Department of Business and Management
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The Credit Channel of Monetary Policy: Theoretical Foundations and Empirical Analysis

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Abstract

In this thesis we examine the transmission of unconventional monetary policies implemented in Europe during the recent crises through Bank Lending Channel (BLC) by performing a series of country specific unrestricted VAR models. We provide a general overview on the past literature relative to both credit channel and unconventional monetary policies. We study the relevance of this transmission channel in Austria, Germany, Italy and Spain using monthly data from September 2004 to January 2014. Our results suggest that BLC has been involved in the transmission mechanism regardless of the type of monetary policy run by the European Central Bank (ECB) in this period. We find a negative reactions of loans aggregate and credit supply following a positive shock on both EONIA and shadow rate. At first glance, all countries analyzed show a BLC functioning similar to each other except for Spain where it appears to be stronger with conventional policies but less effective with unconventional ones. By splitting credit demand and supply, we also find that only Italy shows a loans aggregate depending more on the supply rather than demand side perhaps as a combined result of the structure of the industrial fabric and banking market itself. Overall, our findings suggests that BLC has been only one channel among which the transmission mechanism worked. However, further analyses would be required in order to decompose the relative importance of each transmission channel.

Dedication

To my family, my friends and Clara.

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Acronyms

ABSPP Asset-Backed Security Purchase Program

AIC Akaike's Information Criterion

ARMA AutoRegressive Moving Average

BoJ Bank of Japan

BLS Bank Lending Survey

BLC Bank Lending Channel

CBPP Covered Bond Purchase Program

CC Commodities Credit Curve

CPI Consumer Price Index

ECB European Central Bank

EONIA Euro OverNight Index Average

EU European Union

FED Federal Reserve System

FRFA Fixed Rate Full Allotment Operation

GDP Gross Domestic Product

GNP Gross National Product

HICP Harmonised Index of Consumer Prices

HQ Hannan-Quinn Criterion

IS Investment Saving Curve

LM Liquidity Money Curve

LSAP Large Asset Scale Purchase

LTRO Long-Term Refinancing Operation

MFI Monetary Financial Institution

MRO Main Refinancing Operation

NFC Non-Financial Corporation

NIRP Negative Interest Rate Policy

OMT Outright Monetary Transactions

PSPP Public Sector Purchase Program

QE Quantitative Easing

QQE Quantitative and Qualitative Easing

SBIC Schwarz-Bayesian Information Criterion

SME Small and Medium Enterprise

SMP Securities Market Program

SVAR Structural Vector AutoRegression

TLTRO Targeted Long-Term Refinancing Operations

UK United Kingdom

U.S. The United States of America

VAR Vector AutoRegression

VLTRO Very Long Term Refinancing Operation

ZIRP Zero Interest Rate Policy

YoY Year-over-Year

Introduction

From the financial turmoil of 2008 onwards, many aspects of our economy has changed. Central banks of all around the world had to design new monetary policy instruments to cope with one of the biggest global financial crisis ever faced by our society. In such a context, the usual conventional monetary tools were not able alone to manage such a terrific economic crisis. Once in the liquidity trap, with short term rates close or almost equal to zero, central banks needed to look for new ways to tackle the economic downturns and provide further stimulus to the whole economy. Therefore the Federal Reserve System (FED) prior, and the ECB then, had to resort for the first time in their history on the so called unconventional monetary policies which had been pioneered in Japan during 1990s. Even if there is not a unique consistent definition for such non standard policy measures, in this group it is possible to identify different types of policies such as Quantitative Easing (QE) and forward guidance. These are unconventional not only for their features but also for the ways by which their impulses are transmitted to the economy. In fact, in a zero lower bound situation, the "standard" interest rate channel is inhibited. As a consequence, these policies operate through other channels: portfolio-balance, signaling, liquidity, confidence, and BLC.

In recent times, unconventional monetary policies have been increasingly studied in economics research. In the literature we can find lots of empirical works looking for the effects of this kind of policies on various economic aspects and variables such as real estate markets, equity capital markets, exchange rates and many others. However, just few of these take into account the implications for the credit market (i.e. C. Cahn et al., 2018). Here, we want to shed light on the functioning of the BLC in an unconventional monetary policy context. In order to do so, in line with the most empirical works focusing on this topic, we use a Vector AutoRegression (VAR) methodology. In this way, we can investigate on the evolution of certain endogenous variables of our interest following a monetary shock. To account for the credit market, inspired by C. Altavilla et al. (2018), we mainly resort on Bank Lending Survey (BLS). Through this data source, we can firstly analyze the overall effect on the credit market and, then, try to disentangle the relative contribution of both credit supply and demand which is usually the trickiest part of this kind of studies. In particular, we focus on loans to enterprises rather than considering all credit types as a whole. We derive impulse responses for each country taken into account in this analysis (Austria, Germany, Spain, and Italy) which will permit us to look for possible heterogenous transmission of unconventional monetary policies within the European Monetary Union. Finally, this thesis iwill test for the presence and, in turn, the active role played by BLC in the transmission of non standard measures.

The thesis structure can be divided in two main parts. On one side, in Chapter 1, 2, and 3, we provide all the theoretical foundations needed to better understand the credit market and unconventional monetary policies in economics terms. On the other side, Chapter 4 is entirely dedicated to disclose the empirical analysis at the core of this work. More specifically, Chapter 1 describes the asymmetric information nature of the credit market through the most relevant models in the literature. Accordingly, we present the concept of credit rationing pointing out under which conditions this phenomenon can occur. Chapter 2 discusses the difference between the so called money and credit views. Here we highlight the criticisms of money view which have led to the birth of the credit view and, in turn, the conceptualization of credit channel. We describe both bank lending and balance sheet channels with an additional focus on concepts as *financial-accelerator* and *flight to quality* as chapter conclusion. Chapter 3 provides a complete overview on unconventional monetary policy and their transmission channels. In doing this, we start by explaining the difference between conventional and unconventional policies to the description of how BLC is supposed to be activated by these measures, passing through the list of the main unconventional policy tools. Chapter 4 differs from the previous since it concerns the econometric models and their issues. In particular, at the beginning of the chapter we provide the main descriptive on the credit market in terms of country and credit product type. Then we clarify our choices in terms of methodology and data before actually disclosing the different VAR models used for our analysis and their main findings. Here we develop both impulse response functions and variance decomposition in order to run our analysis. Finally, before to conclude, we also perform a robustness check.

Chapter 1

Imperfect Information in the Credit Market

Within our lifetime all of us have to deal with the credit market sooner or later. For instance, a newlyweds couple usually asks for a mortgage in order to have enough money to buy their first house. Another typical example is that one referring to an entrepreneur who resorts to bank loan for financing a business project. All in all thus, credit market is at the heart of our lives one way or another. According to this, credit market has always been center of discussions and studies in the macroeconomics literature. As we will see in these next pages, this market is far from being a perfect market. Both adverse selection and moral hazard issues arise in a typical credit market context. To pursuit our purposes, in this chapter we will deeply discuss about the asymmetric information in the credit market and its impact on it. In doing so, we will firstly provide a general overview by introducing important concepts as adverse selection, moral hazard, and monitoring costs in order to be able later to fully explain the credit rationing phenomenon. Even though in the literature there are many models which describe different mechanisms referring to credit rationing, our analysis will be based on Jaffee and Russell (1976) and Bernanke and Gertler (1989). Moreover, in the final sections of the chapter, we will provide an explanation regarding some important concerns relative to credit rationing such as projects' return heterogeneity, multiple groups context, and the role of collaterals.

1.1 Introduction to Asymmetric Information in lending markets

1.1.1 A brief overview on the Asymmetric Information literature

Before starting our discussions about the role of asymmetric information in the credit market, it is important to have a full understanding of some important concepts. In the economics literature we find two different categories of asymmetric information: adverse selection (*ex ante*) and moral hazard (*ex post*). For what concerns the first, a workhorse reference is Akerlof (1970). This refers to the famous example of the lemons in which the sellers have an informational advantage with respect to buyers about the quality of the goods before the starting of a contractual relation between parties. Turning to moral hazard, it concerns the case in which parties have the same information before that contract starts, but later one of them (the active part) can change its behaviour and act in such a way that is not observable by the other part anymore. In the literature this is usually called hidden action. Furthermore there could be a situation where the actions of the parties are observable, but not the information on which they are based (F. Gjesdal, 2007). This is still a moral hazard issue that regards the case of hidden information. From what just described there are two emerging figures: the agent and the principal. All said so far refers to the so called principal-agent problem (also known as agency dilemma). Generally speaking, the agency problem arises whenever there is *"contract under which one or more persons (the principal(s)) engage another person (the agent) to perform some service on their behalf which involves delegating some decision making authority to the agent"* (M. Jensen and W. Meckling, 1976). At this point, if both parties seek to maximize their own utility, it is credible that agent will act following more their own interests rather than those of the principal. It entails that *"the value of the agent's performance to the principal will be reduced, either directly or because, to assure the quality of the agent's performance, the principal must engage in costly monitoring of the agent"* (J. Armour et al., 2007). More specifically, we can define agency costs as the sum of three different components (M. Jensen and W. Meckling, 1976):

- **Monitoring costs** refers to the amount paid by the principal to measure, observe, and control an agent's behavior (i.e. auditing activity) (I. Clatcher et al., 2010). Even if the principal bears immediately the cost, this will be reflected on the agent only at the moment of the remuneration which will be adjusted to cover the monitoring costs.

- **Bonding costs** can be distinguished from monitoring costs because they concern the commitment by agents to respect some restrictions on their activities. It turns out that they are directly borne by agents. For instance, the implicit cost of a non-competition deal agreed by managers could be considered a bonding cost.

- **Residual losses** are the persisting agency costs despite the use of monitoring and bonding costs. Alternatively, they can be seen as the net losses arising from the forcing use of suboptimal incentive contracts

Thus the following questions arise: why these aspects are so relevant for our purposes? Why a full understanding of them is a key aspect for us? We will answer to these questions in the next paragraphs and, more generally, throughout this work.

1.1.2 Asymmetric Information from the Credit Market perspective

In the previous section we have just limited ourselves to expose the general literature about asymmetric information. Now we seek to link what we have described above with our area of interest: the lending market. This will be our basis to have a better understanding of the credit rationing which is a key concept in this literature field. In the credit market there are two main agents: the lender and the borrower. The first, ordinarily a bank, by making loans is usually concerned to two important aspects: the interest rate relative to the loan and the riskiness (or the probability of repayment) of the loan itself[1] (J. Stiglitz and A. Weiss, 1981). The latter is strictly related with the project that the borrower wants to bring about. However, at this point an adverse selection issue arises since we are in a borrower-advantaged asymmetry (C. Ofonyelu, 2013), namely the borrower has better information about the variables that impact on the success of the project and on its related riskiness. For instance borrower may have a deeper knowledge about the product or the market, or he or she could be aware of his or her real degree of commitment in the project and so on. Since not all borrowers are equal to each other, it entails that bank has to implement a system by which it can distinguish "bad" from "good" borrower (i.e. screening activity). This kind of goodness depends on the ability to pay back the loan and it can be identified by using a variety of screening devices (J. Stiglitz and A. Weiss, 1981). Unfortunately these measures alone are not sufficient for the lender to prevent possible opportunistic behaviours of the borrower. In fact, it still persists a moral hazard issue due to the fact that bank is not able to directly control the behavior changes of the borrower. It follows that the lender will have to put up a costly monitoring system in order to check the borrower's action.

This is the general framework of asymmetric information in the lending market. However, though this section permits us to better approach the next important paragraph relative to credit rationing, it results too simplistic and insufficient to make clear all the implications and consequences concerning the imperfect information in the credit market. Hence, in the following sections we will propose analyses and models about the impact of adverse selection and moral hazard on the lending market.

