th, 2014, deposit facility has been negative and, hence, banks have been charged for parking their money. At the same time, marginal lending facility has declined further from 0.4 in 2014 to 0.25 in 2016, reducing the costs for banks to borrow decisively. To enable the NCB to process the counterparties' requests, they need to send it via TARGET2 at latest half an hour after the closing which is at 6 p.m. CET.

On the last day of reserve maintenance period,[31] this time is extended by another 30 minutes (ECB 2002, p. 22). Here, Appendix 2 and Appendix 3 show the daily amounts of usage of lending and deposit facility in actual numbers, respectively. It can be derived from Appendix 2 that the counterparties are not motivated to borrow more due to the attractive marginal lending facility. Instead, the peaks in lending can be found during hard times for the overall banking sector in the past two decades, such as the abovementioned crises, the burst of the dot-com-bubble (2001), and the struggles in the transition to Monetary Union.[32] Furthermore, it is clearly visible that these peaks are only of insubstantial nature and fall as quick as they have risen (Eser et al. 2012, p. 35). On side of the deposits, analysing the time before 2008 discloses only little information since the amounts were rather constant and on a comparatively low level.[33] This is an indicator showing that, under normal circumstances, the deposit facility as such is an unfavourable interest rate in comparison to the market rates and banks would normally deposit their liquidity at other counterparties' accounts rather than leaving it within the Eurosystem (Alvarez et al. 2017, p. 38). As already stated earlier, a huge amount of base money was created by ECB through the later displayed unconventional measures. It is clearly visible that the banks first hoarded these liquidities and used them later to repay the LTROs. However, in 2012, as the sovereign debt crisis intensified, the recourse increased tenfold, also due to the newly introduced three-year LTRO (Eser et al. 2012, p. 33). Shortly afterwards, as the deposit facility was reduced to zero in July 2012, the recourse fell drastically and even furtherly until 2014, with a negative deposit facility in the meantime (Alvarez et al. 2017, p. 40). Yet, ECB's expansionary countermeasures against the ongoing sovereign debt crisis, beginning in 2014, led again to a feasible increase in deposit facilities (ECB 2017a, p. 64).

3.3.3 Minimum Reserves

The imposition of minimum reserves for MFI's is the ECB's last conventional measure for monetary policy, though not actually used as an instrument (see also Section 2.3.2). It rather motivates MFIs to smooth their liquidity during the month, as the reserve

[31] Reserve maintenance periods are set by the ECB in advance, lasting from 42 to 50 days each (ECB 2016a).
[32] For a more detailed explanation of those struggles, e.g. "the downward risk to price stability", see (ECB 2011a, pp. 117-119).
[33] For details see the Excel file on CD, named "Deposit liquidity conditions".

requirements are calculated as monthly average of the daily reserve ratios. Hence, it stabilises the money market interest rates.

Table 2: Eurosystem's Reserve Base and Reserve Ratios

A. Liabilities incl. in the reserve base and to which a positive reserve ratio is applied
Deposits
Overnight deposits
Deposits with agreed maturity up to 2 years
Deposits redeemable at notice up to 2 years
Debt securities issued
Debt securities with agreed maturity up to 2 years
Money market paper
B. Liabilities incl. in the reserve base and to which a zero reserve ratio is applied
Deposits
Deposits with agreed maturity over 2 years
Deposits redeemable at notice over 2 years
Repos
Debt securities issued
Debt securities with agreed maturity over 2 years
C. Liabilities excluded from the reserve base
Liabilities vis-à-vis other institutions subject to the Eurosystem's minimum reserve system
Liabilities vis-à-vis the ECB and the national central banks

Own presentation, based on ECB 2002, p. 54.

Table 2 provides some details on how the computation is executed. First, the institution's balance sheet of the past month is taken as benchmark to calculate the single reserve base (ECB 2002, pp. 52f.).[34] A and B are, therefore, included in the calculation for the reserve base, although only A is affected by the reserve ratio which equals 1% since January 2012 (ECB 2012a, pp. 29f.).[35] In addition, certain portions can be deducted from A. Debt securities which are held by other institutions subject to the Eurosystem, namely the ECB, or NCBs, i.e. those with an agreed maturity of up to two years and money market papers, belong to C. In case an MFI cannot clearly tell how big this portion is, there is a standardised deduction. Until 2016, the deduction

[34] For smaller institutions, there might be a relief in form of a quarterly evaluation of the balance sheet (ECB 2002, p. 53).
[35] From 1999 to 2012, a reserve ratio of 2% applied to A (see ECB Regulation 1998, Art. 4, 2.).

percentage equalled 30% for debt securities and 15% for money market papers.[36] Since then, both numbers have equalled 15% (ECB 2016b). Lastly, the counterparties are allowed to deduct a further sum of €100,000 as lump-sum allowance of their individual reserve requirement (ECB 2002, p. 55). With respect to the different reductions, Appendix 3 displays the development of the Eurosystem's reserve balances. The sharp fall of them in 2012 is rooted in the abovementioned reduced reserve ratio. Still, there is a significant upwards trend visible, going hand in hand with the increased amount of deposits and credit activities of ECB's counterparties.

Summing up the already stated information on the MRR, the Eurosystem obliges every MFI to hold reserves whose amount is determined individually in relation to its reserve base. Under normal conditions, reserves are remunerated (currently this rate equals 0.0%) and have the function of stabilising interest rates and withdrawing liquidity from the banking sector. The voluntarily held excess reserves are remunerated differently, i.e. with the deposit facility (ECB 2002, p. 52).[37]

3.4 Unconventional Measures

Since the outbreak of the subprime crisis, ECB executed some steps beyond the aforementioned measures to prevent the financial system of the euro area from collapsing. However, there "is no consensus on how to define the extraordinary policy measures implemented by the ECB" (Rodriguez et al. 2014, p. 6). Some argue, they are rather defined by what they are not instead of what they are (e.g. Joyce et al. 2012, p. 272). In the context of the euro area, they were first mentioned by the former president of ECB, Jean-Claude Trichet in 2009 (cf. Rodriguez et al. 2014, p. 6). In his speech at the University in Munich, he said that ECB had introduced measures that "have become known as 'non-standard' measures," (Trichet 2009a) to enhance credit support. Some of them have already been discussed above, i.e. the full allotment of loans with fixed rates, relaxing the list of assets eligible as collateral, and the lengthening of the LTRO, all introduced in 2008 (Fawley et al. 2013, p. 62). These measures can be characterised as so-called credit easing, not to be mixed up with quantitative easing (QE, see below). Furthermore, the later adaption of both the

[36] Initially, there was a percentage rate of 10% each implemented in 1999, but these two were changed already in 2000 to the abovementioned ratios because of new statistical evidence (ECB 1999c).
[37] For details on the remuneration see ECB 2002, p. 55.

deposit facility, i.e. negative interest rates for the first time, and the reserve ratio (see also Trichet 2009b, p. 3) have already been discussed before. All of the non-standard measures were characterised as complementary to conventional measures, because they were not designed to provide additional monetary stimulus, but to support the effectiveness of the standard transmission policy (Cour-Thimann et al. 2013, p. 4). Moreover, they were presented as only temporary in nature (ECB 2011b, p. 55), though roughly one year later, Draghi said his famous words, confirming that "[w]ithin our mandate, the ECB is ready to do whatever it takes to preserve the euro" (Draghi 2012). By now, it is without question that the measures will be in place as long as the ECB assesses them necessary, while "some of them might even be deemed standard measures at some point" (Constâncio 2017).

3.4.1 Forward Guidance

Forward Guidance (FG) is one of the measures which has not been presented yet, and it is associated to the non-standard measures because it was used in an unprecedented manner. It refers to the expression of ECB's expectation concerning the future development of policy interest rates and was first introduced in 2013. In contrast to the communication before 2013, FG is not restricted on current and medium-term conditions, but on implications for the longer-term future (ECB 2014a, p. 65). As shown in different studies, these statements have decisive influence on the behaviour of market participants (e.g. Filardo et al. 2014 and Gürkaynak et al. 2004).[38] They can, furthermore, increase the understanding of the broad public regarding ECB's actions, thus providing guidelines for investment decisions. FG is processed in different categories, such as calendar-based guidance, i.e. linking certain expectations to the end of a year or a quarter, or outcome-based guidance, i.e. linking decisions to certain thresholds or numerical conditions of underlying variables (ECB 2014a, pp. 66-69).
However, the effectiveness of FG is subject to a substantial debate in literature with prominent representatives such as ECB's Vice President Vítor Constâncio expressing his doubts as follows (2017): "[E]conomists and policy makers around the world including myself, are much more sceptical about the power of forward guidance".

[38] In their study, Filardo et al. (2014) illustrate the ability of FG to reduce the volatility in near-term expectations of monetary policy, while on the other hand, it is not able to influence inflation expectations verifiably. Gürkaynak et al. (2004) find that FG explains the majority of variations in the yields of U.S. treasury bills around Fed's Committee meetings but point out the limited power of these communication tools with respect to their ability to stand on their own. It is rather usable as complimentary measure.

Recent studies differ in their results concerning the so-called "FG puzzle", for instance, Del Negro et al. 2012 conclude that FG has "on average, positive and meaningful effects on output and inflation" (p. 51). On the contrary, other researches find evidence that FG's ability to influence only holds true for complete markets and as soon as there are uninsurable risks, it has "substantially less power" (McKay et al. 2016, p. 3155). Regardless this debate, it can be stated that it supports ECB's transparency and, hence, its credibility. FG communications "aim at reinforcing (…) expectations on the overall policy orientation of the respective central bank. It is an essential condition for them to be credible," as stated by Benoît Cœuré, member of the Executive Board of the ECB, in 2013.

3.4.2 Large Scale Asset Purchases

Much media attention was attracted by ECB's asset purchases. There have been several packages, differing in their time horizons and scopes, all belonging either to credit easing or QE. Both programmes entail an increase in the central bank's balance sheet, but in contrast to pure QE, credit easing aims at restoring certain market- or interest rates and not only at a bigger monetary base (Fawley et al. 2013, p. 55).[39] Hence, credit easing focuses on the composition of the assets and their effect on the economy, while within QE, "the composition (…) of the asset side (…) is incidental", as its focus is solely the quantity of bank reserves (Bernanke 2009). QE was first applied in Japan in the beginning of the 21st century to fight the deflationary pressures of the 1990s (see also Footnote 25) while credit easing was used by Fed, ECB, and BOE after the subprime crisis. However, there were also ECB packages which can be assigned to pure QE. It is "the most high-profile form of unconventional monetary policy" (Joyce et al. 2012, p. 274).

Both easing measures can be OMO, since central banks buy or sell securities, not necessarily but often held by banks, to influence the banks' level of reserves. By increasing the reserves, central banks create excess reserves on side of the commercial banks which should motivate them to make loans. As concluded in Section 2.3.2, banks cannot be forced to make loans, but under normal conditions, banks would avoid holding excess reserves due to the low remuneration (cf. Section 3.3.3). Thus, the

[39] However, credit easing can likewise be facilitating for bank's lending, e.g. through the already named measures of a decreased standard of eligible collateral assets. The lengthening of the period of refinancing operations, such as the LTRO, can be assigned to it, as well.

central banks' rationale is an increase in loans which are then used by the broader economy to make investments which, in turn, increases asset prices and leads to inflationary movements in the end (Joyce et al. 2012, p. 274).

ECB conducted unconventional OMO for the first time in 2009. Yet, before looking at this, the securities markets programme (SMP) is shortly presented upfront. It was introduced in 2010 and entailed the purchase of government debt, performed at the secondary market. Its aim was to counteract the malfunctioning of the securities market, without influencing the monetary base, i.e. the purchases were sterilised to absorb the created liquidity (this was processed through fine-tuning operations, cf. Section 3.3.1). Moreover, there was no scope pre-defined, leading to a peak of holdings of approximately €220 billion in 2012 when the programme was terminated (Fawley et al. 2013, p. 72). In August of the same year, ECB announced that its outright monetary transaction (OMT) programme would replace SMP because of the lasting struggle of peripheral countries which had been in focus of this programme. OMTs consist of contingent operations buying sovereign bonds with a maturity yielding from one to three years and just like within SMP, the "liquidity created (…) will be fully sterilised" (ECB 2012b). The decisive characteristic of ECB's OMT announcement was that there was neither a time horizon nor a scope pre-defined (ECB 2017c, pp. 47f.). It is rather the unlimited commitment that ECB will buy as much and as long, as necessary. The programme is linked to several conditions that need to be met by the governments in case they want to make use of this offer. For instance, they need to accept structural reform packages when they want the ECB to buy from the primary market, i.e. directly from the issuing government (Fawley et al. 2013, p. 84).[40] Even though there has been no country using OMT yet, it has been argued (e.g. Altavilla et al. 2014) that already the announcement has had a significant positive impact on the real economy, consumer prices, and credit.

In contrast to OMT, the covered bond purchasing programme (CBPP) programme was actually introduced in 2009. It had a scope of €60 billion and lasted for one year. Until now, two further ones have been introduced, CBPP2 in 2011 with a scope of €40 billion (when terminated in 2012, securities with a volume of €16.3 billion were purchased), and CBPP3 in 2014 which still lasts. Covered bonds are securities that are equipped

[40] Further details can be taken from ECB 2012b.

with a collateral pool, i.e. investors have priority recourse to this cover pool, in case the issuer runs out of capital, and thus, bear no credit risk. The issuer is responsible for both the interest and principal payment. Typically, mortgages or public-sector loans are taken as collateral (ECB 2010a, p. 46). The aims of these purchases were first, an improved funding condition for covered bond issuing institutions, second, an increased second market liquidity of covered bonds and, third, improving the risk profile of the holders of covered bonds, thereby spurring credit growth (ECB 2010b, p. 32). CBPP3 has a focus on enhancing the functioning of the monetary policy transmission mechanism, it is part of ECB's current expanded asset purchase programme (APP), and its scope is not pre-defined in absolute terms, but by stating that up to 70% of a single ISIN[41] that meets the set criteria can be bought (ECB 2014b, p. 2) which this holds true for the other purchasing programmes within APP, as well.

The current scope can be taken from Table 3. Additionally, this table reveals that ECB's current APP consists of more than CBPP3: The asset-backed security purchase programme (ABSPP) was introduced in 2014. Asset-backed securities are securities that are backed by credit claims such as building- or car loans. In contrast to covered bonds, there is no transfer of risk from the investor, because the securitised loans are regularly bought by so-called special purpose vehicles which do not have further capital beyond the bought credit claims. The aim of ABSPP is to relief banks from these "difficult-to-sell assets" and to motivate them to make further loans (ECB 2013, p. 49).

Table 3: Components of ECB's Current APP, in € millions[42]

Name	CBPP3	ABSPP	PSPP	CSPP	APP total
Introduced in	2014	2014	2015	2016	**2015**
Monthly net purchases	3,363	288	20,905	5,639	**30,195**
Holdings	244,050	25,303	1,909,668	137,232	**2,361,253**

Own presentation, data taken from ECB n.d.

The last two initiatives are the public sector purchase programme (PSPP) and corporate sector purchase programme (CSPP), introduced in 2015 and 2016, respectively. The latter includes the purchase of non-bank issued bonds, meeting the set criteria concerning investment goodness, denotation in euro, and eligibility as collateral for

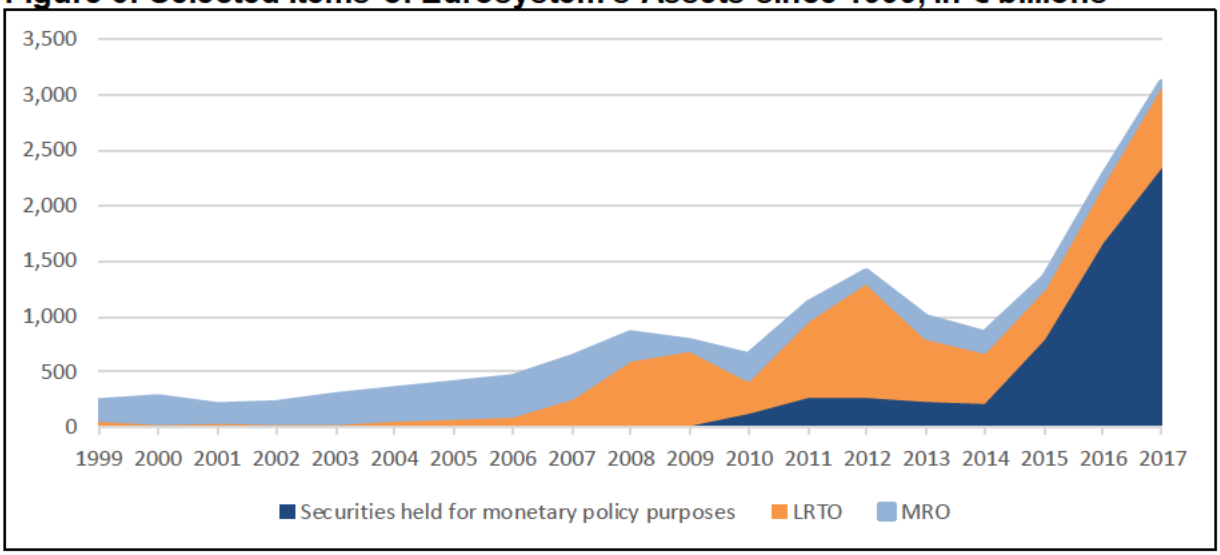
[41] ISIN stands for International Securities Identification Number and is the individual number of every security traded at the capital markets.
[42] As of January 2018.

Eurosystem credit operations (ECB 2016c, p. 20). The biggest portion of APP, however, is contributed by PSPP. It involves the purchase of government bonds and debt securities of both national agencies and European institutions with a "negative yield to maturity" (ECB 2017d).[43] These purchases are processed according to the Eurosystem's capital key, i.e. the single European countries financial contribution. How much a country must contribute is calculated on a five-year basis by regarding a country's share in total population and GDP of the European Union (ECB 2015a).[44] In case the amount of purchased bonds reaches this portion, for instance happened in the case of Greek government bonds (Bernoth et al. 2015, p. 190), ECB cannot by further of them. The current capital key can be obtained from ECB 2015a, revealing Germany's Bundesbank as the biggest contributor with 17.9%, BOE with 13.7%, and Banque de France with 14.2% of the capital. Subsequently, ECB has bought mostly German governmental bonds as can be seen from the Eurosystem's disaggregated balance sheets.

The total amount which is bought monthly within APP differed in the past. When introduced in 2015, it had a pace of €60 billion per month across all four programmes and should last for eighteen months. However, in December 2015, it was extended to last at least until March 2017. From April 2016 to March 2017, it was even enlarged to €80 billion per month. In December 2016, it was again extended by another eight months, but with an in turn decreased pace of €60 billion. After all, in January 2018, the monthly pace was again reduced to €30 billion, showing the increased confidence of ECB in the convergence of the price level to reach the set aim, going at least until September 2018 (ECB 2017e, p. 25). All these purchases have of course left their mark on the liabilities- as well as on the assets side of Eurosystem's balance sheet. Figure 6 shows the growth in selected items of the latter due to the just displayed purchases and other non-standard policy measures. It is clearly visible how CBPP1 began to build up this position in 2009, while APP fired the development in 2015.

[43] A list of these institutions can be taken from ECB 2017d.
[44] Also, in case a new country joins the European Union, the capital key is re-calculated. The current capital of ECB amounts to €10,825,007,069.61 (ECB 2015a).

Figure 6: Selected Items of Eurosystem's Assets since 1999, in € billions[45]



Own presentation, data taken from ECB SDW 2017c.

On the other side of the balance sheet, however, ECB has apparently not reached the desired result. As stated above, one of the main goals of QE is the motivation of an increased lending behaviour of banks. Figure 1 shows the development of ECB's base money, which can be taken from the liabilities side of Eurosystem's balance sheet. The decisive increase in current account holdings, beginning with the start of APP, implies that banks hold crucially more central bank money than they are required by the MRR (cf. Appendix 4). Looking at the ratios, each at the end of the years, the average of the years 1999-2011 equalled 91.8%, i.e. the vast majority of the capital account holdings served to meet the reserve requirements. This is in line with the above statement that banks normally avoid excess reserves due to low remuneration. However, in the years 2012-2017, this ratio dropped to 22.8% which needs to be attributed to the halving of the reserve ratio in 2012, as well. However, even the doubled value of approximately 46% tells a lot about the hording behaviour of banks due to the market conditions. Overall, the Eurosystem's consolidated balance sheet has increased by 200% from €2.2 trillion in 2014 to €4.5 trillion in 2017. What consequences this might have, is furtherly analysed in Section 4.2.2.

[45] As of December 2017.