[1]In the following models, we assume that the borrower consists in an entrepreneur who wants to finance its own firm with loans. It turns out that here the risk for the bank refers to the eventuality in which the entrepreneur is not able to fulfill his or her contractual obligation following a project failure.

1.2 The Credit Rationing

1.2.1 The theoretical roots of Credit Rationing

Credit rationing has its theoretical roots on the so called "Availability Doctrine" designed by A. Rosa (1951). Consistent to this, credit rationing was thought to be one of the factors which influences the investment independently from the interest rates fluctuation (D. Jaffee, 1989). Few years later I. Scott (1957), starting from the availability model of A. Rosa, clearly defines for the first time the credit rationing as that situation where the borrower is not able to borrow the amount desired at the ongoing rate[2]. Furthermore, it is important to point out that here credit rationing was still considered a non-equilibrium phenomenon either caused by not competitive loan markets or exogenous interest rigidities such as interest rate ceilings[3]. Nevertheless, this early literature *"lacked a solid theoretical foundation upon which empirically testable hypotheses could be built and its assumptions validated"* (T. Devinney, 1986). Few years later, however, there was the first attempt to provide microeconomics foundations able to explain the rationing of loans regardless the price effect. This refers to Hodgman (1960), who was also the first to state how credit rationing can persist in a rational equilibrium framework (C. Calomiris and S. Longhofer, 2008). Hodgman focused on the role played by the risk of default in the credit market, recognizing that this alone is not a sufficient condition for credit rationing to occur (D. Jaffe, 1989). More specifically, his model emphasized the linkage between the loan amount and the default risk. To discuss this aspect Hodgman started from the following assumptions:

I. Risk-neutral banks assess the borrowers' creditworthiness looking at the possible outcomes deriving from a fixed-size investment (i);

II. ϕ_i (i's distribution) is supposed to be continuous and limited upward and downward;

III. If default occurs, the bank receives a minimum ratio between expected revenues and expected costs (M);

IV. The banking sector must be competitive. It entails that M is also the maximum required by the market.

Once that we accept these assumptions, we can derive the demand and supply loan curves which are depicted in Fig. 1.1. Because of the market competition, it can be shown that each interest rate level matches one and only one M. It entails that if the loan size grows, the interest rate which corresponds to a certain M will rise accordingly to the increase of expected losses. This results in a upward sloping supply curve. By contrast, an increase in the default risk will be consistently followed by a higher interest rate required, resulting in a downward sloping demand curve. However, in this context Hodgman points out

[2]However this is just a first and "rude" definition of the phenomenon which has been revised many times in the following years.

[3]Usually called interest rate caps, they refer to the maximum level of interest rate that a bank (or other financial institutions) can charge on its (their) products.

how there will be a couple of interest rates and loan sizes which permits the bank to reach the threshold at which it can soak up the total revenues whatever it takes (contract K in Fig. 1.1). As a consequence of that, above the contract X, no interest rate rise can compensate the greater losses arising from a larger loan exposition. In other words, the loan supply curve becomes perfectly inelastic. Therefore it exists a total loan amount a_k beyond which the bank is not willing to go regardless of a further increase in the interest rate. On the other hand, it is important to dwell on the demand side behaviour. In fact, Hodgman argues that if the intersection between the two curves occurs in the inelastic part of the offer, then entrepreneurs will always prefer the contract K rather than the contract A. At the same time the expected utility for banks is not influenced by interest rate levels between r_x and r_a. In conclusion, it results that K is the equilibrium contract of the market.

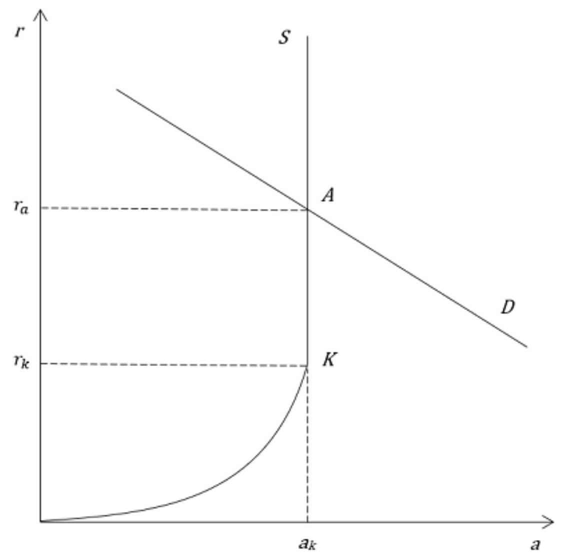

Figure 1.1: Credit rationing in Hodgman's model (1960)

This model was much debated in the ensuing years (C. Calomiris and S. Longhofer, 2008). There were especially two aspects that were strongly criticized[4]. Firstly, it was not clear why banks evaluate borrowers on the basis of the minimum ratio between expected gains and losses. In fact, it appeared to be an excessive arbitrary criterion since it does not consider neither banks' maximizing attitude or any credit risk analysis. Moreover, according to the general thought of the time regarding the *"conservative tastes of bankers"*[5], that criterion was largely criticized because compatible to some excessive risk taking situations by the lender itself. The second source of criticism arose from the position of the demand curve considered to be too much optimistic. Namely, it seemed unlikely that this curve intersects the supply curve over its vertical range. This is due to the implicit presence of asymmetric evaluations in the Hodgman's reasoning. In other words, since the bank keeps the whole revenues both in case of success

[4] S. Chase Jr. (1961) and Ryder (1962)

[5] At that time financial institutions were supposed to be highly risk adverse in contrast to the first hypothesis of the Hodgman's model.

or failure, it appeared difficult that the borrower decided to accept a contract in which he or she could lose the entire capital amount.

1.2.2 Modern theories and definitions of Credit Rationing

Miller (1962) continued on the line developed by Hodgman taking into account the issues and findings described above. In fact, he integrated the Hodgman's model asserting how the existence of bankruptcy costs (both direct and indirect) can justify rational expectations for credit rationing. Another important contribute in this literature stems from Freimer and Gordon (1965). Starting from Hodgman and Miller, and assuming an exogenous interest rate in addition to a monopolist lender, they demonstrated that credit rationing can occur even with risk neutral lenders at condition that borrowers ask for fixed-sized funds (C. Calomiris and S. Longhofer, 2008). In other words, the riskiness of the project affects the loan supply of the monopolist lender, which will offer additional larger loans at higher interest rates only up to a certain threshold. To better and deeply understand the process we can observe the following figure:

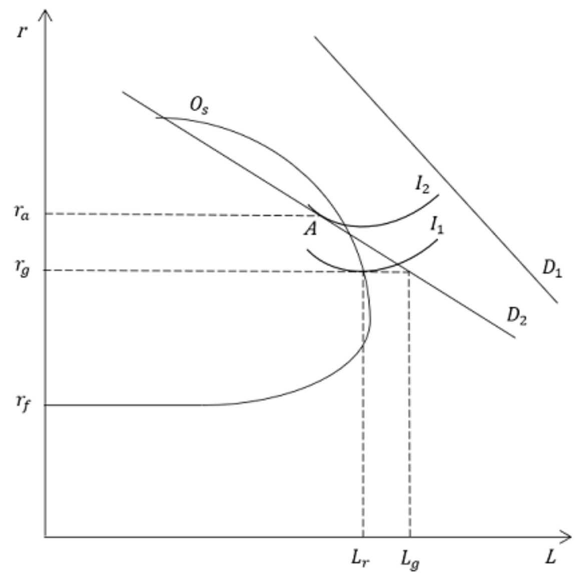

Figure 1.2: Backward-bending loan supply curve (Freimer and Gordon, 1965)

Looking at the graph, we can notice how the bank is willing to offer any loan amount at the risk free rate r_f whenever the asking borrower does not present any default risk given its earnings function. As the interest rate increases, the optimal loan level for the bank rises in turn. However, this is true up to a certain point. Indeed, once exceeded a certain threshold interest rate, losses deriving from defaults are greater than revenues for the bank, forcing it to reduce the amount of loans. It entails that the offer curve O_s beyond the maximum loan size becomes backward-bending. Therefore credit rationing phenomenon occurs whenever the demand curve is not consistent with the supply curve (i.e. D_1). This rationing will persist until the offer curve will intersect the supply curve as in the case of D_2. Even if at that time there was uncertainty about the kind of rationing, this is a typical example of *Redlining* (Type II credit rationing). More specifically, accordingly to E. Luci (2010) in the literature we can distinguish between two different types of credit rationing[6]:

Type I. **Pure credit rationing** refers to the situation in which some individuals obtain loans, while apparently identical individuals, who want to borrow exactly the same loan amount at the same terms, do not.

Type II. **Redlining** is defined as that situation in which, in front of a certain loan supply curve, there are identifiable groups of individuals which are unable to borrow at any interest rates, whereas with a larger supply of credit they would.

As we can notice now, the models described above effectively refer to the case of Type II credit rationing. However, this type is not that one which is usually considered as credit rationing phenomenon (T. Devinney, 1986). Instead, an important model referring to Type I credit rationing which tries to go beyond the limits of the previous literature (i.e. assumption of exogenous interest rates) is that one of D. Jaffee and F. Modigliani (1969). In their model, in addition to the backward-bending offer curve developed by Freimer and Gordon, they assumed that a monopolist bank was able to discriminate borrowing entrepreneurs on the base of objective factors such as industry affiliation and firm size (D. Jaffee and J. Stiglitz, 1990). However, in this context the bank cannot force the borrower to rise the loan amount requested above what he or she has already asked for. This means that the lender can choose any contract on the demand curve but not above it. Therefore banks will ration those group of borrowers whose loan demand exceeds the loan offer. To better understand this point we can also look at the Fig. 1.3. This is similar to the Fig. 1.1 with a couple of important differences that we must consider. Firstly, we introduce in the graph the iso-profit curves (I_n) for the bank. Secondly, the loan supply and demand curve refer now only to a specific entrepreneur s (O_s and D_s). If we further suppose perfect discrimination, the bank will decide to offer a contract which makes the demand offer tangent to its own iso-curve in order to maximize profit (i.e. point A). In this way credit rationing is not profitable for the bank *"which instead, as in the standard theory of monopoly under uncertainty, would be glad to lend more than the customer is prepared to take"*(D. Jaffee and F. Modigliani, 1969). However, at this point a question should arise: what happens if the bank is unable to fully distinguish all borrowers? In other words, if the bank is not able to perfect discriminate entrepreneurs, is there a possible presence of credit rationing? To answer these questions we can use again the previous graph. Supposing now that for some exogenous reasons the bank is not able to perfectly discriminate borrowers anymore, it will be forced to apply a certain interest rate (r_g) to a group of borrowers within is comprised also the entrepreneur s. At that point, conversely to what happened before, credit rationing could be profitable for the bank. This could be explained as follows: because of the curve O_s outlines the loan amounts through which the lender can maximize its profit, it means that the bank will provide the amount L_r rather than L_g since it refers to higher profit levels. As a consequence, some borrowers in the group will

[6]These definitions stem from W. Keeton (1979), J. Stiglitz and A. Weiss (1981), and D. Jaffee and J. Stiglitz (1990).

not have access to credit. In this situation, even if an entrepreneur is willing to pay a higher interest rates in order to borrow a larger amount, this would not be possible due to the fact that *"it would conflict with the purpose of the classification scheme, namely to simplify rate-setting with just one rate for each group"* (D. Jaffee and J. Stiglitz, 1990). Nonetheless, we still have to explain which are those "exogenous reasons" mentioned before to explain why a perfect discrimination could not occur. Concerning this issue, Jaffee and Modigliani provided two different examples. Firstly, the presence of usury laws in the banking system prevents the banker from charging any rate greater than the legal limit. This aspect combined to *"social mores"* would stop banks to charge widely different rates to different customers. Secondly, given the competitive nature of the banking market it is difficult for a perfectly collusive system to exist. In the following years, some important additions were made as extension to what we have just described. For instance, D. Jaffee (1972) was able to go beyond the assumption of fixed investment, showing how the same offer curve in the Fig. 1.3 could result even in the case of projects characterized by decreasing returns to scale.
At this point we have all the theoretical bases that we need in order to better explain and understand some important models and aspects relative to credit rationing. In fact, as we said before, adverse selection, moral hazard, and costly monitoring affect the nature of credit contracts and may lead to the presence of equilibrium rationing. In the next sections thus, we will present relevant models in the literature which try to further clarify and motivate the relation between credit rationing and markets with imperfect information.

1.3 Adverse Selection and Credit Rationing

As we said at the beginning of this chapter, Akerlof (1970) is the first treating adverse selection with his lemons model. However, he only considered extreme cases of market failure such as the whole absence of a credit market. It turns out that for our purposes this is not enough. In fact, we want to go deeper in order to better explain the linkage between adverse selection and credit rationing. Accordingly, we will use two important models respectively developed by Jaffee and Russell (1976) and Stiglitz and Weiss (1981).

1.3.1 Jaffee and Russell's contribute

The first fundamental assumption on which the model is based concerns the distinction between two different types of borrower. In fact, Jaffee and Russell define:

- **"Honest" borrowers** as those borrowers who accept only loan contracts which they are certain to be able to repay (as they effectively do);

- **"Dishonest" borrowers** are instead those who will default whenever the default costs are sufficiently low.

The fundamental point here is that *ex ante* the lender is unable to distinguish between these two categories[7]. The model is set like a two-period Fisherian consumption model where there are two different types of agent: consumers and banks. In this context, each honest individual is assumed to receive an exogenous income stream for the two periods (Y_1, Y_2) by which he or she will try to maximize his or her utility function defined in terms of consumption levels for the two periods $U[C_1,C_2]$. Moreover, another source of financing for the individual is given by the credit market. More specifically, each individual can borrow a certain amount of money at the beginning of the first period, and then repaying the principal with interests owed at the beginning of the second period. This results in an increase in C_1 and a subsequent decrease in C_2 which could be formalized as follows:

$$\text{Maximize } U[C_1,C_2] \text{ with respect to } C_1,C_2,$$
$$\text{under the constraint } C_2 = Y_2 - (C_1 - Y_1) * (R)$$

Where $R = 1 + r$ is the interest rate and $(C_1 - Y_1)$ could be seen as the loan amount. Starting from this, it is possible to demonstrate that the loan demand function assumes the following form:

$$L^* = L^*(R), \qquad \frac{dL^*}{dR} < 0,$$

In addition, we can derive the iso-utility curves of the individual in (L, R) space:

$$U(L + Y_1, Y_2 - LR) = K, \quad \text{with } K \text{ constant},$$

More specifically, Jaffee and Russell find that these curves assume a form equal to those shown in Fig. 1.2. For what concerns a dishonest borrowers instead, they are considered as honest borrowers with the addition of two relevant conditions which must be considered when default can occur:

I. In order to not permit to banks to recognize a dishonest borrower from a honest one, "*the observed loan demand of dishonest individuals must equal the loan demand of honest individuals*".

II. Every consumer bears a fixed personal cost to default which we will call Z. It entails that this cost will be subtracted from Y_2 when default occurs. This cost could be seen as a result of either the social or psychological pressure or as the following denial of further financing resources.

According to this last condition thus, the dishonest borrower will try to maximize his or her own utility function as follows:

$$\begin{cases} \text{default} & \text{if } Z < L^*R \\ \text{repay loan} & \text{if } Z > L^*R \end{cases}$$

Therefore, it turns out that dishonest borrowers will decide to default and to not repay the loan whenever it is convenient or, in other words, when the default costs are less than the contracted repayment. It is important to point out that here when borrower defaults he or she does not repay the loan amount at all (partial repayments are not taken into account).

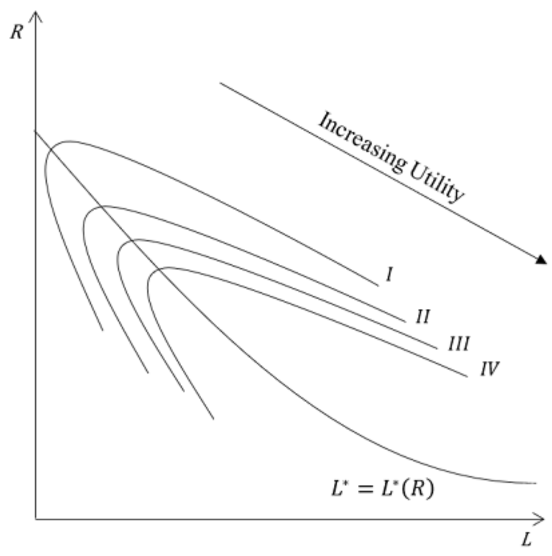

Figure 1.3: Iso-utility family curves for borrowers (Jaffee and Russell, 1976)

We have assumed so far that Z is equal for all individuals. However, this does not reflect the reality where the cost of default and contract size (LR) vary among different individuals. Thus we can assume that Z is distributed as a continuous variable where Z_{min} corresponds to the minimum loan size at which default is observed, and Z_{max} is the level at which individuals never default. Starting from that, we can derive a function $\lambda[LR]$ where λ indicates the proportion of borrowers who pay back a loan of a contract size LR:

$$\lambda[LR] = 1 \text{ for } LR \leq Z_{min}$$
$$\text{where } \lambda[LR] \text{ is continuous with } \lambda^{'}[LR] < 0 \text{ for } LR > Z_{min}$$

At this stage, Jaffee and Russell distinguish and analyze two different scenarios of market: competitive and monopoly. More specifically, for the competitive market they consider three possible outcomes:

I. **No rationing equilibrium with single contract**. Here the authors demonstrate how in case of constant return to scale and no other costs except for the interest rate (i) for lenders who finance themselves in a perfect capital market, there will be an equilibrium with default activity in the market. Assuming that lenders act to maximize the expected value of their profits which is equal to:

$$\pi = LR * \lambda[LR] - LI \text{ with } I = 1 + i$$

where the expected revenue is given by the product between the contract revenue (LR) and the likelihood of repayment ($\lambda[LR]$), and the expected costs are equal to LI.

[7] As emphasized by Jaffee and Russell, honest borrowers could be better define as "pathological" honest since they will always repay the loan even when default would result to be more convenient. In contrast, dishonest borrowers are only potentially dishonest due to the fact that sometimes they can honestly behave.

Due to the zero profit perfect market condition, we can derive from the previous the supply function which is equal to:

$$R\lambda[LR] = I$$

Starting from these assumptions, we can represent what just described in a supply-demand graph as follows:

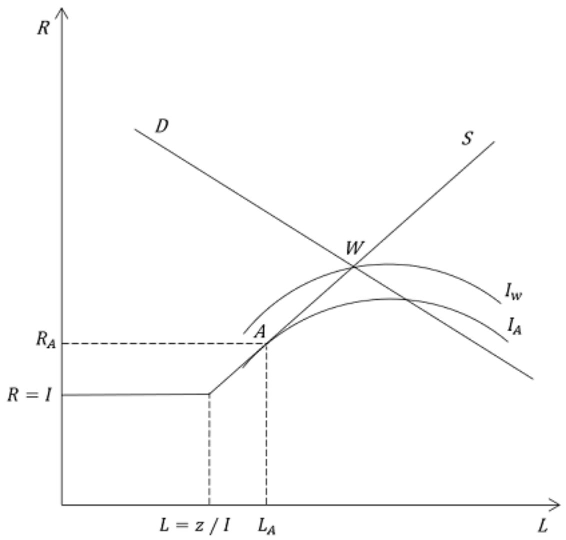

Figure 1.4: Loan market in the Jaffee-Russell's framework

As it is possible to notice here, the supply curve is composed by two main parts. The first flat curve stretch (i.e. OL segment) refers to that loans in which no borrowers default because the repayment amount never exceeds the personal cost. As a consequence, it results that $R = I$ and in turn $\lambda = 1$. The second part of the supply curve instead, as explained by Jaffee and Russell, could be positively sloped (as illustrated in Fig. 1.4.) or backward-bending depending on the characteristics of λ distribution without affecting the results of the model. Moreover, we can introduce the iso-utility curves for borrowers which present the usual concave shape. In this context, Jaffee and Russell demonstrated that the equilibrium occurs where the interest rate factor (R) exceeds the marginal costs (I) which is illustrated in the graph at point $W(L_w, R_w)$. More specifically, the amount by which R exceeds I is exactly equal to the amount needed by the lender to fully cover the default of the dishonest borrowers. In other words, honest borrowers "accept" to pay a premium above the marginal cost to sustain the other dishonest borrowers. In this way the credit rationing equilibrium cannot materialize. Since the same single contract is offered to all individuals independently from their behaviour, this is a case of "pooling" contract.

II. **Rationing equilibrium with single contract**. Conversely to what said in the previous point where supply and demand had to meet each other, here we assume that the only condition that must hold is that the supply function does not exceed the demand one. This means that different equilibrium points can occur which can in turn imply credit rationing. In such a case, even if the supply function remains unchanged, it is now subject to the following constraint:

$$L \leq L^*[R]$$

This implies that all the contracts with R above R_s are not available anymore. However, what is relevant here is that honest borrowers have an incentive to ask for a new separate loan pool, since they can subsidize the dishonest borrowers. Particularly, recalling Fig. 1.4.,this new pool contract (A) will obviously present a lower interest rate ($R_A < R_W$) and in turn a lower loan size ($L_A < L_W$). As a result of that, the lender must offer the new contract A, rationing in this way a part of borrowers. It turns out that honest borrowers will always prefer the rationed equilibrium rather than the non-rationing equilibrium described above. For what concerns dishonest borrowers instead, in this situation they can only try to replicate what the honest ones do. Overall, the credit rationing provides in this context an advantage for honest borrowers. As explained by Jaffee and Russell, here fewer individuals default, so the loan rate is in turn lower. These gains under a perfect competition market structure completely move in the hands of honest borrowers.

III. **Multiple contract equilibria** Continuing from the conclusion of the previous point, it is now possible to assume that a new player enters the market by offering a new contract which can be profitable. In order to be able to gain profits, this new lender should offer a contract which lays below the supply curve and, at the same time, that is palatable only for honest borrowers. Jaffee and Russell explain in their model which are the three main characteristics that such a contract must have:

1. An interest rate below R_A but obviously higher than I;
2. A loan size smaller than the size of contract A;
3. An iso-utility curve related to this new contract which lays below the iso-utility curve relative to the contract A.

Moreover, in this situation we face a case of *self-selection*. It entails that with these types of offer in the market, there will be a clear distinction between honest borrowers who opt for the new more competitive loan contract, and dishonest borrowers who instead still prefer the contract A. By the way, this solution is not viable because it would imply that dishonest individuals must reveal themselves in advance, implying that all lenders will shift towards the honest borrowers in order to avoid to suffer losses. Therefore, Jaffee and Russell states that this is a possible outcome if and only if we are in a dynamic situations or, in other words, in a market environment where the banks, by offering the A type contract realize what they have done only in a later stage. In conclusion, what we have just described can be summed up as the impossibility to have a multiple-contract equilibrium because of a potential market entry by a new player. Indeed, this latter will always find profitable to enter in the market by offering a new and more competitive contract.