4 Monetary Transmission Mechanism

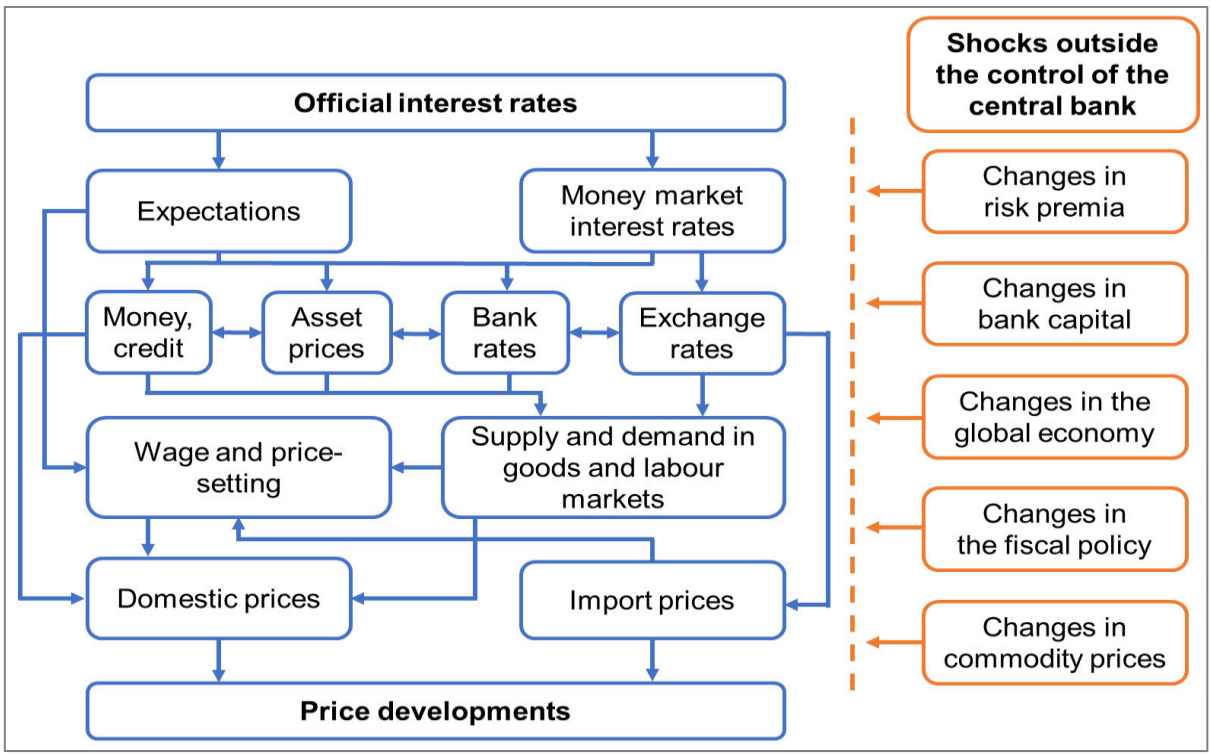
The transmission mechanism of monetary policy is considered to be one of the most extensively studied topics of monetary economics (Borio et al. 2008, p. 1). The present paper does not aim at presenting the related discussion and analyses holistically. Rather, this section provides a presentation of the theory behind it, as it is understood by the ECB. This includes its functioning as well as its channels, however concentrating on how the monetary policy actions are "translated" and not how prices and output may be addressed differently through these measures.
Following the presentation of the theory, a literature review on the processed analyses and discussions intends to build the bridge to the upcoming empirical part of this paper.

4.1 Definition and General Functioning

The transmission mechanism is the process which transports the monetary policy measures of central banks to the real economy, i.e. above all, the actual price level. This takes place on two stages. First, changes in the policy interest rates or the base money affect the market interest rates, exchange rates, prices of assets, and conditions on the credit market which directly influence the demand for investments and credits. On the second stage, these changes influence the spending behaviour of firms and households which, in the end, determine the price level (Delivorias 2015, p. 6). As stated earlier, central banks do not interact with consumers directly, under normal conditions. Therefore, they need some kind of access, referred to as channels, to the different areas of the economy. In these channels, a various number of agents is involved to (re-)act according to the central bank's impulses, given by both non-standard and conventional monetary policy measures. There might also be several channels involved at the same time, combined with the fact that they all interact with each other. Here, so-called time lags become of importance since the different "steps" of the channels need time to adapt to the impulses.[46] How much time it takes, is hard to predict due to the dependence on heterogeneous factors, yet, there has been done many research on this topic to get an estimation.

[46] Examples for these time lags are the recognition- (decision-makers need to grasp deviations), the administrative- (after deciding what to do, they have to set up the countermeasures), and the outside lag (the market participants need to adapt to the new circumstances). The last lag is expected to be the longest (cf. Friedman 1961).

Figure 7: Transmission Mechanism of Monetary Policy



Own presentation, based on ECB 2011a, p. 59.

For instance, Havranek et al. 2013 analyse nearly 70 studies and conclude that the average time lag equals 29.2 months (p. 41). Moreover, they find evidence that there is a correlation between the level of financial development of the country and the length of the transmission: the better a country's financial sector is developed, the slower it reacts to changes in the monetary policy. It is argued that this is based on the various hedging measures, developed agents have in place to counteract drastic and sudden shocks while financial institutions of less developed countries have no other possibility than adapt to these shocks immediately (cf. ibid., p. 63).

These time lags, of course, cause uncertainties for the central bank concerning its transmission mechanism. Additionally, there is a significant impact through exogenous shocks that can neither be predicted precisely, nor influenced by the central banks. Figure 7 displays some of these shocks (orange side), steering from, e.g. changes in the oil price which have a direct influence on the price level in the short-run. As other examples, movements in the global economy and national fiscal policy can be named. Both can be a strong incentive or likewise impediment of consumers to invest, thereby influencing aggregate demand and, ultimately, the price level (ECB 2011a, p. 58).

To analyse the functioning of the transmission mechanism more closely, the above-mentioned channels need to be addressed. In the following, they will be displayed as well as the underlying assumptions concerning the interactions are pointed out. This section is divided into those nine channels, ECB differentiates between.

4.1.1 Interest Rate and Assets' Price Channel

The consideration starts with the interest rate channel. It is the most important one, as it stands above all other developments. It has been empirically proven that it has the highest influence on the economy (ECB 2011a, p. 62). The interest rate channel is determined by ECB's standing facilities, influencing both the expectations of market participants and the money market interest rates. The latter are mainly set by financial institutions through loans and bank rates (Beyer et al. 2017, p. 13). Expectations on the other hand are influenced according to the expectation hypothesis of the term structure.[47] It states that short-term changes in an official interest rate, e.g. a decrease of the deposit facility, will persist and should, thus, lead to a decrease in both nominal and real interest rates in the long-run, "as investors act to arbitrage away differences in risk-adjusted expected returns on debt instruments" (Ireland 2005, p. 3). All other things being equal, a change in interest rates then influences the supply and demand on the labour market insofar as consumers will demand more, if "durable consumption", e.g. for housing or automobiles (Mishkin et al. 2011, p. 651), gets easier affordable. This increased consumption in turn influences both wage-setting of the suppliers and domestic prices, pushing the price level upwards (ECB 2011a, p. 60).

Closely related to the interest rate channel, the asset price and wealth channels do also focus the changes of current debt holdings. From point of view of the investor, an increased nominal interest rate raises the attractiveness of new debt securities since the existing ones have become less worthwhile due to the higher yields of newly issued securities. Simultaneously, the old asset's prices will fall and the affected firms will be forced to cut investments. With a fall in the value of assets, their eligibility as collateral is reduced, impeding the borrowing behaviour. On the other hand, lenders might reduce risk premia due to this development because of the increased value of newly issued assets (Beyer et al. 2017, pp. 15f). These changes in asset prices have also

[47] Additionally, FG influences the expectations of market participants, as displayed in 3.4.1.

effects on the wealth of investors and hence, on investment and consumption, as house- and share owners become wealthier. As several studies have shown, these two assets build important or even major components of the resources available within a consumer's lifetime (see the argumentation in Mishkin et al. 2011, p. 655).

4.1.2 Exchange Rate Channel

The official interest rates also affect other financial variables, such as the exchange rate which can influence the inflation directly in three ways. First, an increase in the interest rate of the Fed, as just recently happened (Fed 2017a), could make it worthwhile for European investors to buy US-American assets. These investments would lead to an appreciation of the US-dollar, hence facilitating the purchase of European goods, i.e. improved competitiveness. Net exports would rise, as do domestic output and employment, leading to an increased price level (ECB 2015b, p. 14). Second, there might be also long-term effects through such exchange rate adjustments, in case these products are used as inputs for production. A persistent appreciation of the US-dollar might, subsequently, lead to higher prices for final goods in the euro area, as well. Third, the depreciation would impede the purchase of US-American goods for European citizens. Since some of the goods in the consumption basket steer from overseas, the price level would also increase. Concluding, a depreciation of the euro would lead to an increased price level and vice versa. The strength of this effect depends on the openness of the economy to international trade, its size, and various other factors not in the context of monetary policy (ECB 2011a, pp. 60f).

4.1.3 Money and Risk-Taking Channel

Next, the money channel is presented. It is addressed through the adjustment of the monetary base, mainly with OMO. Its influence on the price level is then exerted both directly and indirectly. Directly, the transactions may influence the money supply when they are processed with the money holding sector. For instance, within APP, ECB buys securities from MFI which in turn receive deposits that can then be used for making new loans. Hence, money supply is increased, putting "downward pressure on market interest rates" (Beyer et al. 2017, p. 14). Indirectly, OMO can influence the price level through so-called portfolio rebalancing. The rationale behind it is as follows: again, APP is taken as feasible example. In case the seller of the security who gets liquidity from ECB for the transaction is not convinced that holding this liquidity is the best

alternative, i.e. there are opportunity costs, he might be interested in investing the received money again. It might come to a rebalancing of his portfolio towards other assets which causes a chain of such attempts by market participant, "until a new equilibrium is reached, implying lower yields and costs of external funding" (ECB 2015b, p. 35). Because external funding is cheaper, again money supply will rise, putting again pressure on the market interest rate level.

In the context of the above-mentioned opportunity costs, there happens a re-thinking in terms of risk affinity, as well. In times where the only way left to retain one's asset's value is investing in something else than the saving accounts, the perception and tolerance of risk may vary. Hence, a further channel for monetary policy is the motivation of market participants to invest in riskier assets because the safer ones, e.g. state-issued bonds, are not worthwhile anymore. The purchase of other assets can then have easing effects on the overall economy (Beyer et al. 2017, p. 16). This motivation can take place through both the actual decrease of the policy interest rate, the corresponding communication, and the perception of future rates of return (due to the expected stickiness of policy actions, see also below). However, it needs to be stated that it is primarily a passive channel, since it does not bear additional measures and depends solely on the subjective perception of risk – which might be incorrect. It is completely individual and depending on the willingness or ability of the investor to bear risk (Borio et al. 2008, pp. 13-15).

4.1.4 Expectations Channel

Just as subjective is the expectations channel. It has been shown in Section 3.4.1 that FG is able to influence the behaviour of market participants and help to re-establish healthy market conditions as they are able to plan and calculate with certain policy actions. It has been found that proper communication of future policy rate changes may have similar influence on the expectation of market participants as the actual target rate change itself (Neuenkirch 2013). These expectations may then work as motivators to consume or to invest, thus indirectly affecting employment, price-setting, and production. Even though the actual effectiveness of this channel is debateable, one can certainly argue that it depends crucially on the credibility of the central bank due to the more powerful direct influence, their messages might have on the receivers, i.e. market participants (ECB 2011a, p. 61).

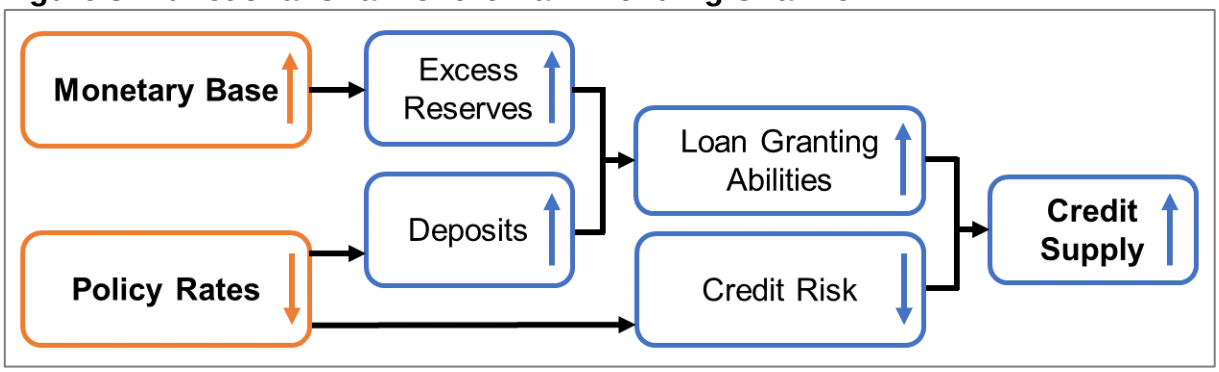
4.1.5 Balance Sheet and Lending Channel

Looking at the balance sheets of market participants, comparable effects of interest rate adjustments can be obtained. For instance, an increased interest rate increases the burden for a borrower and thus decreases his net worth. On the other hand, as mentioned above, the value of assets held by lenders decreases which hinders them from making new loans – hence, the demand for as well as the supply of loans may be affected negatively by higher interest rates (Beyer et al. 2017, p. 15).

Further changes on the asset prices can occur through the so-called financial accelerator mechanism. The term was first introduced by Bernanke et al. in 1996, describing an amplified worsening of credit conditions rooted in a market shock, such as the increased interest rate. Due to the principal/agent theory behind lender and borrower, i.e. the lender cannot be sure, whether the borrower is worth the money, the latter will be required to give collateral. In case the asset's prices fall, the collateral is worth less, reducing his ability to borrow money. Thus, economic activities and investments that need external financing are reduced, leading to furtherly tightened credit conditions for lenders. A rise in interest rate may, therefore, reduce financial stability as a secondary effect after all. "To the extent that negative shocks to the economy reduce the net worth of a borrower (…), the spending and production effects of the initial shock will be amplified" (p. 2). This effect works of course vice versa, as well. For instance, Shabbir 2012 presents empirical evidence of the financial accelerator mechanism, proving the resulting cash flow squeeze in the corporate sector.

Concentrating on banks' balance sheets, the bank capital channel argues that increased interest rates leads to decreased value of banks' assets which raises the probability of not-fulfilling the minimum reserve requirements and, hence, a reduction in loan supply (Beyer et al. 2017, p. 16). The capital channel is regarded as more important in times of non-standard measures as they increase the likelihood of structural reforms or other shocks, such as stock market re-valuations, with influence on the banking sector and their balance sheets. Another example is the portfolio rebalancing of bank's assets which is promoted by APP and the negative interest rate "since banks are incentivised to offload the newly created cash reserves" (ibid., p. 17).

Figure 8: Functional Chain of the Bank Lending Channel



Own presentation, based on Hagemann et al. 2017, p. 214.

In case monetary policy is loosened, the abovementioned arguments show that banks are expected to increase their loan making, which has also been confirmed empirically (e.g. Bendel 2015). Figure 8 shows the theoretical functional chain of the lending channel which is the direct translation of policy actions from central banks. Together with the previously presented balance sheet channel, these two form the so-called credit channel (Disyatat 2010, p. 4). With lower interest rates and an increased monetary base, both excess reserves and deposits of banks are likely to grow. This gives further abilities to grant loans while, simultaneously, credit risk is reduced since the borrowers have less burden from the interest rate (Hagemann et al. 2017, p. 213). Both developments should enhance credit supply, but, as already stated in introduction, the increased monetary base did not result in a comparable growth in M3. Likewise, the lending rates have not behaved as expected. Due to lowered interest rates, deposits from customers and issued bonds (both liabilities for banks) got cheaper since lower rates were demanded (Beyer et al. 2017, p. 16). Whether, on the other hand, the rates on loans (assets) have become more profitable for banks depends on the individual bank. Even though the relationship between nominal interest rates and bank lending rates cannot be dismissed, it has been shown that the lending rates of euro area banks have declined significantly more than MRO in the past years. Subsequently, an increase is unlikely to have linear altering effects on the lending rates, as well (ECB 2017f, pp. 41f.).

Through credit and deposits, monetary policy measures are normally passed through directly by banks to NFCs, however, in times of unconventional measures, this is harder to achieve. This is due to two reasons: First, a further lowering of nominal interest rates does not have any effect in case the banks are perceived as risky investment. In case they issue bonds, they are demanded to offer higher risk premia,

which puts additional pressure on them. Moreover, they might not transfer the lowered rates to their customers to grow profits from their regular business activities (Beyer et al. 2017, p. 16.).

The credit channel as such has been of great attention in literature and stands in focus of this paper, as well. The earlier discussion of the creation process and the money multiplier is closely linked to this part of the transmission mechanism as commercial banks perform their money creation through this channel. And just like the alteration in the mindsets concerning the link of reserves and actual loan giving (cf. Section 2.2), the credit channel as such has also gone through some changes. A prominent paper in this context was written by Disyatat in 2010. He proposes to reinterpret the lending channel as follows. First, the argumentation that shifts in deposits influence the lending behaviour of banks needs to be neglected since they are able to create reserves with loans and not vice versa (cf. Section 2.3.2). Second, the main driver of his model is closely linked to the balance sheet channel insofar as monetary policy affects the banks' external finance premium which is determined by their balance sheet strength. Put differently, "the impact of policy will be transmitted through changes in required rates" (Disyatat 2010, p. 9), i.e. banks will face a disproportionate rise in the price of funding liquidity when monetary policy is tightened, instead of a shorted liquidity as presumed by the traditional model. This is mainly due to the higher premium, banks' creditors demand from them in case their capital buffer, i.e. health, decreases. Empirical evidence in this context is provided by Kapuściński 2016, showing that monetary policy impulses lead to a reduced bank profitability and weaker balance sheets "which, in turn, are associated with lower lending growth" (p. 24). Carpenter et al. (2010) conclude, "our results indicate that bank loan supply does not respond to changes in monetary policy through a [traditional] bank lending channel" (p. 28). Further, they argue that "shocks to reservable deposits do not change banks' lending decisions" (ibid., p. 29).

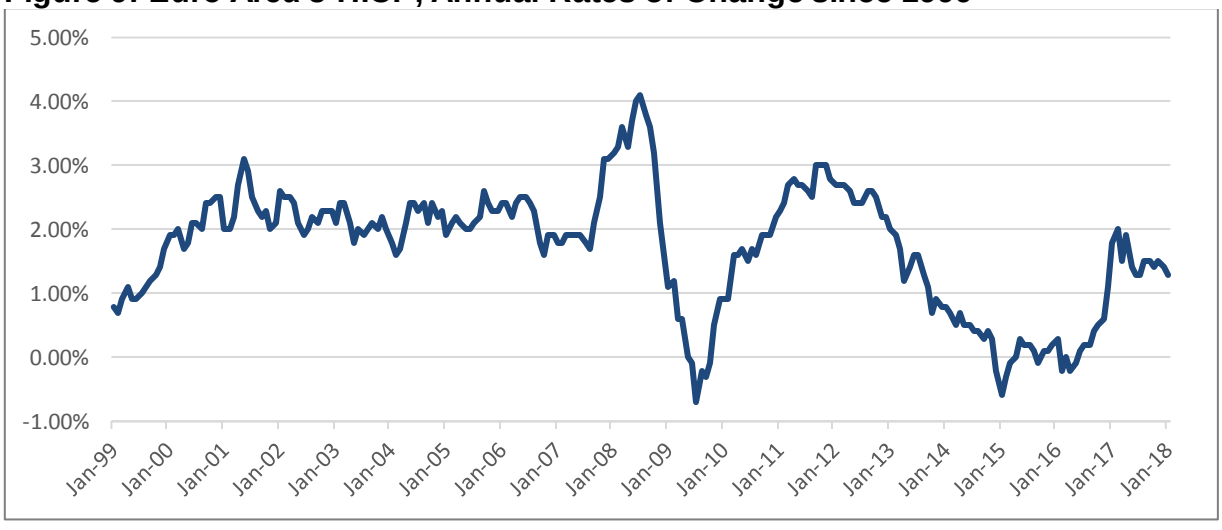
However, slightly different results can be found in Gräb et al. (2017): they show empirically that the influence of monetary tightening measures which lead to higher funding costs of banks can be mitigated in case the banks have other access to money, such as funding-networks beyond the euro area. Hence, a decreased lending is not the inevitable consequence.

4.2 Actual Functioning and Effectiveness of ECB's Measures

After displaying the general idea behind the monetary transmission mechanism, this section is dedicated to the ongoing discussion on its current functioning to which this paper contributes to through its empirical part. In the end, this is a discussion on the effectiveness of ECB's monetary policy, as well, because of the central bank's influence on the transmission's functioning. Especially the non-standard measures, as complement, are in place to make the monetary transmission mechanism work, as it is their main goal to support its effectiveness, rather than providing a further monetary stimulus (Cour-Thimann et al. 2013, p. 22).

It is the obvious choice to start off with ECB's primary objective, the price level. Figure 9 displays the harmonised indices of consumer prices (HICP) development over the past 19 years. With an average value of 1.7%, one could argue that ECB has managed to reach its goal quite successfully, even though it has "not yet achieved [its] main goal of inflation being below but close to 2 percent" (Constâncio 2017). Even though volatility increased sharply with the subprime crisis' outbreak, even during these rough years, the anchoring contributed well to limit the consequences from adverse financial shocks (Fahr et al. 2011, p. 38).

Figure 9: Euro Area's HICP, Annual Rates of Change since 1999



Own presentation, data taken from ECB SDW 2018a.

However, this is not the only topic which should be addressed when assessing the policy's effectiveness and there is a lot of critical assessment expressed, as well. The main critique is that ECB did too little, too late (e.g. Marelli et al. 2016 and

De Grauwe 2010) and looking at Fed's decision to end QE approximately one year before ECB, combined with the increase of its policy interest rate shows that the US-American economy has recovered decisively faster (Fed 2017a and Fed 2017b). It has been shown that the markets reacted positively on the lowering of Fed's policy interest rate (which was reduced from 5.25% in 2007 to 0-0.25% within 14 months) while the reactions on the slower-moving ECB lowering was negative both from 2007-2009 and 2011-2014, on average. Among others, this led to the development that "by mid-2009, Eurozone output had fallen behind that of the US, and it never caught up" (Kang et al. 2016). However, ECB has also proven the effectiveness of its actions.

4.2.1 Functioning of the Monetary Transmission's Channels

ECB's recent APP, which can be regarded as its most important measure ever undertaken, has been analysed by a broad range of studies. They provide evidence that it has been effective in different contexts regardless the circumstance that it can only be influential indirectly, as asset purchases by themselves produce no effect (Andrade et al. 2016, p. 9). First, it contributed increasingly to the abovementioned inflation developments (Gambetti et al. 2017, p. 21). Second, APP had influence on the exchange-rate channel. On the path to the subprime crisis, the US-dollar/euro exchange rate has grown steadily, reaching its peak in July of 2008 with $ 1.599 (see Appendix 5). Despite the recent reversing movement, ECB has managed to reduce the exchange rate decisively, facilitating the exports and, hence, contributing positively to euro area's GDP (ibid., p. 19 and Demertzis et al. 2016, p. 8). Third, a significant decrease regarding the bond yields of Eurosystem's countries can be put in relation to APP. Due to the sovereign debt crisis, especially those of the periphery, i.e. crisis, countries have experienced enormous interest rate increases (Spain peaked with 7.6 % for the 10-year bond in middle of 2012), which were crucially reduced through the programme and Mario Draghi's famous words in 2012 (Demertzis et al. 2016, pp. 8f; cf. also Section 3.4). Similar results can be drawn from Jäger et al. 2017, although they differentiate between the single components of APP and find evidence that e.g. SMP reduced the spread on bonds of periphery countries, but had the opposite effect on core, i.e. non-crisis, countries. Here, the spreads actually increased which is explained by the higher fiscal risk, those capital strong countries bear through the increased balance sheet of the Eurosystem (pp. 34f).

Remarkably, the majority of the reduction effects of periphery countries' bond yields took place after the announcement but before the actual start of the programme which provides another proof of the importance and the functioning of the expectations channel (De Santis 2016, p.13). However, regarding the latter, also ambiguous results are found. A recent study provides indication from VAR that the conventional policy measures have significantly stronger impact on the expectations of core countries' market participants, yet also peripheric countries are affected positively. In contrast, ECB's unconventional measures have had a negative effect in the short run and became only positive in the medium- to long-term (Galariotis et al. 2017, pp. 30f.).

Demertzis et al. 2016 furtherly showed that APP reduced bank's profitability through the switch from short-term deposits to long-term loans. Adding to this, the overall spread between lending and deposit rates in euro area countries declined over the years, which on the one hand, created favourable conditions for investments, but on the other hand, reduced the bank's profitability furtherly (pp. 11f). This point of view is shared by Bundesbank which assumes that it would harm the financial stability if interest rates remained at their low level for too long, especially due to reduced margins (Bundesbank 2017b, p. 44). Then again, Altavilla et al. 2017 provide evidence that the overall increased economic productivity, supported by the expansive monetary policy, has increased bank profitability and offsets the adverse impact. Furthermore, both the share- and debtholders of banks tend to realise higher profits when new, accommodative measures are announced (pp. 33f.).

There is also evidence that portfolio rebalancing took place, showing that the money- and bank capital channel were activated through APP. Gambetti et al. 2017 analysed a broad range of stock price movements on a quarterly basis and found that due to APP, prices rose by 10% immediately and afterwards significantly during the succeeding year (p. 17). In this context, Altavilla et al. 2015 provide evidence that the risk-taking channel is in place, as they found movements from bond holdings to untargeted assets, e.g. stocks, due to the lower yields on the more conservative asset.

4.2.2 Eurosystem's Increased Balance Sheet

The increase of Eurosystem's balance sheet by 295% since 2007 (two-third of which realised in the past three years, see Section 3.4.2) needs to be assessed cautiously since it is currently and "will remain much more extended (…) than is desirable in any

normal equilibrium" (Turner 2014, p. 17) for many years ahead. However, there is no actual consensus on what the "new normal" should look like and whether the ECB should go back to pre-crisis levels because there are both advantages and downsides of the large balance sheet. On the one hand, it is argued that a larger balance sheet facilitates monetary policy actions and contributes to financial stability (e.g. Greenwood et al. 2016). On the other hand, this high level of excess reserves may decrease the caution in commercial banks' liquidity management because there is no need for them to use the interbank market and, hence, the exposure of ECB to the banks is higher. Furthermore, there might be reduced seigniorage profits or even financial losses on side of ECB against the background of many low-yielding long-term assets against the short-term liabilities that are likely be remunerated at a higher interest rate some time in future (Claeys et al. 2017, pp. 9f.).

With reducing the pace of APP, ECB has already somehow announced an exit strategy back to conventional measures but without clarifying how it aims to reduce its balance sheet. Letting the balance shrink passively, i.e. holding the bought assets until their maturity is reached, would take approximately 14 years until the pre-crisis portion of euro area's GDP is re-established again (cf. ibid., p. 10). Subsequently, ECB might be interested in going another path which is associated with some challenges. One of these is the risk of financial dominance which describes the concerns of central bankers about short-term adverse financial market developments that might dominate and distract from the actions that need to be undertaken to reach the goal of price stability (Hannoun 2012, p. 9). Another risk may be the exchange rate dominance which would, likewise, hinder the ECB to pursue the actually necessary steps because it does not want the euro to appreciate too much (ibid., p. 13). The third risk is related to a surprisingly instating inflation that might harm the ECB's credibility. As repeatedly argued, the sentiment of market participants towards the central bank are crucially important for the effectiveness of its measures. Even though different aspects give reason to assess the current price level as stable, there might be an increased volatility again, leading to a harmed credibility to some extent (ibid., pp. 15f.). The last risk in this context is the fiscal dominance. ECB holds considerable parts of the outstanding debt of several European countries, leading to the question how they might react on sells and related price changes. Of course, they cannot put as much pressure on the central bank due to the many sovereigns within the euro area (Turner 2014, p. 16).

However, this topic needs to be addressed also in context of ECB's position as lender of last resort.[48] Independently from its ability to create money out of nothing and help out distressed countries, it cannot pursue these actions limitlessly: "Central banks, as the guardians of price stability, should universally dismiss the notion of being the lender of last resort for their respective sovereigns, a notion that backs us onto the slippery slope of debt monetisation. The theory of the printing press is just another illustration of the illusion of unlimited intervention" (Hannoun 2012, p. 23).

In conclusion, ECB's approach is yet unclear but no matter how ECB wants to cope with its balance sheet problems, every action needs to be wisely communicated and predictable by the market participants as it is assumed to be essential for maintaining economic and financial stability (Blot et al. 2017, p. 6).

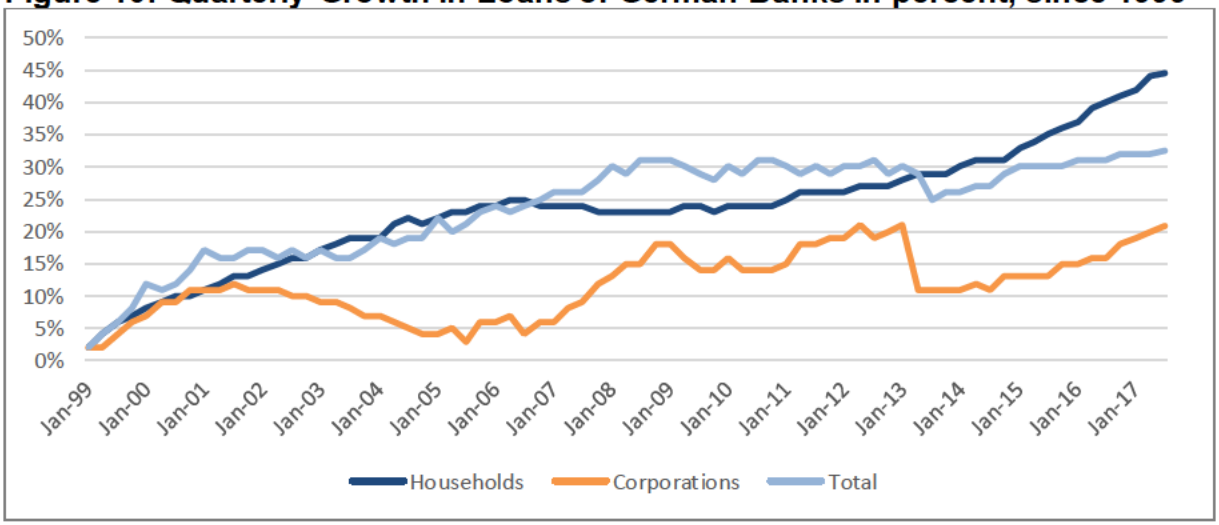
4.2.3 Banks' Lending

A further section is dedicated to the lending behaviour of banks with a special focus on German ones to provide, among others, the bridge to the empirical part.
It has been shown in many studies that expansionary balance sheet shocks have relaxed the bank capital and liquidity constraints as well as the very low interest rates provided significant support to the real economy (e.g. Boeckx et al. 2017). The credit channel was operational for both NFCs and households and the bank lending- along with the balance sheet channels contributed significantly to GDP movements implied by monetary policy shocks (Ciccarelli et al. 2010, p. 33). Additionally, the increased regulatory requirements have led to a more robust banking sector than before the subprime crisis: the equity ratio of German banks has overall nearly doubled while the banks have reduced their risk-weighted assets, such as non-performing loans, feasibly. Overall, Bundesbank's current stress indicator for the financial system equals approximately 0.2 which is a comparatively low level (Bundesbank 2017b, pp. 42-45).[49]

[48] The term lender of last resort refers to the act of providing liquidity to a country by the central bank "at times where no private agent is willing to do so" (Garcia-de-Andoain et al. 2016, p. 25), as de-facto pursued by ECB in the years after 2008 even though its operational framework does not contain any reference to it (cf. ibid. and also Praet 2016). Here, the discussion on whether the ECB overstepped its mandate has arose. However, the latter is not displayed in this paper.
[49] This financial stress indicator is based on a scale from 0 – 1 where 1 equals the financial stress of October 2008 (Bundesbank 2017b, p. 43).

Additionally, these measures have increased bank lending on both sides of the Atlantic Ocean, while they decreased the lending rates (see e.g. Lewis et al. 2017 and Carpenter et al. 2013). However, there is a clear distinction necessary between private- and corporate lending, partly due to wholesale funding, i.e. banks' funding by using deposits of other banks or e.g. pension funds. De Haan et al. 2016 showed that shocks in the interbank funding lead to a decline in corporate lending while private lending increases. Accordingly, corporate sector lending interest rates are more sensitive to shocks in the wholesale funding market. Here, ECB's "funding mitigated the impact of wholesale funding shocks on bank lending volumes, but less so on lending rates" (p. 21), which provides evidence that the unconventional measures were able to support mainly private credit growth. Another study has revealed that banks with high levels of non-performing loans and low capital have responded the most to the non-standard measures, e.g. regarding the decline of lending margins (Altavilla et al. 2016). Moreover, the so-called size effect plays an important role regarding the effectiveness of the measures, as smaller banks tend to react more strongly to credit easing measures. This is due to their higher exposure to asymmetric information problems, leading to a hindered ability to substitute deposit funding by another mean (Boeckx et al. 2014, p. 13).

Figure 10: Quarterly Growth in Loans of German Banks in percent, since 1999[50]



Own presentation, data taken from Bundesbank, see Appendix 6 and also Footnote 56.

German banks' lending to the private sector has increased feasibly (see Figure 10) giving the impression that both lending and investments have indeed been motivated.

[50] As of November 14th, 2017. Index = January 1999.

On the other hand, however, this development has led to the building of bubbles in the residential properties market, especially in urban areas: according to the current financial stability report of Bundesbank, the price exaggerations in 127 German cities equalled 15 - 30% in 2016 and 10 - 20% in 2015, respectively. Even though it does not assess these exaggerations as risk for the country's financial stability (Bundesbank 2017b, p. 11), this decisive increase in demand can certainly be regarded as negative side-effect of the easy accessibility of cheap money.

The corporate sector and the overall loan level are not as clear in their growth, additionally, these two have a decisively higher volatility attributed (households with a value of 0.42% while the total sum has 1.01%, and corporations even 1.61%).

It is clearly visible where the different crises hit the loan-making to corporations and that they were hit harder than loans to consumers. First, after the burst of the dotcom-bubble, the corporate loan making declined feasibly and on the path to the subprime crisis, it grew bigger than before. During the time of the sovereign debt crisis, a sideways trend is visible. In 2014, i.e. the time of the introduction of TLTRO, the quarterly growth increases again, bringing it approximately onto the pre-crisis level. However, whether there is a link between these measures and the growth is yet unproven. For instance, Lewis et al. 2017 investigate the German lending to its corporate sector and conclude that lending to "firms does not expand or become cheaper" because of asset purchases (p. 13). Moreover, they find evidence that the positive effects of ECB's actions to reduce financial stress are only of temporary nature and several months afterwards, the stress is again above pre-shock level. At the same time, despite the decreased number loan write-offs, bank lending is assumed to have become riskier due to a significantly increased implicit firm default in Germany. Ultimately, "the asset purchases are not successful in restoring credit creation in Germany" (ibid., p. 14), and bank lending rates do not decrease through the portfolio balancing channel. At the end of their paper, the authors argue that it would be recommendable to use more disaggregated data to find evidence on how the asset purchases might have influenced single MFIs (cf. ibid.). It is now the aim of this paper to, at least partly, fill this gap by analysing different German bank types to find possible differences in the extent to which ECB has been able to motivate them regarding their loan making.

5 Empirical Analysis

5.1 Data Description and Corresponding Assumptions

To recall it once again, the upcoming analysis regards the time frame from 1999Q1 – 2017Q3 and all data is presented on quarterly basis. Sometimes, there were adjustments necessary, for instance, the composite indicator of systemic stress (CISS) is provided solely on a weekly and CPI on a monthly basis. In these cases, the last value of each quarter's month was taken into consideration, i.e. March, June, September, and December of every year. Moreover, the data is analysed in first differences to reach stationarity as this is one of above-mentioned assumptions.[51]

5.1.1 Macroeconomic Variables

Table 4 displays the used data as well as its definition and source.[52] The selection is based on the following reasoning. CISS is a stress indicator of the euro area's financial system that was proposed by Holló et al. (2012) to capture contemporaneous dangers putting pressure on the whole system, including the markets, intermediaries, and infrastructure (p. 11). Its values yield a half-open interval (0,1], i.e. it cannot be zero but can reach all values bigger than zero up to and including 1. It peaked in the end of 2008 with a value of approximately 0.8 (pp. 18-20). Within this analysis, it shall serve as benchmark for the pressure, banks might have experienced in the analysed time frame. This variable served well in Boeckx et al. 2017 and Lewis et al. 2017. There are further parallels between the latter and this paper, e.g. German CPI and GDP are used as overall economic indicators. Especially GDP, as measure of changes in production and consumption, is expected to have significant influence on the lending behaviour.

[51] At first, 1998Q4 was included, too, to prevent the sample size from decreasing due to the usage of first differences. However, due to significantly high changes from 1998Q4 to 1999Q1, e.g. a drop in commercial banks' loans to NFCs from €692 bn. to €335 bn., probably rooted in an altered reporting standard with launch of the Eurosystem, this specific quarter was not suitable for consideration.

[52] With the single identifiers, the data can be obtained from the respective sources. This paper does not provide any further reference in the list of references. The exemption is Germany's GDP since there is no identifier assigned to it from Federal Statistical Office. Bundesbank data as of November 14th, 2017.

Table 4: Data on Macroeconomic Variables

Variable	Definition	Source	Identifier
GDP	Real GDP, seasonally & calendar adj.	Federal Statistical Office 2017	---
CPI	Index, seasonally & calendar adj., 2010 = 100	Bundesbank	BDP1.M.DE.Y.VPI.C.A00000.I10
CISS	Index	ECB SDW	CISS.D.U2.Z0Z.4F.EC.SS_CI.IDX
Rate	MRO in %, both fixed and variable tendering		FM.B.U2.EUR.4F.KR.MRR_FR.LEV FM.B.U2.EUR.4F.KR.MRR_MBR.LEV
EONIA	In %		FM.M.U2.EUR.4F.MM.EONIA.HSTA
SHFMP	Total volumes, in € mill.		ILM.W.U2.C.A070100.U2.EUR
MRO			ILM.W.U2.C.A050100.U2.EUR
LTRO			ILM.W.U2.C.A050200.U2.EUR

Own presentation.

To map ECB's policy decisions, three variables are included in the model. First, EONIA serves as indirect measurement of ECB's decision on MRO rates. As displayed in Section 3.3.2, EONIA has moved between the marginal lending and deposit facility, hence, both are somehow included in the movements of this rate. Slightly different approaches were taken by Boeckx et al. 2017, using the difference between EONIA and MRO, and by Lenza et al. 2010 who used the difference between EURIBOR and MRO, respectively. However, also using solely EONIA has led to feasible results and it is, therefore, seen as adequate measure (e.g. Borrallo Egea et al. 2016). As second variable to measure ECB's policy, refinancing operations are considered. Here, both the MRO and LTRO volumes are used because ECB has expressed its unconventional as well as its standard measures through them. The third variable is expected to be the most important one, representing APP, and it can be obtained from the balance sheet position securities held for monetary purposes (SHFMP). The present paper regards this variable as significantly different from the refinancing operation variables since ECB can influence the former without adjusting the policy rates and is more active, i.e. the variable is not demand-driven. As displayed in Section 3.3.2, the counterparties ask for the liquidity provided with them and, hence, the withdrawable conclusions might differ. This approach is used e.g. by Szczerbowicz 2015, too, yet, it is worth to mention that Peersman 2011 does not differentiate between these two measures. He argues that both are actively decided by ECB and the counterparties can only react on the measures, no matter whether they are demand- or supply-driven.

Obviously, there is no consensus and the analysis aims at shedding further light on the underlying mechanisms.

5.1.2 Aggregated Bank Data

After presenting the macroenomic variables, this paper now regards the aggregated bank data. It is completely gathered from Bundesbank and, subsequently, the aggregation was applied according to its customer classification (Bundesbank 2017c, p. 13). Four different bank types are differentiated, i.e. commercial banks, Sparkassen, building and loan associations (BLA), and credit cooperatives (see Table 5). While the loan numbers are on quarterly basis, the characteristics are based on monthly observations of the same time frame. These four groups cover most of the German banking sector and their loans constitute for 82.5% up to 94.4% of the total German loan amounts since 1999 while offering some decisive differences which will possibly lead to deviating results within the analysis.