Once demonstrated how a stable and long term equilibrium in a competitive market context is not feasible, Jaffee and Russell decided to consider also a monopoly market setup. In fact, they assume a direct action from the government aimed at reducing this market failure by providing a certain degree of monopoly to banks. In this case, the authors showed how there will always be an incentive for lenders to reduce the default rate but conversely to the case of competitive market, they will never find convenient a rationing solution. More specifically, the monopolist instead of opting for a cut in the loan contract size, it will prefer to directly increase the interest rate. Consequently, this will have a negative impact on honest borrowers with respect to the case of competitive market. To conclude, Jaffee and Russell though recognizing that their model was not able to faithfully depict the features of the credit market (i.e. in a competitive loan market there is no a continuous instability as described in the model), they consider their own model as a good forecasting tool for *"what would happen in the absence of the institutional arrangements found in actual loan".* Nevertheless, as we will see in the next paragraphs, this first proposal of credit rationing concept has been sharply reviewed and criticized in the following years. However, we have opted for disclosing this model here not only because it is still considered one of the main pillars of the credit rationing literature, but also because it permits us to have a first idea about how credit rationing works and under which (potential) circumstances it occurs.

1.3.2 Adverse Selection effects in Stiglitz and Weiss' model

Even if the Jaffee and Russell model can help to figure out a first idea of credit rationing in a credit market affected by adverse selection, as we have seen, it is not able to provide a significant explanation about a stable rationing equilibrium in the long run. To cope with this problem, in 1981 Stiglitz and Weiss published the first model able to fully endogenize contract choices with stable rationing equilibrium which soon became the canonical model of credit rationing[8] (C. Calomiris and S. Longhofer, 2008). As in the Jaffee and Russell's model, there are two distinct players which are banks and individuals seeking to maximize profits. In doing so, lenders concern about interest rates and collateral pledged on loan contracts, while borrowers try to carry out the best possible project. However, in contrast to the previous model, here the market is not set up as perfectly competitive (i.e. price taking equilibrium) but just competitive[9]. Stiglitz and Weiss analyze the role played by interest rate in terms of screening device to demonstrate the adverse selection effects on the loan market. Behind this model there are several important assumptions that we need to point out. Firstly, both lenders and borrowers are risk neutral with the latter also owning a certain fixed amount of equity. Secondly, interest rates charged on loan contracts do not impact on the availability of loanable funds for lenders. Thirdly,

[8]This model considers both adverse selection and moral hazard effects on credit market. By the way, we focus now on the first whereas the latter will be presented in the next section.

[9]Stiglitz and Weiss consider a market where banks compete to each other in terms of interest rates in order to maximize their profits.

individuals face a fixed cost for each project which would not have been undertaken without the possibility to have access to debt financing in case of a cost higher than the equity available. These projects provide the same return despite having different levels of risk. Lastly, in order to be able to exploit distribution functions, we assume that the amount borrowed for each project is identical. Based upon this pattern, we can derive the following net return to the lender:

$$\phi = min(R + C; B(1 + \hat{r}))$$

where R is the project's (gross) return, C is the value of the pledged collateral, B is the amount borrowed, and $\hat{r}$ is the interest rate. This means that bank will receive either what promised by the borrower in the loan contract or the maximum that he or she is able to pay back (i.e. $R + C$). This is shown in the Fig. 1.5a where the lender's profit function is a concave function of the project's return. Turning now to the borrower, his or her net return will be equal to:

$$\pi = max(R - (1 + \hat{r})B; -C))$$

As we can see, thanks to the limited liability of the borrower, at the worst he or she will lose an amount equal to the value of the collateral such that his or her profit function is instead convex (Fig. 1.5b).

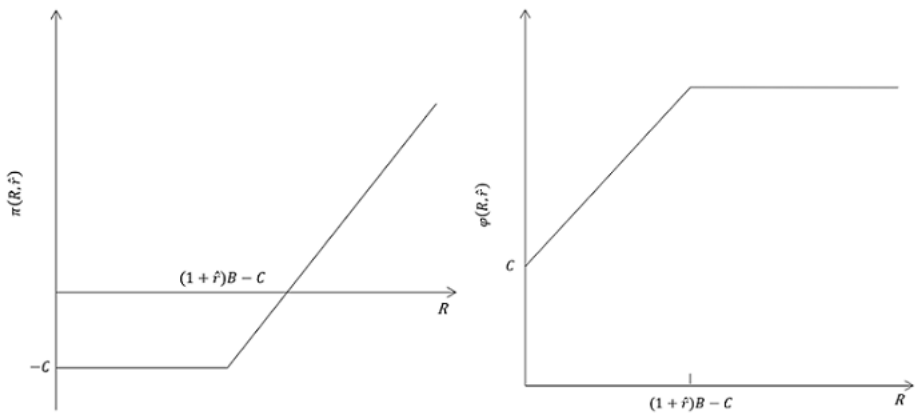

Figure 1.5: a) convexity of firm profit function (left); b) concavity of bank return function (right), (Stiglitz and Weiss, 1981)

Considering now that different projects bear different risks (θ), from the Fig. 1.5b it is possible to notice how there will be a given interest rate ($\hat{r}$), associated with a certain $\hat{\theta}$ which in turn makes the expected profit be equal to 0. Thus, the entrepreneur will borrow money from the bank if and only if $\theta > \hat{\theta}$, otherwise it would not have any incentive to do that since his or her expected profit would be negative. Moreover, Stiglitz and Weiss also showed how there is a positive relation between the interest rate and the critical value θ. These two aspects together provide the fundamentals to derive one of the most important conclusions of the model, namely that an increase of the riskiness of the borrowers' projects leads to a subsequent reduction in the expected profit for the lenders. This can be better understood by isolating the two opposite effects affecting banks' expected profit following a change in interest rate. In fact, an increase in the interest rate charged on borrowers directly consists in a higher expected return. However, at the same time, this also leads to an indirect effect on expected return which can completely outweigh the first direct effect. Indeed, when such a situation occurs, instead of carrying out the investments and paying back the higher loan interests, the low risk borrowers prefer to drop out of the market and using their resources in other alternative ways. Gradually that interest rate becomes higher and higher, this effect strengthens even more, leading to an overall reduction in the quality of the remaining borrowers in terms of creditworthiness. In turn, this implies a lower level of expected return for any given loan. As a consequence of what just described, Stiglitz and Weiss conclude that the lender's profit function will assume a non-monotonic form such as shown in the following graph:

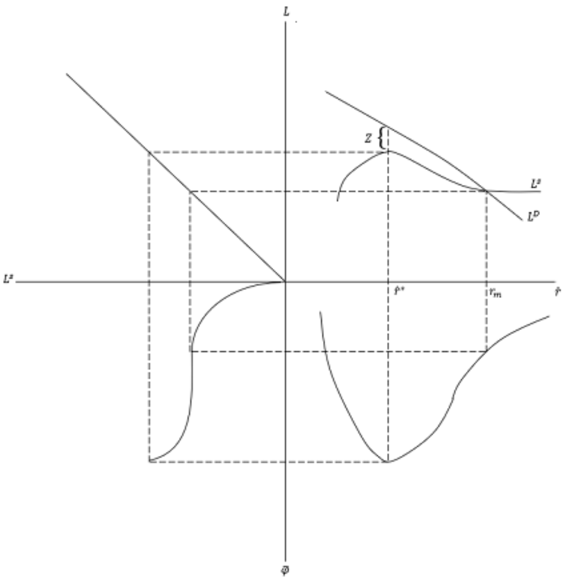

Figure 1.6: Determination of market equilibrium (Stiglitz and Weiss, 1981)

At this point it is possible to show how a rationing equilibrium can occur. First of all, we need to define the different elements depicted on Fig. 1.6. Here, the loan demand (L^D) and offer (L^S) curves lay in the upper right quadrant whereas in the lower right one we find the non-monotonic relation between the interest rate and the bank's expected return. As we can see, instead of meeting the offer curve, at $\hat{r}^*$ (i.e. the interest rate level which maximize the expected return for the lender) the loan demand oversteps it of a certain amount Z. Therefore, this is a typical case of credit rationing. In fact, even if L^S and L^D meets each other at r_m, this cannot be an equilibrium point due to the fact that for the bank is more remunerative to charge $\hat{r}^*$ rather than r_m, rationing in this way a part of borrower. By the way, it is important to point out that low-risk borrowers instead of being rationed by the lender, they voluntarily drop out from the market. Therefore, this is not the case of high-risk borrowers who remain in the market and are effectively rationed out (C. Calomiris and S. Longhofer, 2008).

1.4 The Moral Hazard impact on the Credit Market

In the previous section we have illustrated how adverse selection is an important concern for the credit market and its equilibrium. Particularly, we have presented two important models, one of which is not completely focused on adverse selection. In fact, in the second part of their model, Stiglitz and Weiss spend time to analyze the role of interest rate played in the market as an incentive mechanism. The starting point here refers to the misalignment between the relative goals of lenders and borrowers. While banks care about those actions by which firms and individuals can increase their likelihood of going bankrupt, borrowers only concern investments and their subsequent returns. In addition, borrowers' behaviour cannot be monitored without costs by the lender. If many of the assumptions made in the previous section still remain, one important distinction needs to be pointed out. While previously we considered exogenous returns to be able to demonstrate the adverse selection impact on the market, here we suppose that borrowers can choose amongst a range of projects marked by different levels of risk. In such a context thus, moral hazard arises because banks cannot monitor this choice. Stiglitz and Weiss show that an increase in interest rates leads the borrower to pursuit riskier projects (in contrast then to the bank's interests), lowering in turn the expected return to the lender. Therefore, this will have an additional incentive to limit its credit supply rather than raise interest rates in case of an excess demand. To illustrate this phenomenon, the first step to do is to state the expected return for the generic project i:

$$\pi = p^i[R^i - (1+\hat{r})B] - (1-p^i)C$$

where p^i is the probability of success whereas the other terms refer to the same elements described in the previous section. Suppose now that the borrower can decide to carry out two projects A and B where $R^a > R^b$ and $p^a < p^b$. Given these conditions, it results that:

$$E\pi^A > E\pi^B$$

if and only if:

$$\frac{p^a R^a - p^b R^b}{p^a - p^b} > (1+\hat{r})B - C$$

From this, we can now replace $\hat{r}$ with the interest rate which makes indifferent the borrower between the two projects. It entails that:

$$\frac{p^a R^a - p^b R^b}{p^a - p^b} = (1+\hat{r}^*)B - C$$

Hence, it turns out that the borrower will opt for the safer project B whenever the interest rate remains below $\hat{r}^*$, whereas he or she will prefer the riskier project A when it overcomes $\hat{r}^*$. It follows that the expected payoffs for the lender are:

$$\begin{cases} \mathrm{p}^a(1+\hat{r})B + (1-p^a)C & \text{if } \hat{r} < \hat{r}^* \\ \mathrm{p}^b(1+\hat{r})B + (1-p^b)C & \text{if } \hat{r} > \hat{r}^* \end{cases}$$

Since the first payoff is higher than the second one, the lender's profits fall whenever it increases the interest rate over $\hat{r}^*$. Therefore it can be shown that even in this case the lender's net return function (θ) is not monotonic, implying that credit rationing may occur again.

1.5 Further developments in the Credit Rationing literature

The models exposed in this chapter so far are among the most important of the whole credit market literature. By the way, as we have seen, all these models present restrictive and (to a certain extent) simplified assumptions. For this reason, in the past many authors tried to analyze and investigate more deeply credit ration in order to provide further explanations about it. In this section thus, we will emphasize the most relevant findings and developments relatively to what described above.