Table 5: Average Data on German Bank Types

Bank Type	Number of Institutes	Balance Sheet Size (€ bn.)	Current Account Holdings (€ bn.)
Commercial Banks	BBK01.OUZ031	BBK01.OUZ032	BBK01.OUZ034
	272	3,089,550	78,574
Sparkassen	BBK01.OUZ501	BBK01.OUZ502	BBK01.OUZ504
	474	2,471,537	23,907
Building & Loan Associations	BBK01.OUZ421	BBK01.OUZ422	BBK01.OUZ424
	25	188,373	173
Credit Cooperatives	BBK01.OUZ514	BBK01.OUZ515	BBK01.OUZ517
	1,347	899,654	8,620

Own presentation.[53]

First, commercial banks build the biggest part of the German banking sector with big banks (e.g. Deutsche Bank), regional banks (e.g. HSH Nordbank), other commercial banks (e.g. BMW Bank), and branches of foreign banks (e.g. BNP Paribas). Even though the average number of institutes is only third in absolute terms, the institutions have relatively seen by far the biggest balance sheet size. Looking at the average relative balance sheets reveals that the individual institutions have balance sheets

[53] Over the actual values, again the Bundesbank identifier can be obtained as only reference of the data's sources. Data as of November 14th, 2017.

nearly twenty times bigger than the credit cooperatives, twice as big as the Sparkassen, and 35% bigger than the ones of the BLAs.[54] Another difference can be obtained from the average number of current account holdings at ECB which is more than threefold as much as of the second biggest group, the Sparkassen. This might be due to higher interdependecies with the interbank market or the higher amount of outstanding loans.

There are also other balance sheet items in which they differ from the other three groups, such as interest rate- and currency swaps which belong to derivative hedging measures. Recalling that the better a financial sector is developped – in this context the bigger the bank is – the more hedging measures are established (cf. Section 4.1), it is not surprising to see that the vast majority of swaps in the German banking sector is held by commerical banks: in the years 2011 – 2017, its portion equalled on average crucial 74.7% and 15.3%, respectively (Bundesbank 2018b, p. 89).[55] It is worth to highlight here that, while the total amount of interest rate swaps decreases both in total terms and in relative terms for the commercial banks, the currency swaps in total decrease while the amount of commercial banks has increased remarkably by more than 100% since 2014 (cf. ibid). This allows two very different assumptions. First, banks in general are not as dependent on hedging measures against interest rates changes anymore. As also found by Hagemann et al. 2017, ECB's has managed to stabilise the refinancing possibilities of banks (p. 214). Additionally, the bigger, well-capitalised banks seem to be more active beyond the euro area, which is assumably rooted in more internationally oriented business activities. On the other hand, this might be evidence for their network of other refinancing possibilities, independently from the ECB measures (cf. Section 4.1).

The second group is made of the Sparkassen. They were initially formed due to the German Sparkassengesetz which defines their main objective as the provision of financial services to all social classes equally and all over the country, including the economic education of the youth. Therefore, their main focus is the regional support of local inhabitants and small and medium-sized companies (Sparkassengesetz, §6 I).

[54] The respective sums equal in € bn. 11,379, 7,422, 5,212, and 668, respectively.
[55] The latter sum seems small but as a matter of fact, the other bank types together make up for less than 1% on average.

Subsequently, the number of institutions is decisively higher – despite a feasible reduction in the past quarters due to the cost pressure – while the balance sheet and current account holdings are the second biggest ones. Here, the assumption is that they are not as strongly influenced from the challenges in the European context due to their focus on regional business activities.

The third group consits of BLAs (e.g. Schwäbisch Hall or Wüstenrot) which are by far the fewest in this sample. Interestingly, these few institutions have a bigger balance sheet than both the Sparkassen and the credit cooperatives in relative terms while their current account holdings are the second smallest. In comparison to their balance sheet size, this number is by far the smallest: while commercial banks have a portion of 2.5% at ECB and Sparkassen and credit cooperatives approximately 1% each, BLAs have only 0.092%. This shows that they do not participate much in the interbank market and that these holdings are probably mainly to satisfy the minimum reserves for their amount of outstanding loans. Due to their focus on mortgage loans – of which approximately 90% have been granted to consumers – there might be decisive characteristics visible from the recent developments in the housing market.

The last group is built of credit cooperatives, belonging to the cooperative sector, such as Sparda Bank eG or Volks- and Raiffeisen Bank eG. Just like the Sparkassen, their focus lies on the regional support. Currently, this is the biggest group in terms of belonging institutes, equipped with both the smallest balance sheets and current account holdings in average. Here, the same assumptions as for Sparkassen apply while they may even be intensified in terms of the regional focusation and a greater degree of dependance on ECB's measures.

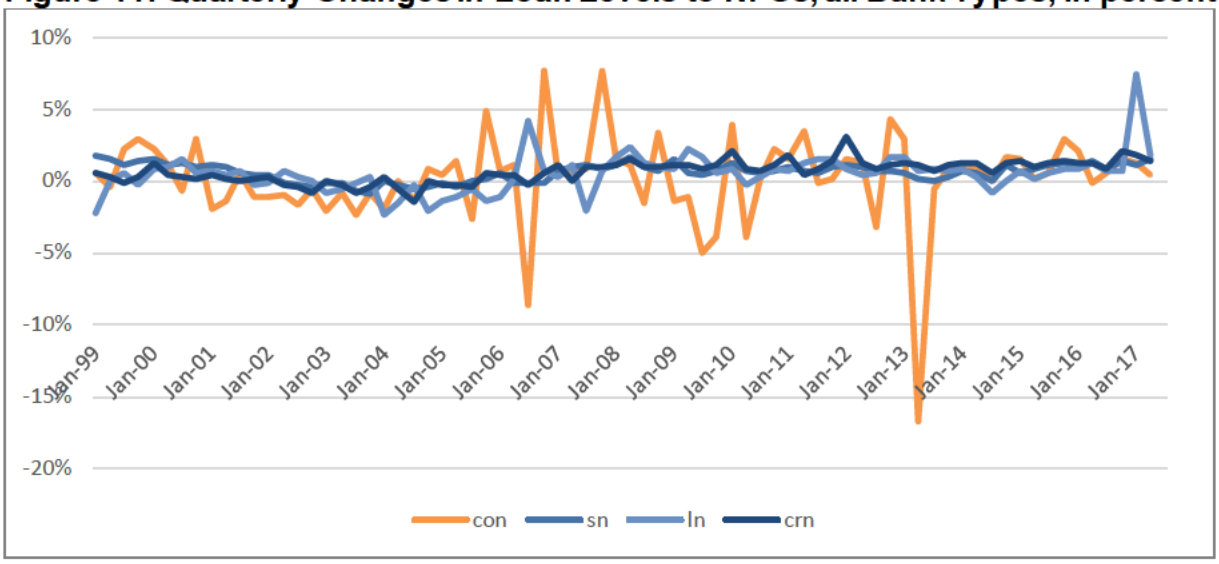
5.1.3 Loan Making Developments

This paper regards both the loans to domestic consumers and NFCs from all the above presented bank types. The abbreviated name of the time series and the respective identifier of Bundesbank can be obtained in Appendix 6.[56] Looking at the loan developments of the past years reveals several characteristics worth to mention. First, the volatility is always, except for the credit cooperatives, higher in the context of NFCs. It is clearly derivable that the banking sector has had more troubles in granting loans to companies, possibly due to the existing insecurities at the markets. Moreover, the vola-

[56] Again, no further reference is made in the list of references. Data as of November 14th, 2017.

titliy of commercial banks' loans to NFCs is approximately as big as the ones of the other three groups combined which can be obtained from the following graph, as well.

Figure 11: Quarterly Changes in Loan Levels to NFCs, all Bank Types, in percent



Own presentation.

At the same time, the growth in loan amounts has been very heterogenous, as well (cf. also Figure 10). Regarding the loans to consumers, it can easily be obtained from Appendix 7 that they have grown on a nearly steady level. Especially those of commercial banks and credit cooperatives grow relatively even and there is no distinct reduction visibile, not even during the hardest times of financial crises. The loans of Sparkassen and BLAs to consumers develop relatively even, likewise, while there is a sideways trend visible on side of the Sparkassen from 2004 to 2010. In the same time frame, BLAs experienced a feasible reduction in loan growth, especially from 2004 to 2008. Since the other two types do not experience such a reduction, it can already be derived that the crises cannot be the direct reason for consumers getting less credit and must rather be rooted in the business models of the Sparkassen and BLAs.

Looking at the loan development granted to NFCs, a different picture can be obtained (see Appendix 8). The loan making of Sparkassen, credit cooperatives, and BLAs is very much comparable, at times they are even parallel. However, the Sparkassen are the only MFIs which are able to manage a growth in loans which is positive throughout the whole analysed time frame. Here again, a sideways trend with slight reduction is visible on path to the subprime crisis. In 2014, the credit cooperatives manage to surpass the Sparkassen in their growth rate which is decisively steeper than the one

of the latter: until 2007, its loan levels stay approximately on the same level with only small deviations. Yet, it grows at the highest rate of all bank types afterwards. The loans of BLAs have a constant level until 2004, drop sharply (-9% in 2006) and remain negative until 2008, before they grow at the same level as the one of the Sparkassen (correlation of 0.99 from July 2007 to the end of the sample). Lastly, the commercial banks experience the highest volatility in their loan growth rates and both the sharpest increases and decreases in the same. Even though they have the highest amount of loans to NFCs in total numbers for the majority of the sample, the sovereign debt crisis influences this type the most. Loans drop sharply (-4% and further -5% in April and July 2013, respectively) and the Sparkassen surpass in absolute terms. Moreover, commercial banks face the smallest overall growth in NFC loans as the total amount at the end of the sample is only 10% bigger than in 1999.

5.2 Theory on SVAR and Course of Analysis

In the following, the basic backgrounds of the VAR method are presented, putting the focus on the practical relevance for answering the research questions of this paper. To enhance understandability, theory is supplemented by application on the example of commercial banks' loans to NFCs. The resulting model will be the benchmark model for all loans to NFCs afterwards. As the analysis in the previous section has revealed, the developments of the two time series NFCs and consumers differ decisively and these two categories are addressed separately. Because the outputs are numerous, only in this section they are included in the text to illustrate the processed steps. The others can either be obtained from the Appendix or the corresponding Excel file called "Stata Output". Subsequently, every mentioning of aspects of the output refers to the single table sheets in this exact file.

The VAR analysis was the response of economist Christopher Sims, who later was awarded with the Nobel Prize in Economic Science,[57] on the contemporary large-scale macroeconomic analysis methods in 1980. He criticised these models inherited from the 1960s because of their "standard, but incredible, assumptions" (p. 33) which restricted the applicability on practical problems. Consequently, reducing the assumptions is both the main advantage and drawback of this, comparatively young, multi-

[57] Together with Thomas Sargent, see Nobel Media AB 2014.

variate time series analysis method: it only needs little theoretical description upfront and is rather data-driven than model-dependent. On the other hand, it is not possible to interpret it economically since it does only identify the relationships in the datasets.[58] Nonetheless, it is not only a multivariate generalisation of univariate autoregressive models, but one of the key empirical tools in modern macroeconomics (Del Negro et al. 2011, p. 298). Especially in the context of this paper, as can also be seen from the various articles included using this method, "VAR models with macro and financial variables have become standard tools to identify the effect of monetary policy shocks on the economy" (Ciccarelli et al. 2013, p. 15).

In general, VAR is used to predict several variables, i.e. vectors, simultaneously which are all regarded as endogenous.[59] It regresses these endogenous variables based on their own past values and those of the other included variables, i.e. autoregression. The resulting equation is of minor importance because of a considerable probability that the single parameters will be insignificant. However, the equation can still be used to analyse underlying interdependencies between the variables and with some further developments, it can be interpreted by usage of impulse response functions (IRF). As stated above, the general model, i.e. the so-called reduced form, can be built without any further theoretical definition.

5.2.1 Derivation of the Reduced Form and its Assumptions

The following model of the two variables consumption C_t and GDP Y_t, is considered (see Equation 2, example taken from Dreger et al. 2014, pp. 369-372). In a VAR(p) model, p equals the number of lags and it is always constructed with the variable vector y_t on the left side, i.e. the variables' current value. On the right side, one finds the vectors of the constant c, the variables' past values $A_p y_{t-p}$, and the error terms u_t. This matrix notation can also be written in single equations which is not displayed here.[60] According to these equations, the current consumption and GDP depend on the past-periods values for both consumption and GDP which, hence, explain each other.

[58] For further weaknesses see Section 5.4.

[59] However, also exogenous variables can be included. Since this is not performed in this paper, it is not regarded furtherly.

[60] See Dreger et al. 2014, p. 370 for the two single equations.

Equation 2: Reduced VAR(p) Form

$$y_t = c + A_1 y_{t-1} + A_2 y_{t-2} \ \ldots + A_p y_{t-p} + u_t$$

where

$$y_t = \begin{pmatrix} C_t \\ Y_t \end{pmatrix}, \qquad c = \begin{pmatrix} \beta_0 \\ \propto_0 \end{pmatrix}, \qquad u_t = \begin{pmatrix} u_{1t} \\ u_{2t} \end{pmatrix}$$

and

$$A_i = \begin{pmatrix} \beta_i & \propto_i \\ \delta_i & \gamma_i \end{pmatrix}$$

for $i = 1, \ldots, p$.

The error terms (structural shocks) are so-called white noises, i.e. they satisfy the following three conditions (see Auer et al. 2015, p. 587), which influence the own equation directly and the corresponding one indirectly. Hence, the error terms are responsible for interdependencies between the single variables (cf. ibid., pp. 371f.):

Equation 3: Three Conditions of Error Terms

$$E(u_t) = 0 \qquad E(u_t u_t') = \Sigma_u \qquad E(u_t u_s') = 0$$

First, their expected value equals the zero vector. Second, their variance covariance matrix Σ_u is constant over time. The diagonal elements represent the error terms' variances which might be different between the single equations. Moreover, the non-diagonal elements represent the covariances between contemporaneous error terms of the single equations that may be different from 0. For instance, if variables face the same shocks, this shows that they influence the other equations indirectly, as well. Lastly, there is no correlation between error terms at different points of time which holds true both for error terms within one equation and for error terms of other several ones. These conditions are important because they enable, together with the assumption of normality of the error terms, the usage of ordinary least squares (OLS) to estimate the single parameters equation-by-equation (Neusser 2011, pp. 191-193).

In contrast to univariate interpretations, VAR regards vectors instead of single values. The parameters are displayed in matrix A_i. It is worthwhile to note here that p is of crucial importance as there exists the so-called curse of dimensionality. A lag expresses the number of periods that is taken into account to explain the current value. If there are too many lags, too many degrees of freedom are consumed. Then again, this leads to a reduced quality of the model. If there are too few lags, there are too few observations considered and there might be an autocorrelation of the error terms, resulting in a model which is apparently significant but with biased estimators and, thus, likewise imprecise (Bjørnland 2000, p. 6).[61] To get the right number of lags, different estimations can be executed, e.g. the Akaike information criteria (AIC). Even though it tends to overestimate the number of lags, and there are also other criteria which sometimes outperform AIC in their goodness (Hacker et al. 2008), it has the highest relevance in practice (Neusser 2011, pp. 194f.). It is, therefore, taken as measure for the best number of lags.[62] In addition to the decision on the number of lags, the adequate number of variables needs to be determined since using the wrong amount can reduce the model's quality, too, which is also due to the parameters' matrix A_i. For instance, a VAR(4) model with three variables has already 36 parameters which need to be estimated (Neusser 2011, p. 197). In general, the right amount can be found by rotating variables, i.e. adding them one by one or by Bayesian analysis.[63] In this paper, the former procedure is applied.

Despite the theoretical simplicity of the model, the data needs to satisfy an important condition to be analysed with VAR: it needs to be stationary over time, i.e. with a constant mean, variance, and autocorrelation. This is one of the major issues in time series analysis as the data mostly follows a trend, e.g. because of the further development of a nation's wealth, and does, hence, not fulfil this condition (Auer et al. 2015, p. 545). Non-stationarity may, however, lead to spurious regression due to high R^2- values but low Durbin-Watson statistics,[64] meaning that the results are overall

[61] This paper refrains from providing evidence on this circumstance. For further details see e.g. Basu 2014.

[62] Here again, the calculation is not presented for simplicity reasons. See e.g. Dreger et al. 2014, p. 374 for details.

[63] Bayesian analysis is a sophisticated approach using Monte Carlo simulation (MC) or bootstrapping procedures to identify the appropriate variables. For a useful presentation of the advantages of this approach in the SVAR context, see e.g. Plagborg-Møller 2016.

[64] The Durbin-Watson d-test identifies the autocorrelation of error terms. Even though it has some downsides, it is the most common test in this context. In case the variables are non-stationary, the error terms

misleading. Stationarity is tested with the Augmented Dickey-Fuller test (ADF) which has the null hypothesis of the model being non-stationary (ibid., pp. 598f.) which can be rejected at usual confidence levels. To reach stationarity, the variables are used in first differences which has been a proven approach, see e.g. Lewis et al. 2017 and Carpenter et al. 2010.

In practical terms, these steps are processed as follows. First, all variables are transformed into first difference values with Stata to reach stationarity. New variables are created, each beginning with "d_...". For all variables besides SHFMP, this transformation yields stationarity according to ADF (see "ADF"). Here, the usage of logarithmical values does not satisfy the stationarity condition either which is because of its values equalling zero until the start of APP, i.e. from 1999 to 2009.[65] This is the reason why several papers only regard the time frame after the beginning of APP to analyse the influence of ECB's expansionary balance sheet measures (Boeckx et al. 2017, Lewis et al. 2017, and Andrade et al. 2016) or explicitly analyse two time frames within their VAR analyses (e.g. Bacchiocchi et al. 2014). However, splitting the time frame in two parts, i.e. from 1999 to 2009 and from 2009 to 2017, is not expedient for this paper. Due to the consideration of quarterly data, the sample size decreases to 29 and the various tested VAR models do not satisfy the stability condition and are, therefore, not suitable for any further analysis (see "Other Iterations"). To be able to still include the variable SHFMP in the model, it is necessary to adjust it. First, the next higher order of the consolidated balance sheet was considered, i.e. "Securities of euro area residents denominated in euro". Yet, the only other position in this category is "other securities" and even though it is not zero, it stays comparatively small (it reaches approximately € 300,000 right before the start of the asset purchases, ECB SDW 2017c) and fails ADF, too (see "ADF", secu1). Second, a further variable is built, combining the SHFMP and both MRO and LTRO volumes, as it is done in, for instance, Peersman 2011. In fact, this combination finally yields stationarity and the newly created variable secu2 passes the ADF.

are most likely as well, i.e. the model suffers from heteroscedasticity. For further details see Auer et al. 2015, pp. 524-542 and pp. 553-555, respectively.

[65] Note: the values until start of APP were set to 1 to enable the usage of logarithmical values. Otherwise, Stata creates 41 missing values which distorts the analysis, of course.

All variables are now stationary and suitable for the analysis. The proposed VAR for analysing the loans to NFCs (Approach 1) contains the variables GDP (d_gdp), MRO rate (d_rate), CISS (d_ciss), the newly created variable capturing the SHFMP, MRO, and LTRO volumes (d_secu2), and of course the loan level of commercial banks (d_con).[66] An overview of the model's equations can be obtained from Output 1 and the chosen lag length equals four, which is confirmed by the AIC, as well (Output 2).

Output 1: VAR Approach 1, for Loans to NFCs

```
Vector autoregression

Sample:  2000q2 - 2017q3                        Number of obs     =         70
Log likelihood =  -1902.983                     AIC               =   57.37093
FPE            =   6.24e+18                     HQIC              =   58.71063
Det(Sigma_ml)  =   2.82e+17                     SBIC              =   60.74367

Equation           Parms      RMSE     R-sq      chi2     P>chi2
------------------------------------------------------------------
d_gdp                 21   4868.17   0.4063   47.89997   0.0004
d_con                 21   10105.2   0.4662   61.13553   0.0000
d_ciss                21   .083471   0.6889   155.0142   0.0000
d_secu2               21    113112   0.5268   77.93082   0.0000
d_rate                21   .00369    0.4793    64.4346   0.0000
------------------------------------------------------------------
```

Own presentation.

It needs to be stated here that AIC recommends twelve lags when the test is run before the actual VAR estimation which cannot be explained rationally. However, the model becomes overall neglectable at this high level of lags (see sheet "Other Iterations") and, additionally, four lags are taken as upper bound from the economic perspective because this already means one year under observation.

Output 2: Approach 1's Lag Selection Criteria

```
Selection-order criteria
Sample:  2000q2 - 2017q3                        Number of obs     =         70
+---------------------------------------------------------------------------+
| lag |    LL      LR      df    p      FPE       AIC      HQIC      SBIC    |
|-----+---------------------------------------------------------------------|
|   0 | -2038.34                      1.6e+19   58.3813    58.445   58.5419* |
|   1 | -2004.36  67.971   25  0.000  1.2e+19   58.1245   58.5073   59.0882  |
|   2 | -1962.56   83.6    25  0.000  7.6e+18   57.6445   58.3463*  59.4112  |
|   3 | -1935.65  53.814   25  0.001  7.4e+18     57.59   58.6108   60.1598  |
|   4 | -1902.98  65.338*  25  0.000  6.2e+18*  57.3709*   58.7106   60.7437  |
+---------------------------------------------------------------------------+
Endogenous:  d_gdp d_con d_ciss d_secu2 d_rate
 Exogenous:  _cons
```

Own presentation.

[66] The usage of both CPI and EONIA rates has not yielded usable results and these two variables are excluded from further consideration in the context of NFCs.

5.2.2 Tests on the VAR Model's Goodness

After building a model, there are a few tests to check its goodness. First, the single equation's R^2-values show how much of their current value is explained through its own lags and the other variables included in the model. In addition, the p values reveal whether the equations are overall statistically significant, while this does not necessarily mean that it is suitable for the further analysis.

Second, Wald exclusion statistics are executed to identify whether certain lags within the single equations can be excluded. They regard every variable's equation separately and all equations jointly to figure out whether there is an influence of other variables visible. For this, it checks the coefficients of the endogenous variables not under consideration and whether they have jointly zero values within the single variable's or all equations, respectively. The null hypothesis states that this is the case and it is rejected and the usual confidence levels (Amisano et al. 1996, pp. 99f).

Third, Lagrange-multiplier tests can be processed to check whether the residuals at the chosen lag length are autocorrelated. The null hypothesis states that there is no autocorrelation and must be rejected at the usual confidence levels.

Additionally, the overall VAR needs to be stable. This is important because only under this condition, the y_t-vector equals the sum of all white noise shocks u_t, i.e. the so-called vector moving average (VMA) proposition is applicable which is the necessary condition for the transformation into the upcoming structural form.[67] Stability can be tested graphically by checking whether the eigenvalues of A_i lie outside the unit circle and formally by checking whether they have modulus less than 1 (Dreger et al. 2014, p. 373).

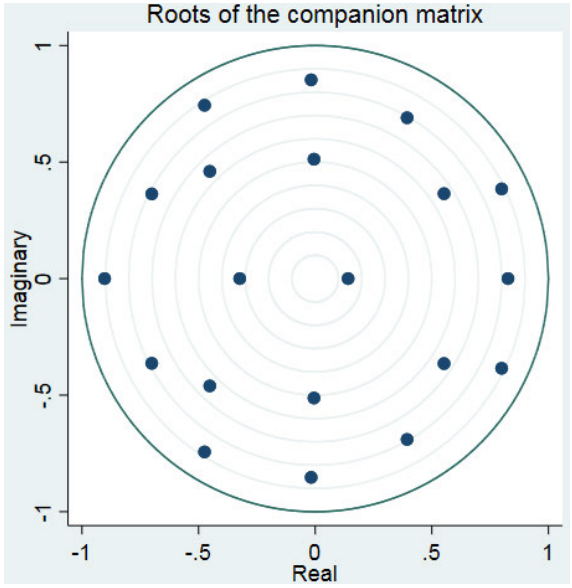
It has been stated above that the influence of the parameters itself is rarely interpretable, also due to the high degree of existing multicollinearity. However, Granger causality can be used to determine the function chain's direction. One can say that y_1 Granger causes y_2 if the usage of y_1's past values improves the predictability of y_2's future values beyond the degree to which it already predicts its own future. In case both variables influence themselves simultaneously, one speaks of a feedback-relationship or bi-directional causation (Dreger et al. 2014, p. 374). In the context of

[67] VMA is also called Wold representation, cf. Dreger et al. 2014, p. 373.

the above-stated example, this means that if consumption did not Granger cause GDP, its coefficients on the lags of GDP would all be zero in the latter's reduced-form equation (cf. Stock et al. 2001, p. 104). It is important to note here that Granger causality is by far weaker than normal causality, i.e. it cannot identify the causal interactions in a system (Barnett et al. 2009, p. 1). Moreover, in contrast to regular correlation, its values change if the variables under consideration are altered due to the interdependence amongst each other which requires a cautious interpretation of the results. It might still reveal interesting results (see e.g. Carpenter et al. 2010, pp. 7-11), and it is tested via a likelihood ratio test with the null hypothesis stating that there is no Granger causality (Dreger et al. 2014, p. 375).[68]

Applying these tests on the estimated Approach 1 reveals that every variable's equation is significant and can be used furtherly. The single R^2-values of at least 0.40 are assessed as good estimates for the purpose of this paper. Furthermore, Approach 1 satisfies the stability condition which can be obtained from both the graphical (see Output 3) as well as the numerical tests (see Appendix 9). The null hypothesis of residuals being free of autocorrelation cannot be rejected at the selected lag order (also Output 3).

Output 3: Approach 1's Stability and Autocorrelation Tests



Lagrange-multiplier test

lag	chi2	df	Prob > chi2
1	32.3942	25	0.14692
2	34.7469	25	0.09288
3	25.5841	25	0.43005
4	24.2611	25	0.50433

H0: no autocorrelation at lag order

Own presentation.

[68] In case of bivariate model, F-Tests would be sufficient. However, in a multivariate model this is not practicable (cf. ibid.).

The results of the Wald exclusion statistics are not taken strictly. As an extract, the results of the d_con variable's equation and the overall model are presented in Output 4. Regarding the second and third lag of d_con, the null hypothesis of all other endogenous variables having zero coefficients cannot be rejected, which can also be obtained from looking at the overall output of the VAR, where several coefficients have insignificantly high p values. This flaw could be eliminated through imposing constraints on the model, i.e. eliminating those coefficients from the analysis. However, the null hypotheses with respect to the model's overall equations can all be strongly rejected and the present paper refrains from imposing constraints. Instead, it continues with this model for the upcoming structural form.

Output 4: Approach 1's Wald Exclusion Statistics

Equation: d_con

lag	chi2	df	Prob > chi2
1	16.75802	5	0.005
2	7.976915	5	0.158
3	8.370315	5	0.137
4	16.64473	5	0.005

Equation: All

lag	chi2	df	Prob > chi2
1	135.4785	25	0.000
2	124.9615	25	0.000
3	60.80158	25	0.000
4	82.13206	25	0.000

Own presentation.

Since the model satisfies all necessary conditions, Granger causality can be regarded next. Output 5 displays the identified values for all variables' influences on loan making. The other results of the tests can be obtained from the sheet "Approach 1".

Output 5: Approach 1's Granger Causality Tests (Extract)

Equation	Excluded	chi2	df	Prob > chi2
d_con	d_gdp	17.762	4	0.001
d_con	d_ciss	13.107	4	0.011
d_con	d_secu2	5.2696	4	0.261
d_con	d_rate	9.8314	4	0.043
d_con	ALL	55.241	16	0.000

Own presentation.

The extracted section shows that loans to NFC of commercial banks are Granger caused by all inserted variables except secu2 because only with regard to the latter,

the null hypothesis that it does not Granger cause d_con cannot be rejected. As stated above, Granger causality is only an indication and, hence, the strength of the same is of minor importance for this paper.

5.2.3 Derivation of the Structural Form and Estimation of IRFs

So far, the reduced form of the VAR has been estimated and possible Granger causality has been identified. Using the reduced form is comparatively straightforward as different variables can be included at the researcher's intention without regarding the underlying economic mechanisms. However, the reduced form is, likewise, strongly restricted in terms of interpretability. If one wants to interpret the underlying relationships with usage of IRF, this reduced form has the decisive disadvantage of being very general, so IRFs based on them are "not unique and it is often not clear which set of impulse responses can be computed from the same underlying VAR" (Lütkepohl 2005, p. 357). This missing link to economic backgrounds is vanished by the more complex SVARs which impose restrictions on the variables to sort out contemporaneous links between them.

To understand the backgrounds of the structural form, it is helpful to consider VMA presentation first. As already stated, it expresses the variables in y_t as a function of current and past reduced form shocks, i.e. innovations, u_t (Gottschalk 2001, p. 14).

Equation 4: VMA format

$$y_t = \delta + B(L)u_t$$

where

$$\delta = A^{-1}(1)c$$

and

$$B(L) = A^{-1}(L) = I - B_1 L - B_2 L^2 \ldots$$

It is visible that δ, which is the parameter for a random walk with drift, includes the inverse of the matrix A_i and the constant (cf. Auer et al. 2015, p. 588). $B(L)$ on the other hand, is the shortened form of parameters as a function of the lag operator L.

Likewise, the inverse of parameters' matrix A_i is underlying and stands in relation to the single equation's lags (Dreger et al. 2014, p. 373).

The problem with this VMA format is that the residuals are correlated across time and across the different equations which needs to be eliminated before it can be analysed economically with IRF (Stock et al. 2001, p. 106). This so-called identification problem is rooted in the circumstance that the reduced form has less parameters than the VMA and only with restricting some of them, the VMA can be fitted to the reduced form. Since these assumptions are completely free, several SVAR models can be derived from the same reduced form model. "The number of structural VARs is limited only by the inventiveness of the researcher" (ibid., p. 103). There are several types of restrictions applicable, most commonly, either zero or sign restrictions which can be both long-term and short-term oriented are used (Neusser 2011, pp. 203f).[69] In this paper, short-term, i.e. first round effects, zero restrictions are imposed because using them "emerges as the most reliable strategy for applied work" (Gospodinov et al. 2013, p. 21). To get to the SVAR, i.e. to obtain identification, one needs to multiply the reduced form with matrix A_0 which characterises the contemporaneous relationships among the variables in the VAR. Matrix $A_0$is derived with imposing $\frac{(n^2-n)}{2}$ restrictions on parameters' matrix A_i, where n stands for the number of included variables (Neusser 2011, p. 205). Hence, the general SVAR can be expressed as follows:

Equation 5: SVAR format

$$A_0\, y_t = B(L)u_t$$

These restrictions on A_0 result in a unique identification in which A_0 is lower triangular matrix, placing zeros on all entries above the diagonal and B is set to $B = I$. This identification method is called Cholesky decomposition which was already promoted by Sims (1980). This implies that the first variable can influence the succeeding ones contemporaneously, while the second can only influence the ones after it but not the first (Dreger et al. 2014, pp. 378f.). Lastly, the last variable can influence all variables only with a lag but is influenced by all other variables under consideration. Ordering

[69] More sophisticated methods to identify the SVAR are obtained with dynamic stochastic general equilibrium (DSGE) models or heteroscedasticity identification. Neither these nor long-term restrictions are presented here. For details see Neusser 2011, p. 204 and pp. 216-223.

the variables in a certain sequence, predetermined by the researcher, makes them easy to handle and to interpret (Gottschalk 2001, p. 23). However, this approach has already been criticised nearly twenty years ago because of the limited transferability of real-world circumstances onto this sequencing (Bjørnland 2000, p. 7). Still, it is common in contemporary literature, e.g. Lewis et al. 2017, and used in this paper, as well.

With applying the restrictions and the ordering, structural innovations are orthogonal, thus uncorrelated, and IRFs can be interpreted economically. They are performed "in order to be able to see the distinct pattern of movement the system may display" (Sims 1980, p. 21). To trace out the response of current and future values of each of the variables, the single current errors are shocked, e.g. by a one-time increase equalling one-unit standard deviation. In the subsequent period, this error returns to zero again and all other errors are equal to zero (Stock et al. 2001, p. 106). Hence, there is always an impulse variable and a response variable. The IRFs are performed at certain confidence levels, which can be calculated upfront using MC or bootstrapping procedures, which is both not applied here (Amisano et al. 1996, pp. 60f.).[70] Instead, the standard confidence interval of Stata/IC 15.1 is used which equals 95%.

Turning to the practical example again, identification is obtained as follows. According to economic theory, the following ordering is proposed while the corresponding zero restrictions are put on matrix A_0 and B is set to $B = I$.

Equation 6: Identifying Parameter Matrices A and B

$$A = \begin{matrix} d\_gdp \\ d\_ciss \\ d\_secu2 \\ d\_rate \\ d\_con \end{matrix} \begin{pmatrix} 1 & 0 & 0 & 0 & 0 \\ . & 1 & 0 & 0 & 0 \\ . & . & 1 & 0 & 0 \\ . & . & . & 1 & 0 \\ . & . & . & . & 1 \end{pmatrix} \quad B = \begin{pmatrix} . & & & & \\ 0 & . & & & \\ 0 & 0 & . & & \\ 0 & 0 & 0 & . & \\ 0 & 0 & 0 & 0 & . \end{pmatrix}$$

This Cholesky ordering means that GDP influences all variables contemporaneously, while it is not influenced by them at the same time. CISS can influence GDP only with a lag but on the contrary the other three variables immediately and so on. Finally, commercial banks' loans to NFCs cannot influence any of the variables contemporane-

[70] For details see e.g. Amisano et al. 1996, pp. 73-78.

ously while all elements of its entries are allowed to be estimated. The result is an exactly identified model, i.e. the minimum amount of restrictions is imposed on the VAR, which focuses on the matrices' coefficients.

Output 6: Approach 1's SVAR Estimation (Extract)

Sample: 2000q2 - 2017q3 — Number of obs = 70
Exactly identified model — Log likelihood = -1902.983

	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
/a_1_1	1	(constrained)				
/a_2_1	1.56e-06	2.04e-06	0.76	0.446	-2.44e-06	5.56e-06
/a_3_1	-2.682655	2.678258	-1.00	0.317	-7.931944	2.566635
/a_4_1	-3.04e-07	8.18e-08	-3.71	0.000	-4.64e-07	-1.43e-07
/a_5_1	-.3709252	.2429592	-1.53	0.127	-.8471164	.105266
/a_1_2	0	(constrained)				
/a_2_2	1	(constrained)				
/a_3_2	329591	156201	2.11	0.035	23442.73	635739.4
/a_4_2	-.0022367	.0048872	-0.46	0.647	-.0118154	.007342
/a_5_2	-54240.73	13282.78	-4.08	0.000	-80274.51	-28206.96

Own presentation.

As can be seen from Output 6, the estimated matrices on pre-defined lagged endogenous variables are supressed by default. Additionally, it is clearly visible that not all the coefficients are statistically significant, since only /a_4_1, /a_3_2, and /a_5_2 have sufficiently low p values. These entries stand for significant coefficients on GDP in the d_rate equation, on CISS in the d_secu2 equation, and on CISS in the d_con equation. With an increased confidence interval of 15%, also /a_5_1 (GDP on d_con) and /a_4_3 (d_secu2 on d_rate) become significant. The entries in matrix B are jointly significant.

For the IRFs, only the shocks on the loan making is considered even though it would also be possible to interpret the shocks of e.g. GDP on the MRO rate. However, as this has already been done by many researchers, this paper concentrates on the effects on lending.[71] For the commercial banks, this leaves mainly CISS and, with some relaxation of the requirements, GDP (see Appendix 10). At first, only the two left-hand sided graphs need to be considered. Order1 is the above presented Cholesky ordering and these two graphs display impulse shocks in either CISS or GDP and the corresponding effect on the lending of commercial banks to NFCs. Interestingly, an increased

[71] Nevertheless, all IRF graphs are presented on CD.

risk leads to a rise in lending on impact (within the same quarter), is rebounded after roughly one year, and the overall effect is also positive. GDP, on the other hand, causes a rise in lending on impact which is smaller than the one of CISS, while the subsequent increase is clearer positive and lasts longer. On the right-hand side, Order2 displays the opposite Cholesky ordering, i.e. (1,.,.,.,.\0,1,.,.,.\ etc.), and while the significance levels are only slightly different (see "Other Iterations"), the coefficients and, hence, impulse responses differ decisively from each other, showing the importance of the ordering. However, this kind of counterfactual analysis is not processed for the other models which is furtherly addressed in Section 5.4.

5.3 Results

After displaying the processed steps in course of this paper's analysis, the results are presented in this section. As already stated, each one model for loans to NFCs and to consumers is estimated and these two borrower types are addressed separately. The model of the former has already been found and was presented in the previous section. In the following, the application on the other three bank types is displayed. The main aspects of the models can be obtained in the Appen-dices 11 to 17, while the complete outputs are included in the Excel file.

5.3.1 Loans to NFCs

The usage of the variables GDP, CISS, secu2, and rate yields statistically significant models for all bank types except credit cooperatives (see "Approach 1"). For the latter, this combination creates an unstable VAR (see "Other Iterations") and CISS is substituted by CPI to eliminate this issue. In fact, by including CPI, the highest R^2 value for the loan variable is found (0.83), while also Sparkassen has a high value of 0.78. Only BLA is comparatively small with only 0.41 (to recall: commercial banks have 0.47). However, the other variables are very much comparable, all equations are strongly significant, and the models are, thus, furtherly considered. The AIC recommends the lag length of four for all models, while the limitation on this criterion presented in the previous section holds true in the context of the other models, as well. Furthermore, all four models satisfy the stability condition (credit cooperatives only barely), are free of autocorrelation, and their equations are strongly significant over all lags, while lags of single variables could be excluded according to Wald exclusion statistics.

Granger causality reveals very heterogeneous results. While GDP Granger causes commercial banks' and Sparkassen loans to NFCs, the other two bank types do not show this relationship. On the other hand, secu2 clearly Granger causes every bank type except commercial banks. However, the latter is the only one which is Granger caused by both CISS and rate. Lastly, CPI Granger causes the loans of credit cooperatives. A thorough interpretation of Granger causality is not processed here due to its ambiguous characteristics. Yet, comparing the results to the actual correlation of the variables reveals an interesting distribution. For instance, secu2 is highly correlated with Sparkassen, credit cooperatives, and BLA (correlation coefficient of at least 0.84 each), while commercial banks are only weakly correlated with a value of 0.37 (see Appendix 18). Moreover, commercial banks are positively correlated with both CISS and rate (yet not strongly), meaning that the loan level increases with an increased risk at the market, which cannot be explained rationally. On the other hand, the other three bank types are equal in the characteristics that they, first, are negatively correlated with CISS (low value) and strongly negatively correlated with rate. While this reflects economic theory more properly, the VAR seems to neglect this relationship.

For identification of the SVAR, the Order1 is applied on all four variables. In the case of credit cooperatives, CPI replaces CISS at the exact same position.[72] The resulting SVAR shows significant coefficients for GDP and CISS in the model of commercial banks, while CISS is also included in the one for Sparkassen. In the latter, additionally rate is significant, just like in the model of credit cooperatives. Here, also CPI has a significant coefficient. Regarding BLA, no significant coefficient is identified and no IRF analysis is possible. However, looking at the IRFs displayed in the Appendices 11, 13, and 14 shows ambiguous results. First, every shock is rebounded after a distinct drop, i.e. not explicit in its influence, and nearly all of them are overall positive, which is neither explainable with economic theory, nor with the correlation coefficients. For instance, it cannot be explained why an increased CISS should motivate commercial banks and Sparkassen (at least for eight periods, afterwards, the loan level drops) to give more loans. On the other hand, a shock in CPI could have a negative impact on

[72] Even though it might not reflect the economic theory that CPI influences e.g. secu2 contemporaneously, the ordering is not changed because the comparability over all four models is assessed as the more important measure in this paper's context. The ordering as such and its weaknesses is furtherly addressed in the limitations.

lending (credit cooperatives) due to a changed demand (Köhler-Ulbrich et al. 2016, p. 38). An increased lending because of a higher price level is, however, unlikely.

5.3.2 Loans to Consumers

For analysing the loan levels to consumers, another model is set up, henceforth called Approach 2 (see the eponymous sheet in the Excel file and Appendices 14 to 17). It entails the variables GDP, CISS, secu2, and CPI for all four bank types.[73] In contrast to Approach 1, it consists only of three lags which is recommended by AIC. Solely for credit cooperatives, a lag length of at least four is identified, however, due to sufficiently high R^2 values of the equations with three lags and to enhance comparability, it is analysed with three lags, as well. Possibly because of the smaller lag length, the R^2 values are in general smaller in Approach 2, reaching from 0.29 for the loan levels of commercial banks to 0.59 for the one of Sparkassen. For the former and for BLA, the CPI equation is only significant at an 10% confidence level, while the other equations are all strongly significant. All models clearly satisfy the stability condition, are not influenced by autocorrelation at the selected lag length, and Wald exclusion statistics yield a comparable result to Approach 1, which is handled accordingly.

Again, Granger causality provides very heterogeneous results. While commercial banks are Granger caused by both secu2 (at 10% confidence level) and CPI – hence, completely different than within Approach 1 – Sparkassen are Granger caused by GDP and secu2 which is complies with the first Approach. No Granger causality is found regarding BLA, while credit cooperatives are only Granger caused by CISS. The correlation coefficients (Appendix 18) are even stronger than regarding NFCs: all four bank types are highly positively correlated with GDP (credit cooperatives even 0.99), CPI, secu2 (more than 0.80 each), and highly negatively correlated with rate (at least 0.74). CISS, however, does not yield unambiguous results as the coefficients are comparatively small and both positive and negative.