1.5.1 Heterogeneity in projects' expected returns

Recalling Par 1.3.2 and the Stiglitz and Weiss' model, among the many assumptions needed to show the stable rationing, there was also the requirement to have exactly the same return for each project, while the level of risk varied. This is clearly unrealistic since risk and return are positively related. Moreover, it has been demonstrated how this assumption sharply affects the final conclusion reached in the model. In this regard, in 1987 De Meza and Webb published on the "The Quarterly Journal of Economics" a model contrary to the results seen above. They proposed a model replicating the most of the assumptions accepted by Stiglitz and Weiss with the exception of that one concerning projects' returns. Every entrepreneur here carries out the ith project with the following returns: R^s if successful and R^f if failure (where $R^s > (1+r)B > R^f$), the probability of each return respectively equals to p and $1-p$. At this point, De Meza and Webb consider two different entrepreneurs (i and j) such that the first i is better than the second j from a lender perspective if and only if $p_i > p_j$. Remembering that Stiglitz and Weiss' assumptions still hold, particularly those referring to the risk neutrality of borrowers and the possess of the same fixed level of equity (E) for all entrepreneurs, we can now derive the following:

$$E\pi_i = p_i(R^s - (1+r_i)B)$$

This is the expression of the expected return of the ith entrepreneur who obviously wants to maximize it[10]. In order to do so, he or she will be willing to accept the loan contract only if $E\pi_i \geq (1+\rho)E$ where ρ is the safe rate of interest. It entails that it will exist a certain level R^s under which it is not convenient anymore for the entrepreneur to pursuit the project and ask for debt. Nevertheless, what it is really important here is that in this case a rationing equilibrium results impossible. This is an important conclusion made by De Meza and Webb in contrast to what assess in the previous section. To demonstrate this achievement we firstly need to define the distribution of success probabilities $F(p_i(R^2))$,

[10]Here we assume no collateral for simplicity.

with density function $f(p_i(R^2))$, to be able to show the expected profit equation of a bank in a pooling equilibrium context:

$$E\phi = (1+r)B\int_{\bar{p}}^{1} p_i f(p_i)dp_i + R^f \int_{\bar{p}}^{1}(1-p)f(p_i)dp_i - (1+\rho)B$$

where $\bar{p}$ is the success probability of the marginal project which implies $E\pi_i = (1+\rho)E$. In such a context we have that not only there is no adverse selection effect, but there can be only a positive selection phenomenon. Therefore in this model, conversely to what presented in section 1.3.2, the profit function for lender is not characterized by the non-monotonic form, but it is rather a positive monotonic curve. Hence the marginal borrower (i.e. the entrepreneur who carries out the project with a $\hat{p}$ probability of R^s) represents the worst client for the lender in terms of profitability. In such a context an increase in the interest rate r leads in turn a raise in p and in projects' revenues (if successful) as well. At the same time, the least profitable entrepreneurs are excluded from the market. It results that in a competitive market the equilibrium must concern an interest rate such that demand and supply function meet each other. However, this is not the only relevant finding in the De Meza and Webb's paper. In fact, the crucial aspect (which also names the paper) that they point out here concerns the level of investments. This is found to be higher than its optimal level in a context of competitive market. Assuming a competitive market context *à la* Bertrand and considering that lender's profits and project's quality are positively related, they were able to find that the aggregate level of investment exceeds its optimal one[11].

1.5.2 Credit Rationing in a multiple groups framework

Until now we have overlooked one of the most typical and important bank activities: the creditworthiness analysis. In fact, in the previous described literature the lender was not able to value and distinguish between a bad and a good project (i.e. Stiglitz and Weiss assumed same expected return for every project). Obviously this does not reflect the reality at all. In order to overcome this problem, Jaffee and Stiglitz (1990) suggest to split up the population in different groups and set for each of this group a certain level of interest rate that equals the deposit rate. Assuming now that the lender can identify the expected return per group with no costs[12], we can divide the borrowers population into three types:

Type 1. This kind of borrower is completely excluded from the credit market. This effect is defined by Jaffee and Stiglitz as "redlining" (see section 1.2.2) and refers to that situation where borrowers are not able to reach the minimum required expected return by the lender as illustrated in the Fig. 1.7.

Type 2. This is the so called "marginal" group of borrowers. Here in fact only few borrowers can have access to loanable funds whereas the remaining which are apparently identical are credit denied. This is a clear case of pure credit rationing (see section 1.2.2).

[11]Since this is not at the core of our work, we limit ourselves to simply disclose assumptions and findings.

[12]Note that here neither theoretical explanations or practical demonstration are provided to justify this bank's ability

Type 3. Conversely to the type 1 and 2 borrowers, in this case not only borrowers do not face credit rationing but they are completely served by the bank since lenders compete each other to fund them.

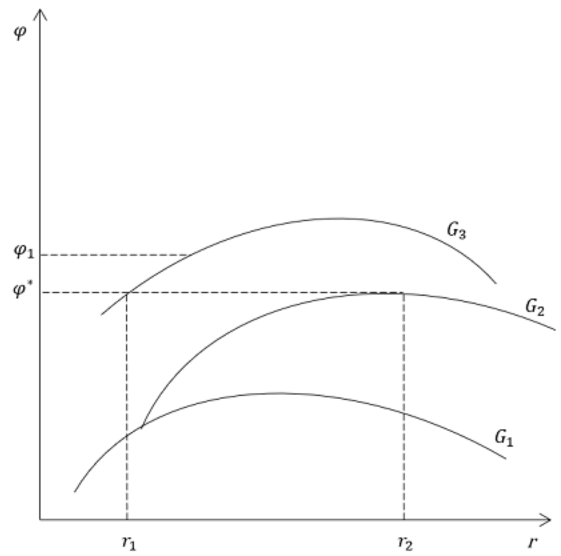

Figure 1.7: Credit rationing in a multi borrower groups environment

Note that here the $(n-1)$ type of borrower has access to credit if and only if the n type is not rationed out. On the contrary, the lender could increase its own profit by satisfying the demand of the rationed borrowers. However, this issue has not been object of study exclusively for Jaffee and Stiglitz. A relevant contribute in this respect is which one referring to the Riley's work of 1987. He emphasizes the importance of the total number of groups since the more borrowers are divided into different categories the less is the significance of credit rationing. Due to the fact that there are groups just above the marginal group who are not rationed and groups just below the marginal group who are redlined (D. Jaffee and J. Stiglitz, 1990), in case of a continuum of groups both redlining and pure credit rationing are almost indistinguishable (J. Stiglitz and A. Weiss, 1987). It turns out that pure credit rationing becomes empirically less important with a large number of groups (R. Lensink et al., 2001).

1.5.3 Collateral and Credit Rationing

Even if so far we have not spent much time talking about it, collateral has always been a key aspect in the credit market. Accordingly, we have decided to avoid to discuss about it in a fragmented way, opting for a whole dedicated paragraph regarding it. Therefore, although we have not mentioned it in section 1.3.2, Stiglitz and Weiss considered collateral in their discussion. More specifically they try to answer to the following question: in case of an excess in loan demand, is it possible to reduce demand and default risk and, at the same time, to increase lender's return simply by strengthening the collateral requirements? Unfortunately the answer is negative. In spite of a positive incentive effect linked to higher collateral requirements, Stiglitz and Weiss demonstrate that under certain plausible hypotheses adverse selection issues still persist. To show that they help themselves by providing two different examples in which banks have not incentive to increase collateral requirements. The first of these refers to a situation in which all potential borrowers present the same amount of wealth where the smaller is the project, the higher is the probability to fail. In such a context, what happens is that if banks increase in the collateral requirements then firms can only finance smaller and riskier projects (under certain reasonable assumptions). The second and last example provided refers to the scenario where borrowers have different wealth, but all projects require the same amount of financing. Assuming that the wealthiest borrowers are those who brought about successful and riskier projects, it turns out that these are less prudent than those who were used to invest in safest businesses. Thereby, we come back to the same circumstance and problematic of the first example. Therefore, both cases present adverse selection effects implying that *"it may not be desirable to require collateral to the point where credit rationing is eliminated"* (D. Jaffee and J. Stiglitz, 1990). However, Jaffee and Stiglitz do not stop studying links between rationing and collateral. They also develop a model in which both interest rate and collateral requirements are taken into account simultaneously. In such a model, two possible types of equilibrium might arise: pooling and separating equilibria. In the first case, banks offer to all borrowers only a single type of contract (similarly to the case shown in Par. 1.3.1) to all different categories of borrower. To avoid respectively possible adverse selection and incentive issues, neither collateral requirements or interest rate are increased. Conversely, the separating equilibrium relates a credit supply based on several different types of contracts which can be chosen by borrowers just based on their discretion. In contrast to their past models, credit rationing hits each type of contract offered in the market. However, this field of credit rationing literature does not exhaust itself just with the works carried out by Stiglitz and Weiss. For instance, an empirical research led by G. Coco (2002) demonstrates how collateral, while not being useful for banks as a signaling tool for projects' quality, can still work well as incentive mechanism. To conclude, more recently, a paper written by JP. Niinimäki (2018) shows how in order to avoid the negative incentive related to the presence of collateral, banks will require a volume of collateral being either sufficiently small to become irrelevant or quite large such that only borrowers bear agency costs related to moral hazard.

Chapter 2

The "traditional" Money View vs. Credit View

The monetary policy transmission mechanism to the real economy has always been a central topic of discussion among economists. The traditional literature refers to the so called "money view" contribute. This relates to the transmission of monetary policy through changes in monetary aggregates via interest rate channel. However, starting from the 90s, this theory has been questioned: *"any simple model may sometimes be too simple"* (B. Bernanke and A. Blinder, 1988). Particularly, lots of discussions regarding the role of banks and the credit market have been made. In this regard, in the previous chapter we have mentioned the presence of asymmetric information in the financial markets. Recalling briefly what we said before (see Par. 1.1.2), lenders and borrowers own different information sets leading to imperfect information and in turn to an imperfect market. In this context, the credit view emphasizes the fundamental role played by banks as financing suppliers especially for some individuals and small firms which otherwise could not be funded. As we will see soon, these information frictions are incompatible with the Modigliani-Miller framework accepted by the monetarist's thought. Since Bernanke and Blinder's first works, the "traditional" macroeconomics' thought has always been source of criticisms and revisions. Hence, the goal of this chapter is to describe the credit view theory, its theoretical pillars and, ultimately, to emphasize the most relevant similarities and differences relatively to the money view. In doing so, we will firstly present the interest rate channel and the standard IS-LM model with a special focus on its main issues. Then we will shift our focus to the functioning of the credit channel by presenting both the bank lending and the balance sheet channels. In addition, an accurate description of the so called *financial-accelerator* will be provided as chapter conclusion.

2.1 A general framework of the Money View

The main idea behind this view is that *"it's the money that matters"* (B. Bernanke). In fact, in the money (or transactions) view, we consider only two different classes of asset: money and all other assets (V. Ramey, 1993). Thus, assuming the Walras' law[1], the equilibrium in the money market implies the equilibrium in the asset market as well (which results in bonds and bank deposits that are perfect substitutes). In this way, with just one single portfolio equation to pool all asset markets, no role is played by the credit market (K. Brunner and H. Meltzer, 1988). This leads to two important consequences. Firstly, it is not relevant how banks decide to make loans or buy other financial assets. Secondly, it makes no difference the source of credit (commercial banks or debt capital market) for borrowers. It entails that although banks offer no special services on the asset side of their balance sheet, they still have the important task to "create" money by issuing demand deposits (R. Hubbard, 1995). In other words, this approach gives a central role in the monetary transmission mechanism to bank liabilities whereas it does not consider bank assets at all (B. Bernanke and A. Blinder, 1988). Moreover, monetarists also assumed the presence of perfect capital markets (as conceived by Modigliani Miller, 1953), which means that all borrowers are equal from the lenders' point of view. Since banks are not able to identify the creditworthiness of the public, the price becomes the only relevant factor in the market. As a consequence, also this assumption excludes an influence of the financial system to the real economy, which is instead considered nothing more than a veil[2]. It concerns that a change in the public's preferences relative to portfolio's structures (bank deposits and/or other financial instruments) does not affect real outcomes.