For SVAR, the same ordering as in Approach 1 is applied, i.e. GDP, CISS, secu2, CPI, and the loan variable as last entry. It leaves different significant coefficients, e.g. for commercial banks, CISS and CPI remain significant. In addition, the former yields one of the best graphs in terms of the unambiguousness of the shock, i.e. a clear increase

[73] Again, EONIA yielded no usable results during the composition of the models.

in lending which dies out comparatively quickly afterwards, but again, the positive effect of a shock in CISS is hardly interpretable economically (see Appendix 14). CPI has an overall positive effect, just like regarding credit cooperatives, where it has a similar kind of influence on loan making. As already stated in the previous section, a motivation of banks to make more loans rooted in increases in the overall price level is unlikely to exist. Likewise, the decrease in loans of BLA due to a shock in GDP is probably not reflecting actual underlying relationships. However, two developments meet the expectation of economic theory. First, an immediate decrease of loans rooted in the increase of the price level, as it is implied by the graphs of Sparkassen and BLA, could actually be rooted in the decreased demand of loans due to higher interest rates. Second, credit cooperatives seem to experience an increase in lending rooted in a shock in secu2 that could reflect the improved capital situation of this bank type which could act as credit enhancement.

5.4 Interpretation

In total, the analysis yields both expected and ambiguous results. Neither the lending to firms nor to consumers is clearly motivated through any of the variables under consideration, rather, some aspects even seem unrealistic according to the general economic mindset. Moreover, none of the previously stated relationships between the monetary policy and, for example, the banks' balance sheets could be confirmed. As displayed in Section 4.2.3, Altavilla et al. 2016 and Boeckx et al. 2016 identify the size effect, meaning that smaller banks do not only respond stronger to ECB's measures, but are more exposed to distortions at the market due to less hedging measures. Similar results can be obtained from the early work of Kashyap et al. 2000. However, neither of these two developments can be identified clearly from the sample. This allows two further derivations. First, the models may be biased due to unidentified underlying circumstances or due to existing weaknesses which overshadow the economic interpretability. This possibility is addressed in the upcoming section. Second, the models may reflect real world conditions which would, then, mean that the loan making developments cannot be explained through usage of the presented variables. The latter is addressed furtherly in the following.

Lewis et al. 2017 concluded that the expansionary balance sheet measures did not influence lending to German firms, neither the amount was increased, nor the loan

rates were decreased. Only indirect influences were determined, such as a temporarily reduction of the financial stress and an overall increased economic output, which indirectly of course influences MFIs, too (p. 14). Likewise, Boeckx et al. 2014 find that balance sheet shocks have basically no effect on lending to German households, while lending to NFCs is affected only in a very limited way (pp. 16f.). In contrast to this paper, the IRFs in these two papers are unambiguous and, hence, there is no doubt about the distinct possibility that ECB was not able to motivate German banks to lend more. It is necessary to broaden the view beyond the variables included it this paper to find those factors which might have been influencing German banks' lending.

One of these factors might be the reduced profitability of the banks due to ECB's measures, even though it has already been argued before that there are also mechanisms working in the opposite direction. However, as a recent paper shows, it is not clearly determinable whether profitability has influenced the MFIs' decisions on taking new credit risks (Hagemann et al. 2017, p. 216). Another factor that has possibly influenced loan making is the amplified regulatory pressure on the banking sector. The increased requirements regarding minimum equity ratios within Basel III and the changed assessment of the existing equity components demands banks to either increase their equity or reduced their risk-weighted assets. This hinders the functioning of the credit channel, as banks tend to increase their exposure to sovereign instead of lending more to consumers and NFCs (Hüther et al. 2015, p. 3). Furtherly, it is assumed that most MFIs will rather decrease their risk-weighted assets than increase their equity because of less associated costs (Hagemann et al. 2017, p. 217). Yet, German banks are probably less affected because of a better capital structure (Boeckx et al. 2014, pp. 16f).

So far, the demand for loans has always been taken as granted. In general, loan demand is determined by the financing costs, the financing need, and alternative financing possibilities (Köhler-Ulbrich et al. 2016, p. 23). Only if the demand exceeds or at least equals the supply, ECB's measures can be the determining factor in the decision of banks to make new loans. However, the demand for loans has changed in the past years which needs to be considered, as well, when analysing the loan developments of German banks. The latter reported that the demand of NFCs decreased from 2002 until 2005 and since 2006, it has faced relatively small, but

constant positive net increases. Even the two crises which led to feasible decreases in loan demand on a total euro area level, did not change much about this development (ibid., p. 39). This complies mostly with the actual German loan growth rates of every bank type except commercial banks (cf. Appendix 8). Another aspect in relation to the demand for bank loans is a change in the way, loans are assessed by NFCs. While still roughly the half of the existing liabilities is made up by regular loans (Rupprecht et al. 2017, p. 675), the pecking order, i.e. which type of financing method a company chooses first, has changed in favour of internal financing. It constituted for roughly two third in the end of 2016, whereas loans only for ca. 5%. For comparison: in 2008, internal financing accounted for ca. 43% and loans for ca. 30%. In addition, companies made increasingly use of other external financing sources, such as intra-holding financing (ibid., p. 671). In this context, valuable information can be obtained from a survey of 2016/2017 that ECB conducted with a sample size of 11,500 European companies. Approximately 46% of the German companies responded that bank loans were not of relevance for them with the majority explaining that there was no need for external financing. Adding to this, they were asked to name their currently biggest problems. On European level, roughly 26% responded that they experience to little customer's demand, while more than 19% bemoaned a shortage of specialists. Less than 8% responded that they had troubles with the access to financing (ibid. p. 673).

Regarding an impeded access to financing, the credit standards can be named which have been adjusted repeatedly in the past decade. For instance, they have been tightened several times and had their highest value in 2011. Even though they have been eased since then, the availability of bank loans to large corporations has still dropped furtherly until the beginning of 2014 (Köhler-Ulbrich et al. 2016, p. 32). This development was crucially less drastic for SMEs which might be an explanation for the sideways trend in commercial banks' loans to NFCs, while the other bank types have experienced a distinct growth. As assumed earlier, the larger corporations are likely to have higher interdependencies with the bigger German banks.

The demand for loans of households experienced a different development. It dropped more sharply in the years 2006 to 2008, but has mostly been stable in its growth afterwards, which can easily be obtained from the loan developments of commercial banks and credit cooperatives (cf. Appendix 7). In general, property financing makes

up for the majority of households' loans and this demand is mainly determined by housing market prospects and consumers' confidence (ibid., p. 44). Looking only at the loans for consumption, there was not even a reduction in times of the subprime crisis visible (ibid., p. 48). For both types, the credit standards have been tightened nearly every year since 2008, even though only at low rates. The collateral requirements, on the other hand, amplified by nearly 30% during the financial crisis and have approximately stayed constant since then, with further, smaller increases in 2011 and 2012, respectively (ibid., p. 33 and p. 36). With respect to the undisturbed growth in the loan levels, this might be a confirmation of the effectiveness of ECB's measures on this borrower type.

5.5 Limitations

This section addresses two main areas. First, the composition of the analysed data entails some weaknesses and second, the model as such has some drawbacks which need to be named. Furthermore, a general questioning of the chosen approach is included because of the course of analysis and the results of this paper.

The biggest limitation lies in the composition of the data. As has been expressed earlier, the corresponding analysis revealed that a splitting into two separate time frames would possibly yield a higher goodness in the resulting models. Likewise, the usage of quarterly data can be named. While this is a sufficient sample size with respect to the total time frame, it made a (necessary) splitting impossible. Additionally, immediate shocks on the variables were comparatively imprecise in comparison to an analysis on, for example, monthly basis.

The combination of all expansionary balance sheet operations through the variable secu2 can also be named. There is definitively a loss of information associated when three independently constituted time series are added to create one which fulfils the requirement of stationarity.

Supplementary in context of the data, the pre-determined aggregation can be named as further weakness of the model. It was not possible to cluster according to certain balance sheet characteristics or business model set ups, which would have possibly increased the homogeneity across the single data types and, hence, improved the corresponding derivations. It is assumed that it would have enhanced the derivations, as well, if further balance sheet aspects were included in the model.

To enrich the analysis with variables beyond the ECB measures, it might have been recommendable to include variables representing, for instance, the demand side of credits or the housing market developments. These exogenous variables would have probably complemented the results by more realistic derivations and would have facilitated the analysis of the shocks.

Additionally, the usage of CISS as such can be criticised. It represents the overall euro area, but, as repeatedly expressed, Germany differs from the other Europe in various contexts. Hence, another risk measurement for the German market is recommendable for the analysis, e.g. the financial stress indicator of Bundesbank (Bundesbank 2017b, p. 43). As further example, the early warning indicators of Jahn et al. 2012 are considered as being helpful, because they regard differences between the different bank types as defined by Bundesbank 2017c. Additionally, the consideration of micro, as well as of macroprudential transmission channels, as displayed in, for instance, Beyer et al. 2017 is expected to increase the goodness of the analysis through the different forms of aggregation.

In the following, some of the drawbacks of SVAR analysis are displayed. Besides the not existing possibility of counterfactual analysis due to the reduced form basis (Fahr et al. 2011, p. 30), first and foremost, the Cholesky ordering needs to be addressed. As stated earlier, it has been criticised already twenty years ago and the analysis within this paper confirmed this disadvantage of this identification procedure. Order2 revealed that the IRF depend crucially on the Cholesky ordering while it is hard to transfer either of the orderings into real-world interdependencies. For instance, the influence of secu2 on the MRO rate is at least strongly debatable and the problems with the interpretation of the shocks is most likely related to this unrealistic characterisation. In this context, the replacement of CISS in Approach 1 for credit cooperatives by CPI is probably another good example for the limited transferability of the ordering requirement. Certainly, the price level does neither influence secu2 nor MRO rate contemporaneously and it was only applied to enhance comparability over the models. Here, as well as in the context of the number and selection of included variables, more sophisticated estimation methods, such as Bayesian analysis, are missing and, hence, the model composition suffers from the weakness of being imprecise.

As displayed in Lewis et al. 2017, there are also other possibilities of identification, including sign restrictions on the parameter's matrix through comparatively complex algorithms (see e.g. Arias et al. 2014). This would have been helpful regarding CISS because it would have been possible to hinder this variable from influencing the loan levels positively. However, even with this more sophisticated approach of identification, the invertibility problem remains. It refers to the drawback of SVAR that the structural shocks recovered linearly from the history only, i.e. from the variables lags, which ignores a possible influence of future values on the current values (Plagborg-Møller 2016, p. 7).

Hence, as last point of limitation, the usage of SVAR as such shall be mentioned. It is one of the main approaches for analysing the effectiveness of monetary policy measures which has been shown by several empirical examples. However, during the analysis, only one loan variable was regarded at a time, mainly due to the already existing excessive number of analysis regarding the other interdependencies. This, on the other hand, complies rather with a regular multivariate regression, having one endogenous variable and the others as exogenous inputs. It might be, therefore, debatable whether another method of analysis would have yielded more feasible results than the SVAR with its corresponding limitations in terms of application on real-world facts.

6 Conclusion

6.1 Areas of Further Research

After displaying the analysis and its shortcomings, some areas of further research remain. First and foremost, the analysis of the considered data with usage of the monthly data can be recommended since it is expected to increase interpretability decisively. This should be supplemented with a cluster analysis to build homogenous groups of banks, i.e. independently from the classification of Bundesbank.
Since the present paper has revealed decisive differences between the different bank types, a further analysis of the underlying mechanisms is desirable. This includes both an intensified consideration of possible balance sheet differences on bank level (as e.g. processed by Gambacorta et al. 2011) and an identifying analysis of, e.g. the customer typology within the NFC consideration. The assumption that commercial

banks have more large corporations in their portfolio and are, hence, more affected by changes on the supra-European level is yet to confirm. If this is not possible, at least different sectors within NFC should be investigated. This might yield usable results not only concerning commercial banks, as e.g. in Spain, the building sector currently suffers from offshoots of the crisis, while other economic areas experience booms (Rupprecht et al. 2017, p. 670). This distribution might also be applicable to certain German business sectors. Here, a panel VAR could deliver the necessary input since it complements the regular VAR with an cross-sectional dimension which might "indicate countries, sectors, markets or combinations of them" (Canova et al. 2013, p. 7). Especially with respect to the analysis of different bank types, this method has yielded valuable results (e.g. Kapuściński 2016).

Likewise regarding the analysis method, more sophisticated approaches are recommendable, including the Bayesian analysis to increase the practical relevance of SVAR, i.e. improve the identification process (see e.g. Plagborg-Møller 2016). In addition, another method, e.g. the time-varying parameter VAR, as applied in Bendel 2015, is expected to yield usable results against the background of this paper because it reflects the real-world circumstances more closely: the included parameters are not expected to be constant over time (p. 93).
In this context, the usage of a completely different approach can be named, too. The performance of IRFs is also possible without specifying the underlying VAR, by using local projections instead of extrapolating into increasingly distant horizons as within VAR frameworks (see e.g. Jordà 2005). With this concept, the weaknesses of identification can be overcome.

Moreover, the analysis of interbank credits, probably mainly regarding commercial banks, might contain useful information. Adding to this, the consideration of other variables, catching the above-named circumstances, such as the demand for loans or the properties markets, is recommendable. Here, high correlation and/or causation values should be reached which might help in analysing the time series. Lastly, complementing the empirical parts with qualitative analysis of factors of influence, such as the bank lending survey (e.g. Köhler-Ulbrich et al. 2016), should improve the applicability, as well. For instance, a possible area of interest regards whether the

percentage of granted loans decreased, i.e. whether consumers and NFCs had asked for loans but did not receive them due to tightened credit standards.

6.2 Summary and Outlook

Despite improving economic conditions around the world, especially in Germany which is the euro area's most influential country, ECB decided to stick to its current stance towards monetary policy in its first Governing Council meeting of 2018. In contrast to Fed or BOE, it leaves its policy rates at their historic low level and continues to flood the financial markets with liquidity in an unprecedented manner. Besides counteracting the lasting offshoots of the recent financial crises, ECB wishes to support the market participants and motivate them to contribute to a growth in the price level. It is convinced that the euro area has not yet reached their desired level of inflation of below, but close to, 2% in the medium-term.

One of the main drivers of inflation is the loan making of commercial banks to both consumers and NFCs which is influenced through the channels of the monetary transmission mechanism. The latter can be considered as the translation of monetary policy measures to the economy and it is one of the most extensively studied topics in monetary economics. Accordingly, its functioning and the effectiveness of the included channels have been investigated repeatedly in times of standard as well as unconventional monetary policy regimes. While consensus has been reached on how central banks can influence the price level with their standard policy tools, the functioning of the channels in times of non-standard measures is still associated with some uncertainty.

The present thesis analysed the monetary transmission mechanism with focus on the loan making of German MFIs to both consumers and NFCs and how the latter may be influenced through ECB's monetary policy measures. Thus, this paper contributed to the ongoing discussion on how the single channels work during non-standard policy times with an empirical analysis.

First, the creation processes of base as well as broad money were presented to illustrate the special position of commercial banks within the economic cycle. An own focus lied on the money multiplier and the corresponding assumptions that monetary policy could motivate banks to make loans solely through adjusting the base rate which was disproven. Afterwards, ECB's toolkit of monetary policy measures was presented.

Here, the overall aim of price stability was addressed separately and the motivation behind it was displayed, as well. The toolkit consists of the analysing methods to evaluate the necessity of possible steps, conventional, and the unconventional measures which have received great attention due to their recent development and influence on, for example, Eurosystem's balance sheet. The analysis of the monetary transmission mechanism revealed that ECB managed to keep most of the channels open and has contributed, therefore, to overall improving economic conditions in the euro area.

Yet, ECB was not as successful regarding the German financial sector which is also related to its unique structure, e.g. concerning its capitalisation. Both the own empirical work and the consideration of previous papers revealed that the direct influence of monetary policy measures on the lending of domestic MFIs can be mostly neglected. Within the processed SVAR, no unambiguous impact was identified, neither for one of the borrower types, nor for the different bank types under consideration which can partly be associated to the weaknesses of the model. Additionally, there were no differences identifiable between the several bank types as implied by the respective literature. Beyond the direct influence, undisputable indirect impacts of the processed measures are visible, amongst others an overall increased economic output, confidence in the market, liquidity conditions of MFIs, and more favourable loan settings.

However, the loan levels are also largely influenced by other factors than the supply side and corresponding restriction on the same. The demand side is determined by e.g. the investment possibilities of the banks' customers and their ability or willingness to realise it through external financing. In the end, various areas of further research have been identified to furtherly investigate the connections between the monetary transmission mechanism and the loan levels.

As for an outlook, one can confidentially say that banks are likely to remain an important factor of influence for the overall price level. However, the banking sector as such is currently going through some decisive changes. As displayed in the paper, the number of German MFIs has decreased remarkably in the past years. It is expected that this reduction will proceed at an even higher pace in the next ten to fifteen years, also due to digitisation. For instance, one current study predicts that only 150 to 300

banks will be able to retain a sustainable business model in 2030 (Oliver Wyman 2018, p. 5). Hence, the importance of the single institution is likely to increase.

Beyond the German banking sector, several determining developments and factors are yet unclear. For example, the development of the housing market and the named troubles of domestic firms to find specialists needs to be addressed by politics while it will take several years until a feasible change will be noticed. Likewise, the harmonising of core and periphery countries will keep the policy makers busy. Foremost, the announced renunciation from the ultra-expansionary monetary policy stance in September this year will have a crucial importance for the markets. It is to be hoped that ECB manages to conduct a careful FG and provides the participants with a transparent exit strategy since this is crucial for the success of the latter. As the alumnus of Wharton School and philosopher Nassim Taleb puts it: “If you are in banking and lending, surprise outcomes are likely to be negative for you” (Taleb 2010, p. 206).

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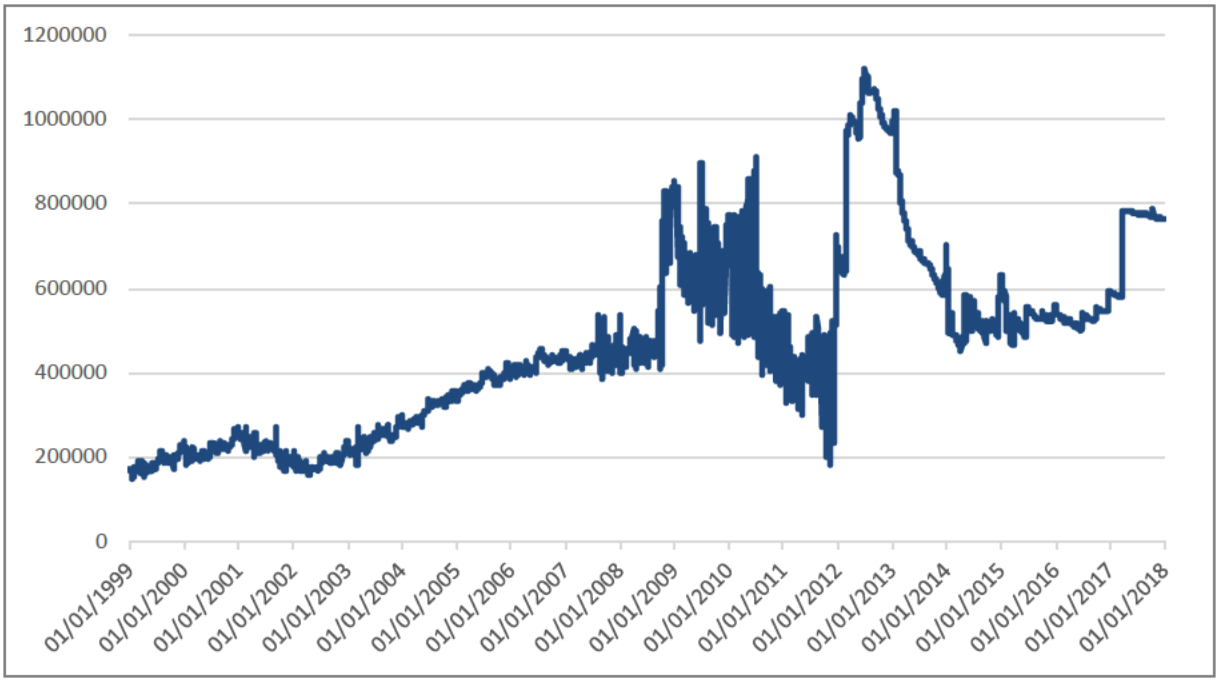
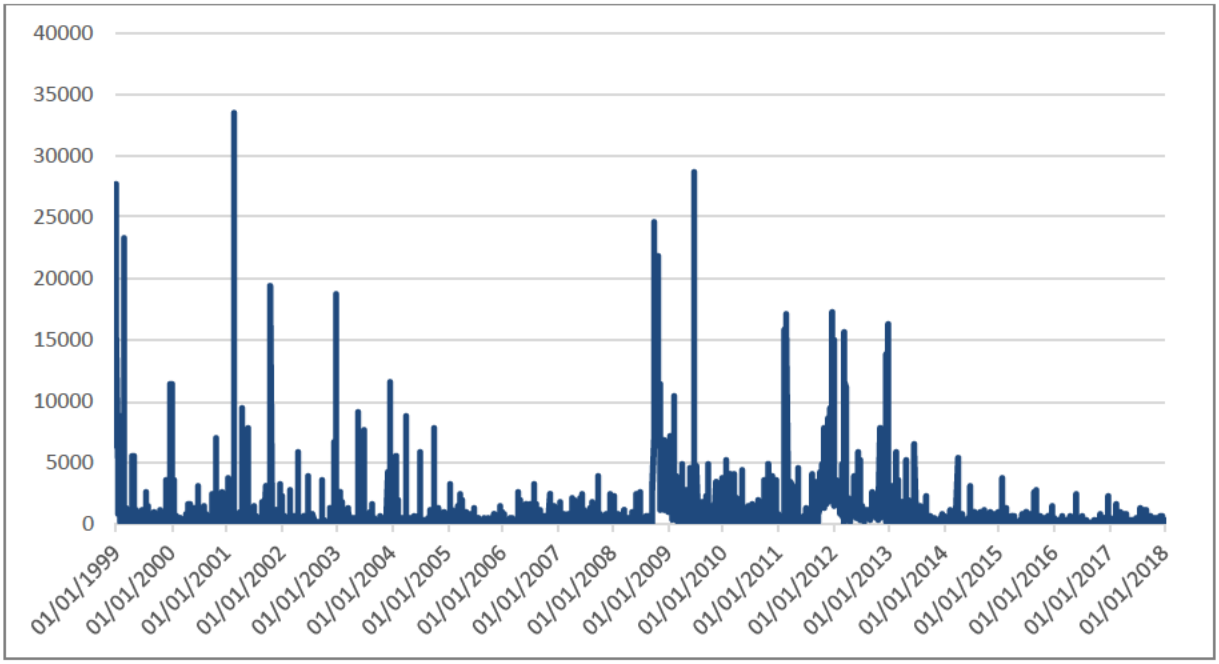
Appendix 1: Eurosystem's Open Market Operations in € millions, 1999-2017



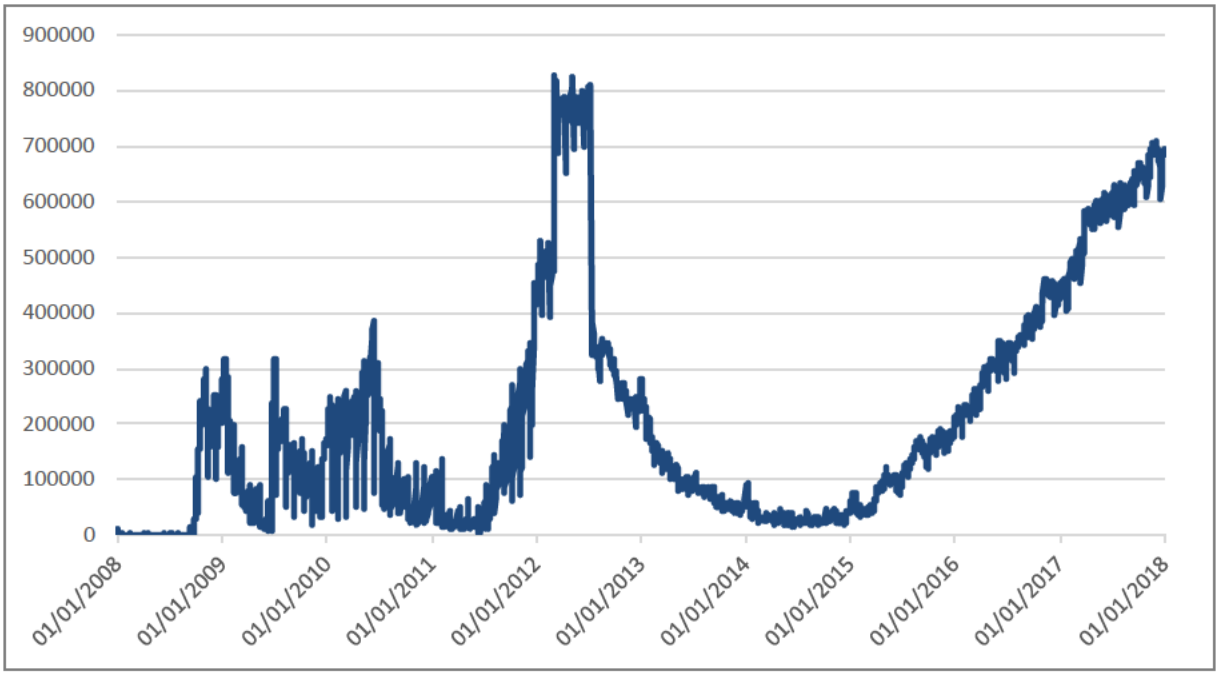
Own presentation, data taken from ECB 2017b.

Appendix 2: Eurosystem's Marginal Lending Facility in € millions, 1999-2017



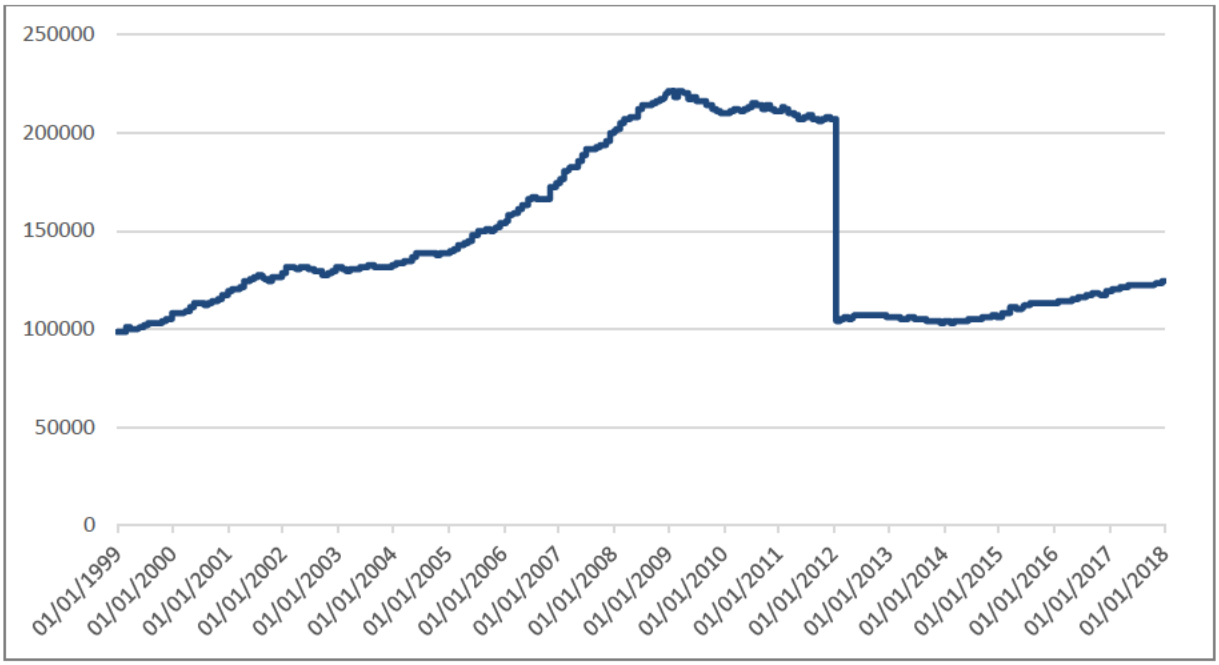
Own presentation, data taken from ECB 2017b.

Appendix 3: Eurosystem's Deposit Facility in € millions, 2008-2017



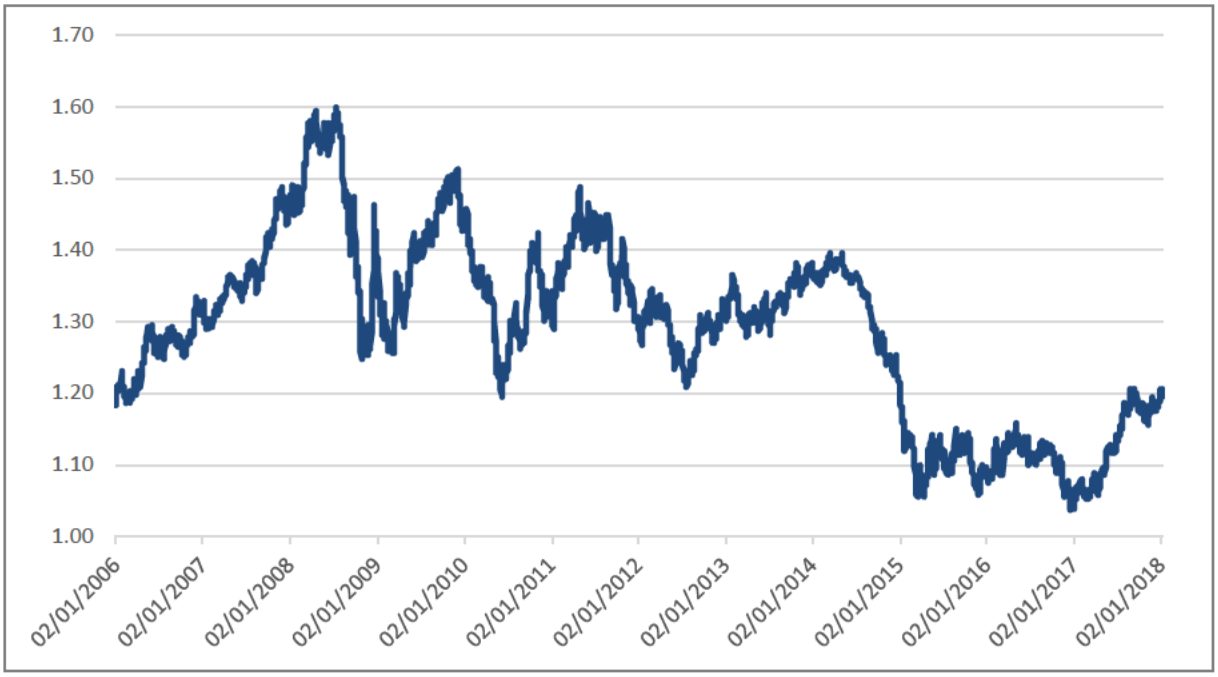
Own presentation, data taken from ECB 2017b.

Appendix 4: Eurosystem's Reserve Requirements in € millions, 1999-2017



Own presentation, data taken from ECB 2017b.

Appendix 5: US-$/€ Daily Exchange Rates, 2006-2017



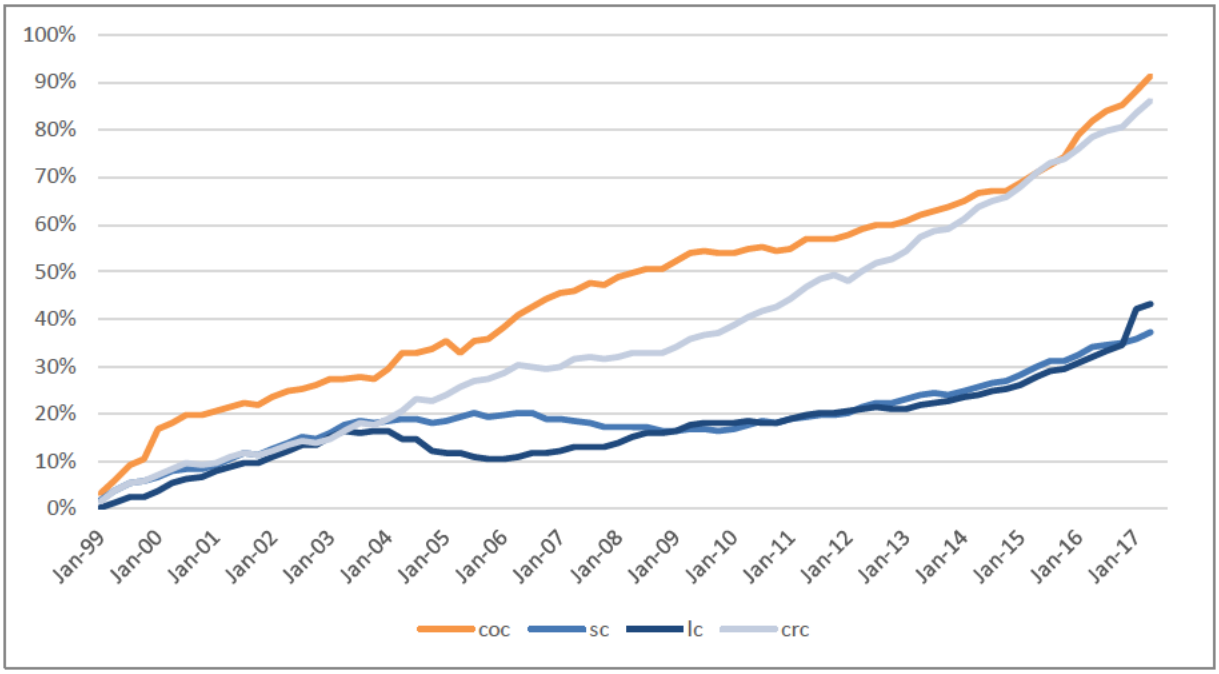
Own presentation, data taken from ECB SDW 2018b.

Appendix 6: Data of Banks' Loan Variables

Borrower	Bank Type	Identifier	Variable	Volatility
NFCs	Commercial Banks	BBK01.PQ0801	con	27.3%
	Sparkassen	BBK01.PC3251	sn	7.51%
	Building & Loan Associations	BBK01.PQ1601	ln	12.5%
	Credit Cooperatives	BBK01.PQ1201	crn	8.8%
Consumers	Commercial Banks	BBK01.PQ0805	coc	11.4%
	Sparkassen	BBK01.PC3255	sc	6.3%
	Building & Loan Associations	BBK01.PQ1605	lc	8.7%
	Credit Cooperatives	BBK01.PQ1205	crc	9.1%

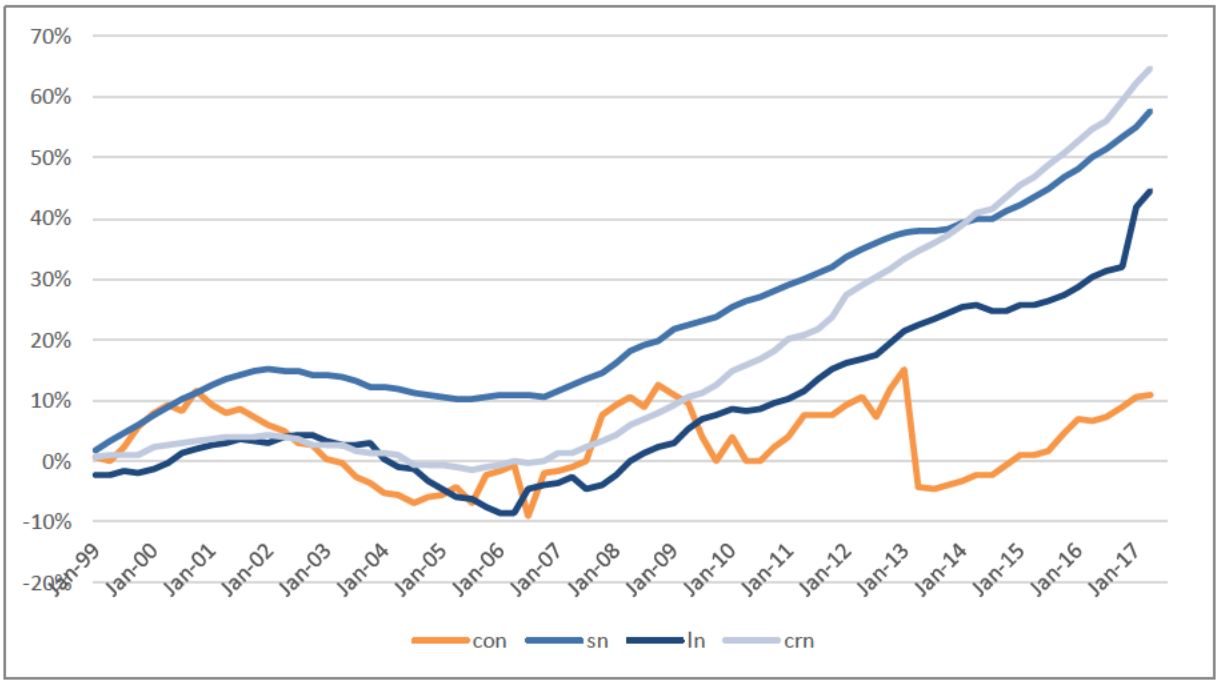
Own presentation.

Appendix 7: Growth in Loan Levels to Consumers, all Bank Types, Index=1999



Own presentation.

Appendix 8: Growth in Loan Levels to NFCs, all Bank Types, Index=1999



Own presentation.

Appendix 9: Approach 1's Numerical Test on Stability

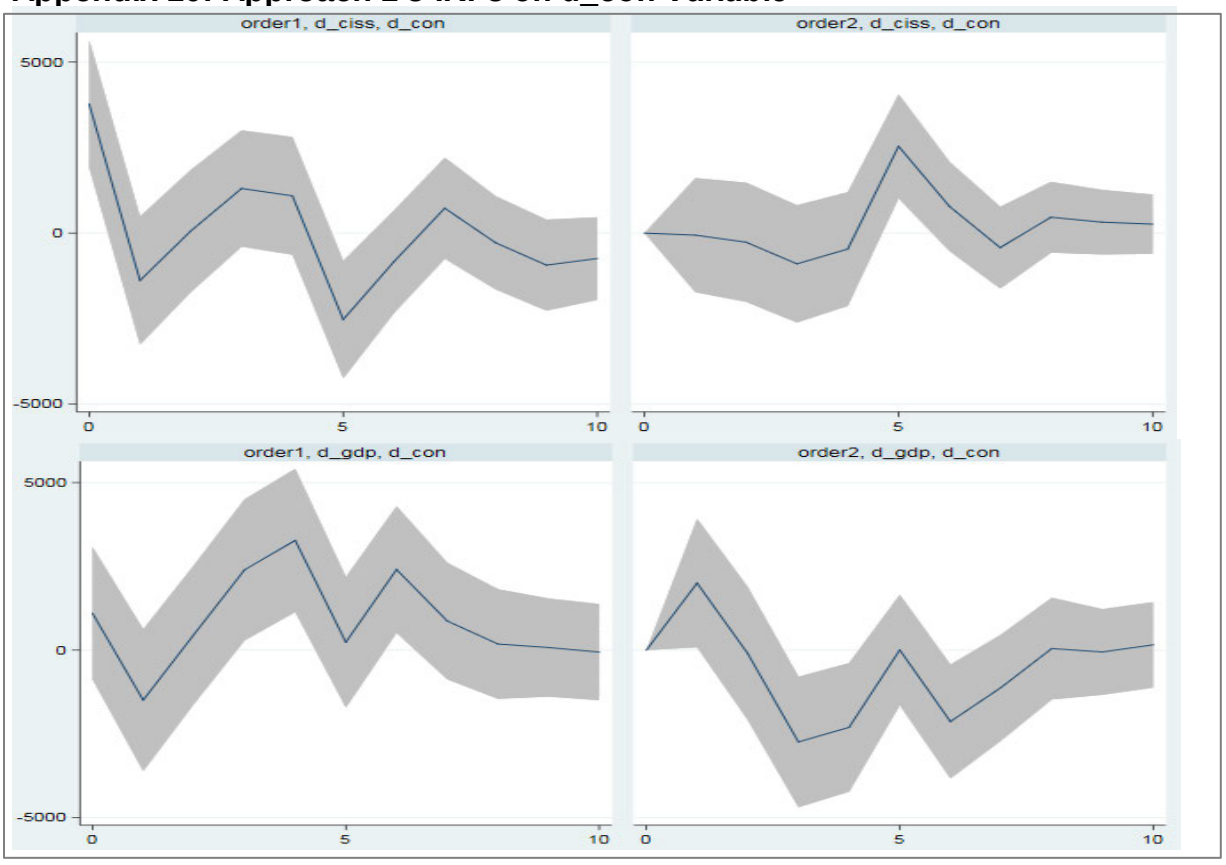
Eigenvalue stability condition

Eigenvalue	Modulus
-.9027559	.902756
.7993891 + .3848867i	.887221
.7993891 - .3848867i	.887221
-.474406 + .7436527i	.882089
-.474406 - .7436527i	.882089
-.0173026 + .8527984i	.852974
-.0173026 - .8527984i	.852974
.8266158	.826616
.3939019 + .6900278i	.794542
.3939019 - .6900278i	.794542
-.7006889 + .3634981i	.789364
-.7006889 - .3634981i	.789364
.5523848 + .3644529i	.661782
.5523848 - .3644529i	.661782
-.4518717 + .4603583i	.645072
-.4518717 - .4603583i	.645072
-.0053187 + .5123458i	.512373
-.0053187 - .5123458i	.512373
-.3235872	.323587
.1412318	.141232

All the eigenvalues lie inside the unit circle.
VAR satisfies stability condition.