2.2 The Money View's hypotheses

To justify the money view and the mechanisms behind the interest rate channel we need some other assumptions in addition to what we have just said in the previous paragraph. In fact, there are other two key hypotheses that must be mentioned. One regards the central bank's control over money supply (for which alternative assets are all imperfect substitutes) by which it is able to affect the short-term interest rate. In doing so, the central bank can influence the long-term interest rates as well. In fact, according to the expectations model of the term structure, the long-term rate results from the weighted average of the future expected short-term rates suitable to the maturity of a long-term bond (J. Taylor, 1995). In addition, the presence of sticky prices has an important implication. Indeed, with aggregate price level that adjusts slowly, a monetary policy shock affects the nominal interest rates and, contemporaneously, the real rates too. The second assumption concerns the relation between investment and consumption level from one side, and real interest rates from the other. More specifically, if both are particularly elastic relative to the interest rates, we will expect a greater impact on the economy arising from a monetary policy change. This is generally the case of long-term oriented investments (i.e. durable consume and housing) (H. Brinkmeyer, 2015).

[1]Walras' law states that a market must be in equilibrium if all other markets are in equilibrium.

[2]This idea is based on the works made by W. Brainard and J. Tobin (1963) prior, and E. F. Fama (1980) later.

2.3 The IS-LM model and the Interest Rate Channel

Once explained the most important assumptions of the monetarists' thought, we can now focus on how effectively the transmission of monetary policies occurs according to this view. As mentioned before, here the key channel consists in the interest rate channel. The mechanisms of this could be better understood by considering the schematic diagram (with the addition of the nominal interest rates) made by S. Mishkin (1995):

$$\boldsymbol{M} \downarrow \Rightarrow \boldsymbol{i} \uparrow \Rightarrow \boldsymbol{r} \uparrow \Rightarrow \boldsymbol{I} \downarrow \Rightarrow \boldsymbol{Y} \uparrow$$

As we can notice, in a Keynesian-type model as IS-LM model[3] , a reduction in the quantity of outside money, which is an exogenous variable, leads to a rise in the interest rate. As explained by J. Taylor (1995), thanks to a combination of sticky prices and rational expectations, an increase in the nominal interest rates is followed by a raise in the real long-term interest rate rises (at least for a while). This results in increased cost of capital that causes a subsequent reduction in the private sector's investments and households' expenditure which, in turn, depresses the aggregate demand. In this way monetary policy can directly affect the real economy. Generally, this process could be illustrated through a standard IS-LM model. Prior to define the two curves, we need to have a look on how the aggregate demand in the goods market[4] is made:

$$Y = C + I + G + NX$$

As we can notice, on the right hand side there are four different variables which defines the total output:

- **consumption** (C) refers to private's consumption level;
- **investments** (I) represents the level of investments made by the private sector;
- **government expenditure** (G);
- **net trade** (NX) is the result of the foreign trading activity. Analytically it is equal to the difference between total **exports** (X) and total **imports** (M).

Once explained the components of the aggregate output, we can now shift the focus to two important functions. IS curve is defined as the curve which represents the combinations of interest rates and output levels that permit to the markets for goods and services to stay in equilibrium. This slopes downward because it reflects the idea that high interest rates lead to a reduction in spending

[3]Standard IS-LM is the usual example of Keynesian-type models even though this literature presents other works such as the Christiano and Eichenbaum's model (1992).

[4]The implied assumption is that total output supply must be equal to total output demand in order to have equilibrium in the economy ($Y^s = Y^d$).

and, in turn, lower levels of output of goods and services. LM curve shows how interest rates and output levels are combined in order to have equilibrium in the money market. Contrarily to IS, it slopes upward due to the positive correlation between the output and money demand. Finally, the intersection of these functions is the point where the markets of goods and money are simultaneously in equilibrium.

2.4 Money View's criticism and the birth of the Credit View

In these first paragraphs we have just exposed the common monetarist approach and the standard IS-LM model. We have also described the theoretical pillars and the most important assumptions relative to the money view literature. In doing so, however, we did not assess if effectively these hypotheses can be considered empirically plausible. In this paragraph thus, we will briefly discuss the main criticisms moved to monetarists which has also led to the birth of a new line of thinking: the so called "credit view". In fact, its starting point is the rejection of the idea that all non-monetary assets are perfect substitutes (V. Ramey, 1993). There is more than one work that shows how effectively financial and real assets are not perfect substitutes. Many studies, such as Tobin (1972) before, and G. S. Lautas and R. Rami (1980) later, pointed out how in the long term *"the elasticity of money demand with respect to nonhuman wealth is somewhat larger than that with respect to total wealth, and the elasticity with respect to human wealth is the lowest"*. More recently, the focus has shifted to the degree of substitution among different classes of financial assets. According to our purposes, one of the most relevant work here refers to B. Bernanke and A. Blinder (1998) (this will be further explained in the next paragraph), two of the most important and famous credit view advocates. They argue that macroeconomic models based on only two classes of asset (as that one described above) are not correct because there is no distinction neither between bank versus non-bank financing sources or, more generally, between internal and external funds. In fact, they elevate the role played by loans and banks to a sort of "special status" due to their ability to finance classes of people and legal entities that conversely would have not had access to the bond market. It entails that, as done in the money view, all debt instrument cannot be lumped together in a single "bond market". This means that not only bank liabilities but also bank assets are involved in the monetary transmission mechanism. Another important monetarists' assumption which has been strongly criticized and then revised in the credit view is the presence of perfect capital markets. According to the credit view literature, the information asymmetries among borrowers and lenders imply imperfect capital markets (V. Ramey, 1993). As touched on before, because of imperfect monitoring there are some classes of borrowers (i.e. certain households and/or small firms) which difficultly could have access to other fund sources outside of bank loans. In fact, only banks can provide external finance to these actors (M. Gertler and S. Gilchrist, 1993). In this context, as explained by B. Bernanke and M. Gertler (1989), *"optimal financial arrangements will typically entail deadweight losses (agency costs), relative to* *the first-best perfect-information equilibrium"*. This in turn creates a wedge between the cost of internal and external finance with this latter more expensive. It follows that (once again) internal finance, bank loans, and other financing sources cannot be considered perfect substitutes (V. Ramey, 1993)[5]. Considering the other assumptions illustrated above, it is not clear in advance the relation that must exist between short and long-term rates described by the expectations model of the term structure. However, in this case many empirical researches have confirmed the positive relationship between rates with different maturity (G. Hubbard, 1995). For instance, Cohen and Wenninger (1994) showed through a time series modelling an increase in the short-run sensitivity of long-term rates with respect to the short ones. Moreover, it has be found by Akhtar (1995) that a one percentage point change in nominal short rates leads to a subsequent variation in the range of long-term rates from about 22 to 66 basis points. Even the extent of changes in the aggregate output sensitiveness relative to interest rates has been questioned. In fact, as said previously, while some economic factors such as consumption of durables and housing are highly sensitive to interest rates moves, the output response arising from a monetary policy stimulus seems to be excessively large if compared with small changes of user costs of capital on investments (G. Hubbard, 1995). In addition to what just described, there is another important aspect of the IS-LM model and the money view that has strongly been source of criticism. Indeed, according to monetarists, the impact of a monetary policy stimulus solely affects aggregate outcomes. Following this thought, only changes in total investment are relevant whereas interest rate increase or decrease can be ignored. As consequence of a policy change, the required rate of return of new investment project varies itself. Here, the worst projects in terms of profitability will be no longer funded while the other profitable ones will continue to be undertaken. As a result: *"there are no direct efficiency losses associated with the distributional aspects of the policy-induced interest rate increase"* (S. G. Cecchetti, 1995). As opposed to this, the credit advocates highly consider the distributional effects arising from monetary policies. Due to the rejection of perfect capital markets and perfect asset substitutability (just described above), they point out how the effects of policy changes could vary across the economic agents depending on their individual characteristics. This contrast has been subject of many empirical researches which have confirmed the important influence of asymmetric frictions in the markets. These results confirm how important distributional aspects concerning monetary policy changes cannot be ignored as the traditional money view does (S. G. Cecchetti, 1995).

2.5 The Credit Channel mechanisms

Once illustrated the theoretical basis behind the birth of the credit view, we can now make a step ahead turning to its most important macroeconomic models. In this section we will define and present both the BLC and the broad credit channel (also known as balance sheet channel) with a specific focus on the so called

[5]With respect to this there are also other important works in the literature such as D. Diamond's contribute (1984).

financial-accelerator effect. Before going in the details of the Bernanke and Blinder's model (1988), we can already provide some anticipations concerning the BLC. This explains how a restrictive monetary policy does not limit to increase short term interest rates (as stated by monetarists), but it further influences availability and terms of bank loans (I. Hernando, 1998). More specifically, a reduction in deposits is followed by a subsequent fall in the overall lending volume *"if banks face frictions in issuing uninsured liabilities to replace the shortfall in deposits"* (P. Disyatat, 2011). Then, due to the imperfect substitution of credit relatively to the other financing sources, a monetary contraction will lead to a larger negative effect on the borrowing of bank dependent firms (A. Aschcraft and M. Campello, 2005). Instead, the balance sheet channel goes beyond to that view according to which the credit market imperfections (see Chapter 1) only impact on loan market. Indeed, these effects have a wider influence which embraces all credit markets (C. Walsh, 2003). Considering again a tight monetary policy, the consequent increase of interest rates directly weakens a firm's balance sheet in several ways. For instance the total net financial position of the firm can suffer as the debt interest expense rises. Moreover, an increase in interest rate implies a reduction in the asset value which can also be used as collateral in a loan contract. So, all in all, this overall balance sheet deterioration limits the access to the credit market. By the way, to provide a full explanation of how this channel works, we will briefly expose across this chapter the main findings of Hubbard (1995) and Bernanke, Gertler, and Gilchrist (1996) and their concept of *financial-accelerator*.

2.5.1 Bank Lending Channel: Bernanke and Blinder's model

By implementing the assumption of imperfect asset substitutability into the conventional IS-LM model, Bernanke and Blinder provided for the first time a model able to show the transmission mechanism accordingly to the credit view. Here we consider an economic environment which is characterized by the presence of three different assets: money, bonds, and loans. Then borrowers decide which form of debt using by looking only at the cost difference of these. After having defined respectively ρ as the interest rate on loans and i as the interest rate on bonds, we can derive the loan demand as follows:

$$L^d = L(-\rho, +i, +y)$$

Bernanke and Blinder justify the positive relation between the loan demand and the GNP (Gross National Product, y) by considering the effects relative to working capital and liquidity issues. Banks have to decide the composition of their balance sheet asset side consistently to the following constraint:

$$B + L^s + E + \tau D = D$$

where the left hand side refers to the total bank assets (bonds B, excess reserves E, and required reserves given by the product between the required reserve ratio on deposits τ and deposits D) and the right hand side that in turn represents the liabilities (deposits, D). At this point, banks will structure their portfolio based on rates of return on the available assets. It entails that the loan supply is equal to:

$$L^s = \lambda(-i, +\rho)D(1-\tau)$$

Therefore, as we could have imagined, the higher the interest rate on loans the higher will be the loan offer. Conversely, a higher interest rate on bonds makes more convenient for banks to invest more resources in form of bonds. Assuming then no credit rationing, the clearing market condition becomes:

$$L(-\rho, +i, +y) = \lambda(-i, +\rho)D(1-\tau)$$

Once identified the equilibrium condition in the loan market, we consider now the money market which can be described by a conventional LM curve. To derive the deposits offer, we firstly need to define the (available) reserves demand which is equal to:

$$E = \epsilon(-i)D(1-\tau)$$

Starting from this and considering that the total reserves can be expressed as $R = E + \tau D$, through the money multiplier (m) we have that:

$$D^s = m(+i)R$$
$$\text{where } m(i) = [\epsilon(i)(1-\tau) + \tau]^{-1}$$

In such a context, the central bank controls the money offering by modifying the liquidity. The required reserves are instead managed through its coefficient τ whereas the other reserves varies according to specific interventions in its own market. For what concerns the demand for deposits, as clearly pointed out by Bernanke and Blinder, it is a function of interest rate and income[6]: $D^d(-i, +y)$. Thus, the money market equilibrium is given by the following equation:

$$D(-i, +y) = m(+i)R$$

For what concerns the market of goods, it could be represented as a conventional IS curve which is equal to: $y = y(-i, -\rho)$. At this point we have almost all the "ingredients" needed to go deeper in the macroeconomic analysis of the model. In fact, the next and last step we need to make is to derive an expression for ρ. In order to do so, we can simply plug the equilibrium condition for the money market into the clearing equation for the credit market. Then, by solving for ρ we obtain the following condition:

$$\rho = \phi(+i, +y, -R)$$

Note that to justify the positive relation between the interest rates ρ and i we need to assume that the interest rate elasticity to the money multiplier is sufficiently low. By substituting this into the IS curve it turns that:

$$Y = Y(-i, -\phi(+i, +y, -R))$$

Bernanke and Blinder define this relation as Commodities Credit Curve (CC) curve. This presents at the same time both an important similarity and difference with respect to the conventional IS curve. In fact, even if the CC curve is negatively sloped like IS curve, in contrast to this latter it is affected by both changes in monetary policy (through R) and shocks in the credit market (through either $L(.)$ or $\lambda(.)$). Nevertheless, there are three extreme cases where IS and CC exactly coincide each other:

[6]There would be also the effect of total wealth to be considered. Nevertheless, here the authors assume it to be constant over time.

- when $\frac{\delta\sigma}{\delta\pi} = \infty$ which refers to the case of perfect substitutability between bonds and loans for lenders;
- when $\frac{\delta L}{\delta\pi} = -\infty$ reflecting a perfect substitutability between bonds and loans for borrowers;
- when $\frac{\delta T}{\delta\pi} = 0$ which is the situation where the aggregate demand is totally insensitive to the loan rate.

If one of this condition is satisfied, the effects of the credit market becomes irrelevant for the IS/LM model. In fact, we would have the case of the traditional IS-LM model brought forth by the money view claimers.
Nevertheless, it is important to point out that it also exists a symmetric case of "credit only" view which is commonly known as liquidity trap. Using the words of P. Krugman (2000), this latter can be defined as *"that situation in which even a zero interest rate is insufficiently low to produce full employment"*. This occurs when $\frac{\delta D}{\delta i} = -\infty$ or, in words, when money and bonds are perfect substitutes. Even if in this case the LM flattens out, Bernanke and Blinder emphasize how changes in monetary policies still influence the CC curve. Anyway, once described these particular cases, we can now shift our focus to the more general and relevant scenario. At a first glance it would appear that from a given shock we register, the same effects both in IS-LM and Bernanke and Blinder frameworks. However, this is only partially true since this effect is more sizable in the credit model. Indeed a change in monetary policy hits simultaneously either IS or CC creating in this way an additional effect with respect to the case of conventional monetarist model presented in the previous section. Finally, in Tab. 1 we sum up the main effects of changes in monetary policy affecting the different economic variables:

Rise in:	Income	Money	Credit	Interest Rate
bank reserves	+	+	+	-
money demand	-	+	-	+
credit supply	+	+	+	+
credit demand	-	-	+	-
commodity demand	+	+	+	+

Table 2.1: Summary of the effects of a monetary policy innovation *(source: B. Bernanke and A. Blinder, 1989)*

2.5.2 Bank Lending Channel's literature and further developments

Even if Bernanke and Blinder's model is a sort of milestone for what concerns BLC, it is just the base of a quite larger literature field. Therefore, here we propose to the reader the most relevant empirical works concerning it, whereas the specific functioning of BLC in an unconventional monetary policies context will be treated later on (see Par. 3.4.5). After Bernanke and Blinder, in the '90s, many economists tried to further investigate and analyze BLC. Among these we find A. Kashyap, J. Stein, and D. Wilcox (1993). By using changes in bank loans and commercial papers as a subject of study, they were able to demonstrate that the non perfect substitutability between loans and both securities and other non banking sources of financing is satisfied, making in this way possible the existence of a BLC. According to them, thus, changes in monetary policies seem to directly affect the loans-commercial papers mix and in turn the investment aggregate. However, here one issue is worthy of attention. Indeed, to build up their model, Kashyap et al. only focused on aggregate data, assuming in this way homogeneous borrowers. As pointed out by C. Walsh (2003), this can be misleading whenever borrowers differ to each other in terms of business cycle or in the credit instruments they rely on. In line with this latter line of thinking there are S. Oliner and G. Rudebusch (1995) and M. Gertler and S. Gilchrist (1994). Both twosome of authors did not find strong evidence for the functioning of BLC. In particular, considering Oliner and Rudebush's findings, it turns out that there is *"almost no evidence that a monetary shock changes the composition of bank and nonbank debt for either small firms or large firms"*. More specifically, the short-term debt simply moves from small to large size enterprises, implying a decline in the total bank loans consistently to the greater reliance of small firms to bank funding sources. Therefore, while recognising the decline in the aggregate debt mix detected by Kashyap et al., S. Oliner and G. Rudebusch assert how this can not be a symptom of the BLC presence. If this were the case, all the reasoning behind this transmission channel would therefore become almost meaningless. In fact, many empirical studies in the literature demonstrate the functioning of the channel by analysing disaggregated data. For instance, by analyzing US bank level data from 1976 to 1993, A. Kashyap and J. Stein (2000) were able to provide new evidence in support of a BLC for monetary transmission. Moreover, they also emphasized the key role played by banks' liquidity. In particular, they state that there are more important effects stemming from monetary policy shocks for those small banks which present illiquid balance sheet asset sides. Further proof for BLC is provided by N. Cetorelli and L. Goldberg (2008). Indeed, by studying the globalization phenomenon in US banking sector, they confirmed the functioning of a BLC despite having more relevance in the case of domestically-oriented financial institutions. In addition, another important characteristic that can influence the lending channel refers to the bank capitalization level (S. Ozsahin, 2015). Indeed, according to the tests performed by R. Kishan and T. Opiela (2000) who divided banks in terms of asset size, the less capitalized a bank is the higher is its response to a monetary shock. Using their own words, they assess how *"small undercapitalized banks are unable to raise alternative funds to continue financing loans during contractionary policy"*, providing in this way further evidence of the BLC functioning. Moreover, an interesting contribute in the bank lending literature refers to P. Disyatat (2010). This latter revised and renewed the theoretical roots of the Bernanke and Blinder's model, trying to restate a BLC theory more aligned to the recent developments of the financial system. More specifically, he provided a new framework based more on the banks' balance sheet strength rather than on changes in the availability of deposits to create loans as it had been for at least two decades. In doing so, he also showed how the effectiveness of policy shocks depends on the banking sector's financial health as well. Nevertheless, in recent times many other empirical analyses have been done in order to assess the existence of this channel. Since the majority of these papers studies the impact of non standard monetary policies, as anticipated above, we postpone their discussion in Chapter 4 where we will dedicate a whole section to widely present them.

2.5.3 The Broad Credit Channel

Here we concentrate more on the general aspects characterizing the broad credit channel also known as balance sheet channel. Contrarily to the BLC analyzed before, the focus here is on the role played by the imperfect information in credit markets and the consequent external finance premium (S. Oliner and D. Rudebusch, 1996). This latter can be defined as the difference between the cost to the borrower of raising external finance and the opportunity cost of using internally generated funds. Indeed, the presence of this premium makes these two types of funds imperfect substitutes (S. Brissimis et al., 2018). What is relevant to point out here is that external finance premium is negatively related to the borrower's collateralizable net worth relative to the amount of funds required (G. Hubbard, 1995). Collateralizable net worth includes all financial and physical assets or unencumbered prospective earnings of borrower's property which may be pledged as collateral (M. Gertler and S. Gilchrist, 1993). Thus, the higher is the total borrowers' net worth the lower is the rate charged by the bank. This is intuitively given by the reduced default risks faced by banks as result of the higher value of the underlined collateral which secured the loan contract (and vice versa). In the literature, the firsts who distinguished between this and the BLC were Bernanke and Gertler in 1995. Using their words it follows that *"balance sheet channel of monetary policy arises because shifts in FED policy affect not only market interest rates per se but also the financial positions of borrowers, both directly and indirectly"*. Even if we will clarify better these aspects later (see next section), we can already anticipate how the borrowers' net worth can be impacted by changes in monetary policy. There are two ways by which borrowers are directly affected by a tight monetary policy for instance. Firstly, following an increase in real interest rates the burdens of firm's debt-service or finance costs rise as well, reducing in turn the borrowers' net cash flows. The macroeconomic chain of this process is the following:

$$\boldsymbol{M \downarrow \Rightarrow i \uparrow \Rightarrow \textit{cash flows} \downarrow \Rightarrow \textit{asymmetric frictions} \uparrow \Rightarrow L \downarrow \Rightarrow I \downarrow \Rightarrow Y \downarrow}$$

At the same time, there is also a decline in asset prices which consequently shrinks the value of borrowers' collateralizable net worth (G. Hubbard, 1995). In fact, this apparently makes sense due to the reduced market demand caused by the rising cost of purchasing assets stemming from a tight monetary policy (H.B. Ping, 2017). Again we can summerize this process as:

$$\boldsymbol{M \downarrow \Rightarrow \textit{equity prices} \downarrow \Rightarrow \textit{asymmetric frictions} \uparrow \Rightarrow L \downarrow \Rightarrow I \downarrow \Rightarrow Y \downarrow}$$

Moreover, there is another possible indirect way by which borrowers' net financial position could be worsened following a contractionary monetary policy.

Indeed, considering a case of a typical manufacturer firm, if its customers reduce the demand (i.e. for balance-sheet reasons), in the short run it will face a fall in the revenues not compensated by a reduction in fixed costs which do not simultaneously adjust. It turns out that there will be a sort of financing gap eroding the firm's net worth and creditworthiness over time (B. Bernanke and M. Gertler, 1995). To sum up thus, all what we said here is relevant from a macroeconomic perspective because of the amplified effect suffered by the real economy following a shift in monetary policy. This is relevant since it permits us to have a better idea on the general functioning of the broad credit channel, before presenting the concept of *financial-accelerator* which is, as we will see in the following section, at the heart of this macroeconomic literature field.

2.5.4 The *financial-accelerator* and the *flight to quality*

In Chapter 1 we have shown that the credit market is far from being a perfect market. In fact, we have seen how it is characterized by a series of important inefficiencies mostly due to asymmetric information issues which impact on its functioning and equilibrium. Nevertheless, in the previous model we have overlooked problems and effects that may arise from this imperfect information framework. By the way, in the attempt to disperse the fog relative to what they called "the *small shocks, large cycles* puzzle", in 1996 Bernanke, Gertler, and Gilchrist introduced for the first time the concept of *financial-accelerator*. They defined this as *"the amplification of initial shock brought about by changes in credit-market conditions"*. At that time the previous literature by introducing only the imperfect asset substitutability was not able to provide a clear explanation regarding the large changes in output stemming from small changes in demand. A *financial-accelerator* phenomenon can occur as consequence of an economic recession that weakens a firm's sources of internal finance (C. Walsh, 2003). In such a situation a firm has to resort more to external financing resources which are more expensive because of the presence of agency costs and asymmetric information[7]. The crucial point is that due to imperfect information, as outlined by Bernanke et al. (1999), there is a negative relation between the external finance premium and borrowers' net worth[8]. This is particular true for firms with weak balance sheets (P. Vermeulen, 2002). In fact, in such a context agency costs increase due to the presence of potential divergence of interests between borrowers and lenders, making these latter asking for a sort of premium in order to be compensated for the higher agency costs faced (B. Bernanke et al., 1999). Moreover, since *"the procyclical behaviour of economic agents' net worth over business cycles implies countercyclical behaviour of the external finance premium"* (B. Coric, 2011), *financial-accelerator* ends up enhancing the swings in borrowing and, in turn, all the macroeconomic variables dependent on it (B. Bernanke et al., 1999). Overall thus, the final effect of a change in monetary policy will result amplified thanks to the influence of the effects of the credit channel just described (C. Walsh, 2003). Supposing for example the case of a tight monetary policy brought about by the central bank, this negatively

[7]Under the assumption that the external finance source is not fully collateralized.