Own presentation.

Appendix 10: Approach 1's IRFs on d_con Variable



Own presentation. Confidence Interval = 95%. Order, impulse variable, response variable.

Appendix 11: Approach 1's Outputs on d_sn Variable

Vector autoregression

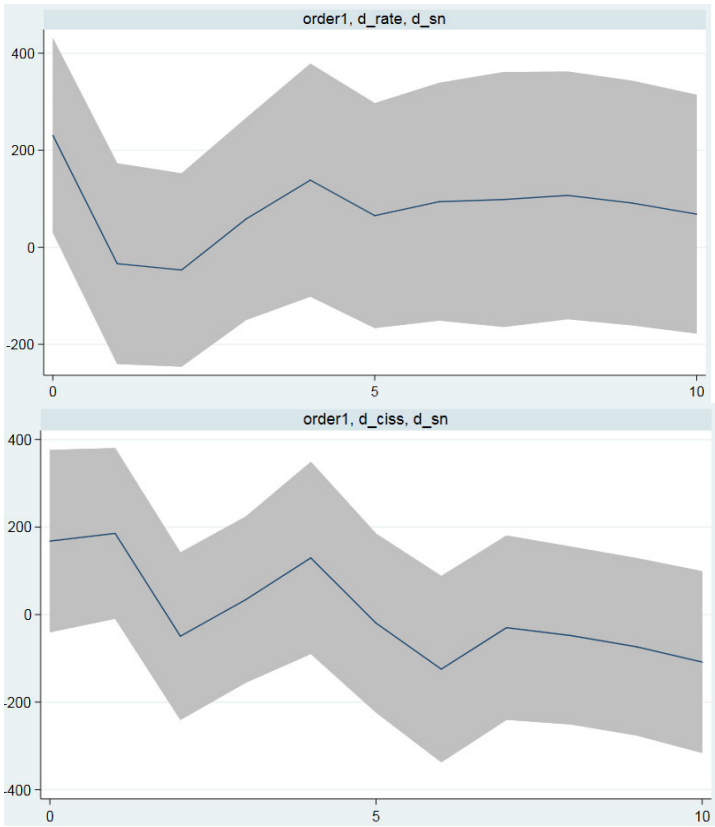
Sample: 2000q2 - 2017q3		Number of obs	= 70
Log likelihood = -1751.085		AIC	= 53.03101
FPE = 8.13e+16		HQIC	= 54.37071
Det(Sigma_ml) = 3.68e+15		SBIC	= 56.40376

Equation	Parms	RMSE	R-sq	chi2	P>chi2
d_gdp	21	4608.96	0.4678	61.53457	0.0000
d_ciss	21	.08495	0.6778	147.2472	0.0000
d_secu2	21	121135	0.4573	58.98334	0.0000
d_rate	21	.003586	0.5082	72.33139	0.0000
d_sn	21	1079.18	0.7747	240.7329	0.0000

Granger causality

d_sn	d_gdp	13.504	4	0.009
d_sn	d_ciss	4.0708	4	0.397
d_sn	d_secu2	10.078	4	0.039
d_sn	d_rate	3.2867	4	0.511
d_sn	ALL	35.819	16	0.003

IRFs



Own presentation. Confidence Interval = 95%. Order, impulse variable, response variable.

Appendix 12: Approach 1's Outputs on d_ln Variable

Vector autoregression

Sample: 2000q2 - 2017q3		Number of obs	= 70
Log likelihood = -1615.803		AIC	= 49.16581
FPE = 1.70e+15		HQIC	= 50.5055
Det(Sigma_ml) = 7.71e+13		SBIC	= 52.53855

Equation	Parms	RMSE	R-sq	chi2	P>chi2
d_gdp	21	4906.62	0.3969	46.05918	0.0008
d_ciss	21	.088558	0.6498	129.9036	0.0000
d_secu2	21	115452	0.5070	71.99444	0.0000
d_rate	21	.003409	0.5556	87.52804	0.0000
d_ln	21	152.64	0.4061	47.85734	0.0004

Granger causality

d_ln	d_gdp	5.5812	4	0.233
d_ln	d_ciss	5.3707	4	0.251
d_ln	d_secu2	11.804	4	0.019
d_ln	d_rate	1.643	4	0.801
d_ln	ALL	25.823	16	0.057

Own presentation.

Appendix 13: Approach 1's Outputs on d_crn Variable

Vector autoregression

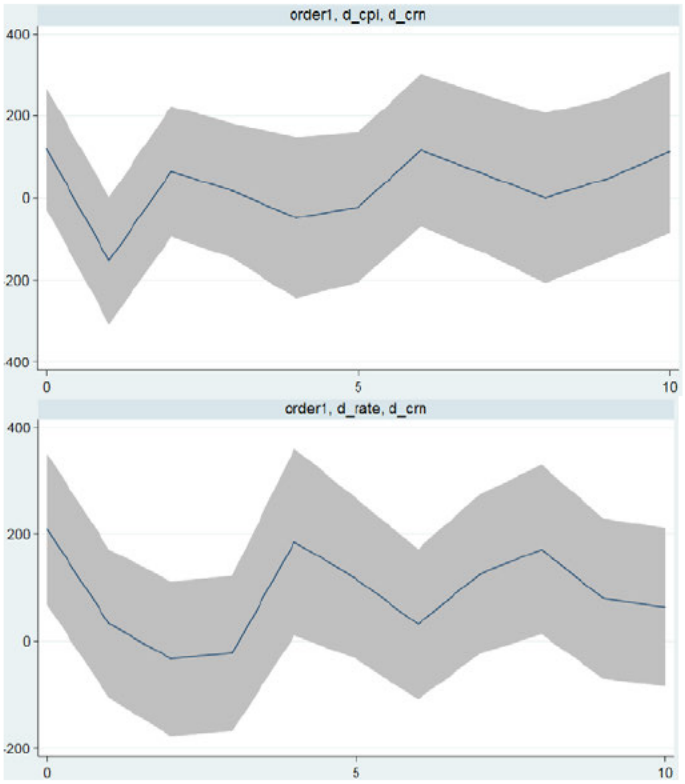
Sample: 2000q2 - 2017q3		Number of obs	= 70
Log likelihood = -2045.985		AIC	= 61.45671
FPE = 3.71e+20		HQIC	= 62.79641
Det(Sigma_ml) = 1.68e+19		SBIC	= 64.82946

Equation	Parms	RMSE	R-sq	chi2	P>chi2
d_gdp	21	4240.98	0.5494	85.35033	0.0000
d_cpi	21	.085316	0.6750	145.386	0.0000
d_secu2	21	123497	0.4359	54.09658	0.0001
d_rate	21	.335137	0.3459	37.02444	0.0116
d_crn	21	736.641	0.8361	357.0043	0.0000

Granger causality

d_crn	d_gdp	4.7132	4	0.318
d_crn	d_cpi	14.062	4	0.007
d_crn	d_secu2	20.425	4	0.000
d_crn	d_rate	5.5966	4	0.231
d_crn	ALL	43.186	16	0.000

IRFs



Own presentation. Confidence Interval = 95%. Order, impulse variable, response variable.

Appendix 14: Approach 2's Outputs on d_coc Variable

Vector autoregression

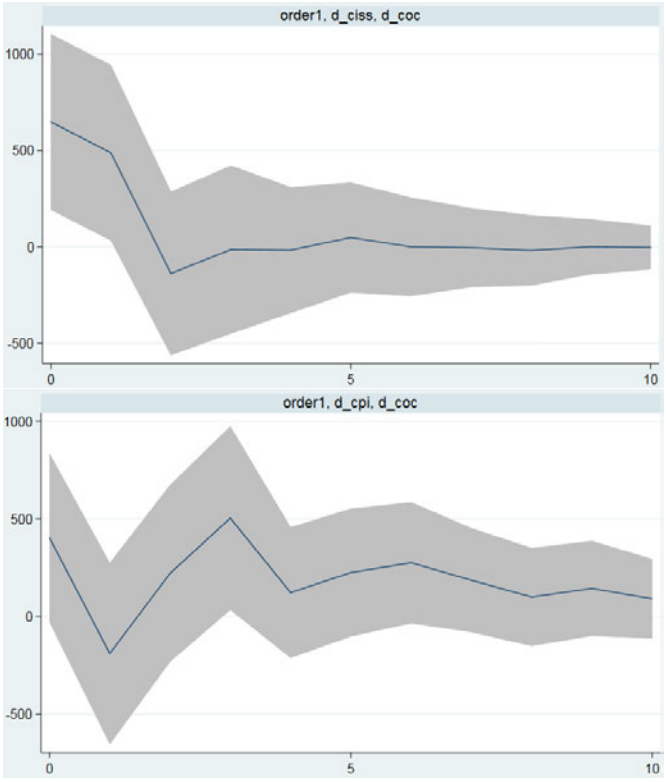
Sample: 2000q1 - 2017q3		Number of obs	= 71
Log likelihood = -2183.587		AIC	= 63.76301
FPE = 3.52e+21		HQIC	= 64.77687
Det(Sigma_ml) = 3.56e+20		SBIC	= 66.31251

Equation	Parms	RMSE	R-sq	chi2	P>chi2
d_gdp	16	4595.79	0.4061	48.54159	0.0000
d_ciss	16	.097485	0.5245	78.30495	0.0000
d_secu2	16	118443	0.4201	51.43521	0.0000
d_cpi	16	.340813	0.2410	22.54728	0.0942
d_coc	16	2315.7	0.2902	29.03196	0.0159

Granger causality

d_coc	d_gdp	1.5	3	0.682
d_coc	d_ciss	3.8287	3	0.281
d_coc	d_secu2	6.4453	3	0.092
d_coc	d_cpi	7.4864	3	0.058
d_coc	ALL	20.688	12	0.055

IRFs



Own presentation. Confidence Interval = 95%. Order, impulse variable, response variable.

Appendix 15: Approach 2's Outputs on d_sc Variable

Vector autoregression

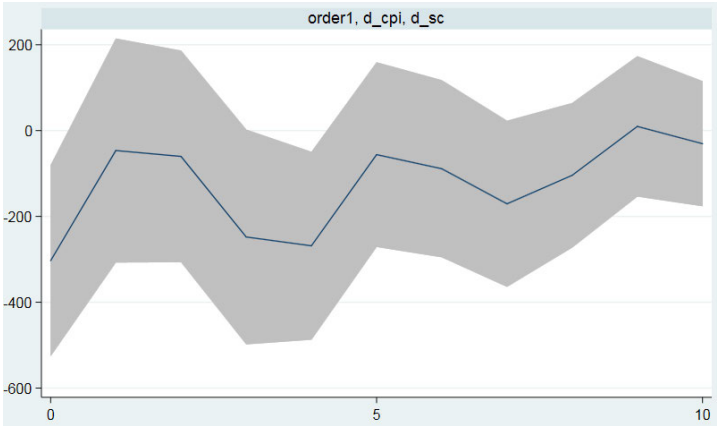
Sample: 2000q1 - 2017q3		Number of obs	= 71
Log likelihood = -2124.022		AIC	= 62.08512
FPE = 6.58e+20		HQIC	= 63.09898
Det(Sigma_ml) = 6.64e+19		SBIC	= 64.63462

Equation	Parms	RMSE	R-sq	chi2	P>chi2
d_gdp	16	4606.69	0.4032	47.97644	0.0000
d_ciss	16	.085713	0.6324	122.1299	0.0000
d_secu2	16	118717	0.4174	50.87096	0.0000
d_cpi	16	.322338	0.3211	33.5776	0.0039
d_sc	16	1137.25	0.5937	103.7677	0.0000

Granger causality

d_sc	d_gdp	7.9599	3	0.047
d_sc	d_ciss	4.0556	3	0.256
d_sc	d_secu2	12.104	3	0.007
d_sc	d_cpi	5.565	3	0.135
d_sc	ALL	37.388	12	0.000

IRFs



Own presentation. Confidence Interval = 95%. Order, impulse variable, response variable.

Appendix 16: Approach 2's Outputs on d_lc Variable

Vector autoregression

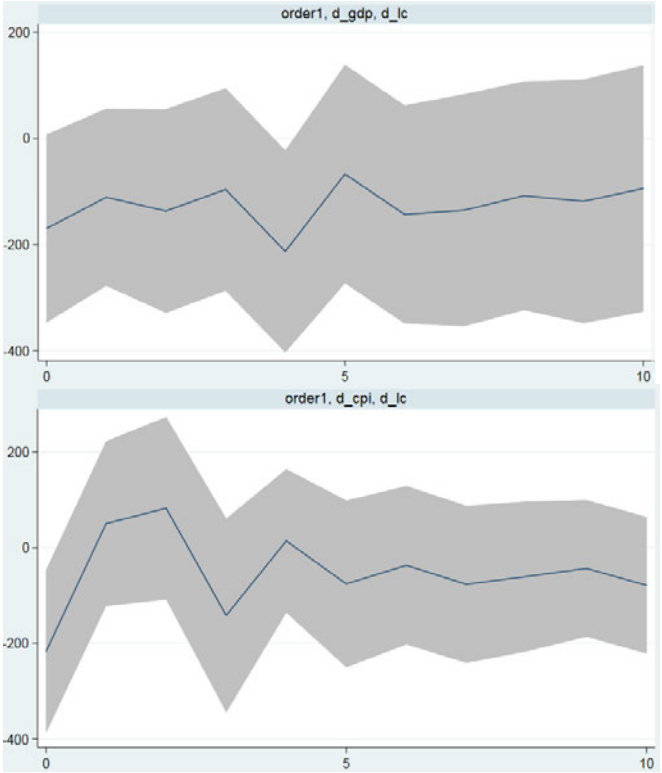
Sample: 2000q1 - 2017q3		Number of obs	= 71
Log likelihood = -2117.469		AIC	= 61.90053
FPE = 5.47e+20		HQIC	= 62.91438
Det(Sigma_ml) = 5.52e+19		SBIC	= 64.45003

Equation	Parms	RMSE	R-sq	chi2	P>chi2
d_gdp	16	4561.68	0.4148	50.33585	0.0000
d_ciss	16	.100419	0.4954	69.70733	0.0000
d_secu2	16	118682	0.4178	50.94229	0.0000
d_cpi	16	.337554	0.2555	24.36226	0.0592
d_lc	16	873.899	0.3482	37.92867	0.0009

Granger causality

d_lc	d_gdp	2.2649	3	0.519
d_lc	d_ciss	5.5405	3	0.136
d_lc	d_secu2	4.9665	3	0.174
d_lc	d_cpi	5.5671	3	0.135
d_lc	ALL	18.676	12	0.097

IRFs



Own presentation. Confidence Interval = 95%. Order, impulse variable, response variable.

Appendix 17: Approach 2's Outputs on d_crc Variable

Vector autoregression

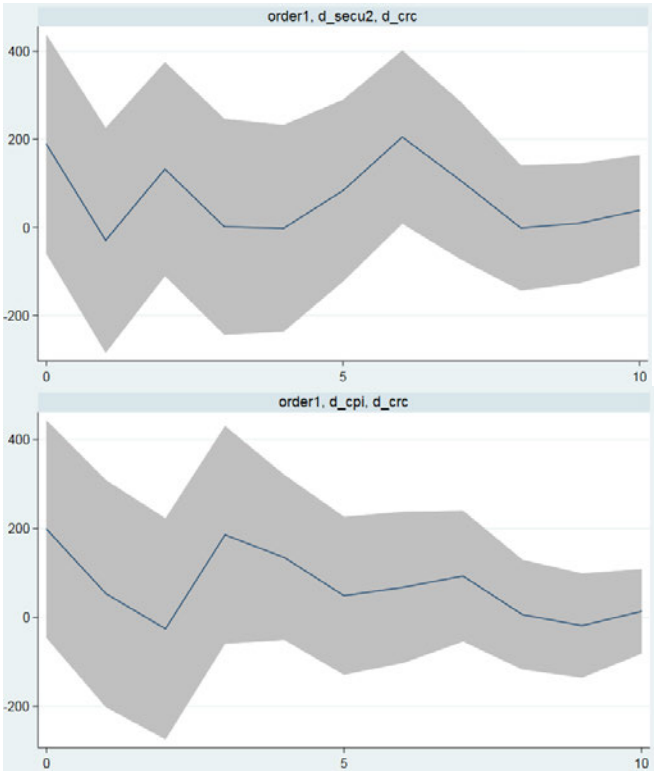
Sample: 2000q1 - 2017q3		Number of obs	= 71
Log likelihood = -2133.228		AIC	= 62.34445
FPE = 8.52e+20		HQIC	= 63.3583
Det(Sigma_ml) = 8.61e+19		SBIC	= 64.89395

Equation	Parms	RMSE	R-sq	chi2	P>chi2
d_gdp	16	4357.08	0.4662	61.99877	0.0000
d_ciss	16	.093897	0.5588	89.9332	0.0000
d_secu2	16	114938	0.4539	59.01667	0.0000
d_cpi	16	.327243	0.3003	30.46603	0.0103
d_crc	16	1227.68	0.4038	48.07796	0.0000

Granger causality

d_crc	d_gdp	2.0771	3	0.557
d_crc	d_ciss	14.41	3	0.002
d_crc	d_secu2	2.5475	3	0.467
d_crc	d_cpi	3.2207	3	0.359
d_crc	ALL	24.427	12	0.018

IRFs



Own presentation. Confidence Interval = 95%. Order, impulse variable, response variable.

Appendix 18: Correlation Matrix

	gdp	*ciss*	*cpi*	*eonia*	*rate*	*shfmp*	*mro*	*ltro*	*secu1*	*secu2*	*con*	*coc*	*ln*	*lc*	*crn*	*crc*	*sn*	*sc*
gdp	1.0000																	
ciss	0.0299	1.0000																
cpi	0.9700	0.1498	1.0000															
eonia	-0.7850	0.0338	-0.8214	1.0000														
rate	-0.7783	0.1621	-0.7881	0.9737	1.0000													
shfmp	0.7616	-0.1571	0.6259	-0.5743	-0.5877	1.0000												
mro	-0.5973	0.0164	-0.5365	0.6130	0.6106	-0.6382	1.0000											
ltro	0.7294	0.2930	0.8085	-0.7355	-0.6368	0.4756	-0.5821	1.0000										
secu1	0.8651	-0.0856	0.7645	-0.7115	-0.7101	0.9770	-0.6948	0.6074	1.0000									
secu2	0.8617	0.0183	0.8013	-0.7160	-0.6800	0.9223	-0.6416	0.7685	0.9592	1.0000								
con	0.1672	0.4918	0.1586	-0.0076	0.0802	0.2994	-0.4748	0.4100	0.2993	0.3652	1.0000							
coc	0.9707	0.1428	0.9777	-0.7835	-0.7498	0.7125	-0.5144	0.7600	0.8249	0.8489	0.1761	1.0000						
ln	0.8843	-0.1298	0.8174	-0.7954	-0.8155	0.8090	-0.8114	0.6713	0.8865	0.8426	0.2688	0.8097	1.0000					
lc	0.9302	-0.0017	0.8934	-0.7995	-0.8008	0.8215	-0.5944	0.6782	0.8961	0.8847	0.1685	0.9371	0.8914	1.0000				
crn	0.9384	-0.1081	0.8677	-0.8045	-0.8171	0.8376	-0.7658	0.6792	0.9178	0.8748	0.2472	0.8655	0.9796	0.9038	1.0000			
crc	0.9937	0.0142	0.9707	-0.8245	-0.8141	0.7657	-0.5836	0.7323	0.8717	0.8682	0.1341	0.9768	0.8811	0.9413	0.9367	1.0000		
sn	0.9611	-0.0056	0.9267	-0.8353	-0.8317	0.7950	-0.7265	0.7487	0.8953	0.8797	0.2709	0.9278	0.9616	0.9473	0.9781	0.9630	1.0000	
sc	0.9118	-0.0976	0.8710	-0.7236	-0.7405	0.7569	-0.3873	0.5615	0.8215	0.8065	-0.0186	0.9225	0.7711	0.9422	0.8285	0.9309	0.8704	1.0000

Own presentation.

Declaration of Originality and of Consent

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