[8]This is usually defined as the sum of the liquid and illiquid (i.e. collateralized asset) assets values.

impacts on the economic agents net worth (i.e. through a reduction in money supply leading in turn a shrinking in the aggregate demand) and, as a consequence, it further increases the cost of external funds (for the negative relation disclosed above). Finally, this strengthens the negative impact on the economy since economic agents are forced to reduce their investments and/or spending. This process is generalized and illustrated in the following figure:

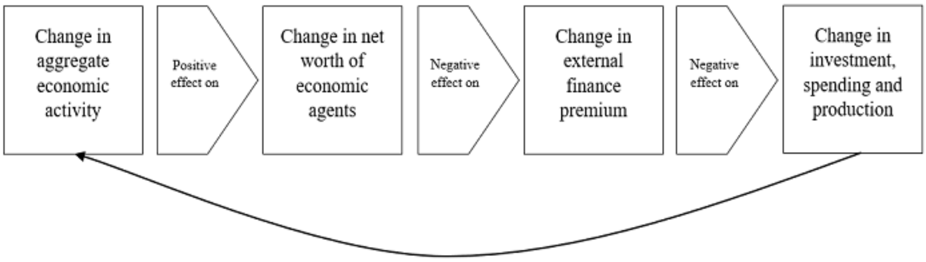

Figure 2.1: The *financial-accelerator* effect *(source: B. Coric, 2011)*

Now that we have introduced the general aspects and considerations concerning the *financial-accelerator* effect, we can finally provide the model designed by Bernanke, Gertler, and Gilchrist to understand how it effectively works. The scenario considered here starts from an entrepreneur facing a two periods (0 and 1) horizon who buys raw materials (input) in the first and then sells the final product (output) in the second one. To run this business, he or she uses two different factors: a fixed and available factor K and one variable x_1. Then the entrepreneur will sell the output at the unitary price q_1 at the end of the period 1. Here the variable input x_1 fully depreciates over one period and its price is normalized to one. At this stage, authors introduce an increasing and concave production function $f(x_1)$ that multiplied by a given technology parameter called a_1 gives back at the total output produced in period 1. Moreover, Bernanke et al. assume that at the beginning of period 0 the entrepreneur still maintains the past productions and debt obligations which are respectively equal to $a_0 f(x_0)$ and $r_0 b_0$ with b_0 corresponding to the past debt value and r_0 being the gross real interest rate inherent to this. From a purely accounting perspective it results that:

$$x_1 = a_1 f(x_0) + b_1 - (1 + r_0)b_0$$

Introducing now r_1, which is the interest rate paid by the borrower for the debt raised at time 0 and paid back at time 1, we can now analyze how the entrepreneur can maximize his or her profit in function of x_1 and b_1 chosen at time 0. Particularly, the entrepreneur faces the following situation:

$$x_1, b_1 \qquad \max\, a_1 f(x_1) - (1 + r_1)b_1$$
$$\text{under constraint } x_1 = a_0 f(x_0) + b_1 - (1 + r_0)b_0$$

By solving this we derive the following result:

$$af'(x_1) = 1 + r_1$$

From this expression we can see how a restrictive monetary policy directly impacts on r_1 which increases as response, forcing the entrepreneur to bring forth a project with a higher productivity. Overall, due to the $f(x_1)$ characteristics, a restrictive monetary policy leads to a reduction in investments. Moreover, by introducing a bind on the debt for the entrepreneur, we can see how effectively the *financial-accelerator* amplify the monetary policy effects which we would have had in the traditional money transmission channel. Bernanke et al. recalling the Kiyotaki and Moore's model (1993) assume that it is costly for the lender to seize entrepreneur's output in case of default whereas is much cheaper to obtaining redress through the fixed factor K which is pledged as collateral. It turns out that there will be an additional constraint for the entrepreneur given by:

$$b_1 \leq \frac{q_1 K}{1 + r_1}$$

In words this means that will not be possible to reach a debt level higher than the value of the time-discounted collateral market value. We can now derive the new complete constraint for the borrower that is:

$$x_1 \leq a_0 f(x_0) + \frac{q_1 K}{1 + r_1} - (1 + r_0) b_0$$

It entails that the input bought at time 0 cannot exceed the sum of the net income of the same period ($a_0 f(x_0)$) and the net discounted assets ($\frac{q_1 K}{1+r_1} - (1 + r_0)b_0$). Therefore, Bernanke et al. here demonstrate how in the case of entrepreneur's net worth lower than the optimal value x_1, the constraint described above bind. As a consequence, the marginal productivity of x_1 is higher than its marginal cost. Moreover a change in monetary policy simultaneously leads to a decrease in the firms' net income due to both financing costs and loan size constraints (C. Favero, 2001). In conclusion, Bernanke et al. with the help of this model show the existence of the so called *flight to quality* phenomenon. This refers to the situation where borrowers dealing with higher agency costs in credit markets will bear more the consequences of economic phases characterized by downturns and restrictive monetary policy. For instance, due to their informational opacity[9], SMEs are usually more subject to deal with credit restrictions under tightening policy periods, leading to a *flight to quality* phenomenon and consequently to a further fall in output (R. Troncoso, 2009). Therefore it turns out that *"reduced spending, production, and investment by high-agency-cost borrowers will exacerbate the effects of recessionary shocks"*(Bernanke et al., 1996). Overall, as assessed by different works in the literature such as W. Lang and L. Nakamura (1995), the effects of *flight to quality* on the real economy can be quantitatively relevant.

[9]A. Berger and G. Udell (1998) coined this term to identify the lack of transparency of small firms' information if compared to large and/or public companies.

Chapter 3

A review of definitions and functioning of Unconventional Monetary Policies

After defining the main aspects and problems of both credit market and monetary transmission channels, the aim of this chapter is therefore to expose the most relevant features and mechanics of unconventional monetary policies, which are key in order to facilitate the understanding of the results that we will disclose later. Before analyzing each specific topic relative to unconventional monetary policies, we clearly need to define them. Generally speaking, in economics we do not find a real and clear definition of what an unconventional monetary policy is. In fact, usually economists refer to unconventional monetary policies to categorize those *"measures that are not what is generally done, so they are not supposed to become the standard mode of monetary policy"* (L. Bini Smaghi, 2009). As we will discuss in the following section, this latter refers to that situation where central bank decides to directly affect market prices and conditions beyond a short-term, typically overnight, interest rate (C. Borio and P. Disyatat, 2009). However, in serious economic contexts of crisis, conventional monetary policies result to be insufficient to permit the achievement of monetary policy's goals. Consistent to this, in Par 3.2 we will present the evolution of unconventional monetary policies from an historical perspective, starting from the first adoption of QE by the Bank of Japan (BoJ) in 2001 until the latest implementations in the monetary policy field carried out by the ECB. In doing so, following a chronological order, we describe all the different non standard measures adopted, explaining simultaneously the causes and the objectives which led central banks to bring these about. Moreover, before presenting in the last section the transmission mechanisms through which unconventional monetary policies are supposed to operate through, in Par 3.3 we will set out the different types of monetary policy nowadays recognised as unconventional, from QE to negative policy rates tools, passing through forward guidance. We conclude this chapter with the five transmission channels[1] for non standard policies: portfolio-balance, signaling, liquidity, confidence, and BLC. In particular, this latter will

[1]Note that the following classification refers to M. Joyce et al. (2011), but this is not the only one. For instance, A. Krishnamurthy and A. Vissing-Jorgensen (2011) recognize seven different transmission channels just for QE.

be the "bridge" which will lead us to the fourth and final chapter where we disclose the empirical analysis embedded in this work.

3.1 A distinction between Conventional and Unconventional Monetary Policies

3.1.1 The Conventional Monetary Policy tools

As anticipated above, in economics we just find a residual definition of unconventional monetary policy. However, this may be somewhat vague. Sometimes this difference can be so subtle that it is very difficult to make a clear distinction. For instance, according to the common economic thought in the 1970s, some monetary policy interventions experienced during the last crisis would not be classified as unconventional (C. Borio and P. Disyatat, 2009). Understanding the difference between conventional and unconventional policies is thus so relevant for our purposes, that we have decided to dedicate to this topic this first section of chapter. In fact, here and in the next section we will try to answer to the following questions: how can we distinguish an unconventional policy from a conventional one? Why and when is it useful for central banks to carry out an unconventional monetary policy? Starting to answer the first of these, usually we define as conventional policies those measures aiming at steering official interest rates[2] and in turn market liquidity, and publicly signalling to the market central bank's expectations regarding the most important macroeconomics variables or even central banks' intentions about future policy changes (M. Cecioni et al., 2011). Therefore, the central bank is able to accomplish its most important objective: maintaining price stability over the medium term (i.e. low and stable inflation)(L. Bini Smaghi, 2009). In order to do so, the central bank usually uses three different tools to pursuit its own goals (U. Bindseil, 2004):

I. **Standing Facilities.** This first type of conventional monetary policy instrument is usually put in place to provide an interest rate cap *"at which financial institutions lend to one another overnight, reducing the volatility of the overnight interest rate"* (C. Furfine, 2003). Conversely to open market operations, standing facilities start for the initiative of central bank's counterparties rather than the central bank itself. In the Eurosystem we find two possible standing facilities alternatives: the margin lending and the deposit facilities. The first is used by commercial banks to cope with short-term liquidity requirements within the shortest possible time. The second instead permits to counterparties to *"deposit their end-of-day surplus liquidity with central bank on a remunerated account"* (U. Bindseil and J. Jablecki, 2011). Overall, since the marginal lending rate and deposit facility rate are respectively higher and lower than their money market reference rate, counterparties usually opt for standing facilities as a last resort.

[2]Note that here we refer to overnight interest rates. In fact, the central bank targets this kind of rate rather than rates with longer maturities. In this way, it can avoid yield curve's anomalies related to time-series properties of longer-term rates (U. Bindseil, 2004).

II. **Open Market Operations**. In general terms, we can define an open market operation as a buy or sell transaction brought forth by the central bank in the open market. Due to the involvement of government securities bought or sold by commercial banks acting as counterparties, this results in an expansion or contraction of the liquidity in the banking system. More specifically, ECB usually resorts to two different types of operations: the main refinancing (MROs) and the longer-term refinancing (LTROs). In this context, the first is aimed at steering short-term interest rates through one-week liquidity-providing operations. The main goal of the seconds is to refinance the financial sector in a long term horizon base[3].

III. **Reserve Requirements**. These are those regulations imposed by the central bank to commercial banks which must hold an amount of money in accordance to a given cash reserve ratio. This latter is usually function of the deposits present in the liability side of the bank's balance sheet. However, it is worthy to point out that nowadays in the advanced economies there is reluctance towards this policy instrument (C. Montoro and R. Moreno, 2011). This is mostly due to both innovation and reduced effectiveness stemming from more developed capital markets (M. Brei and R. Moreno, 2011). Nevertheless, it is still considered an important policy tool for particular contexts and situations (i.e. when an open market operation results insufficient to guarantee a certain level of financial stability in the market).

3.1.2 Unconventional Monetary Policies and their features

After having listed the different types of monetary policies recognized as conventional, we can now turn to the unconventional ones. Before starting, however, it is important to make clear why unconventional monetary policies have become necessary for central banks around the world to achieve their objectives. Recalling the second question made in the previous section, central bank is forced to resort to unconventional policies whenever the conventional ones result to be insufficient to guarantee the achievement of their goals. It entails that *"exceptional times call for exceptional measures"* (M. Lenza et al., 2010). These measures are peculiar not only because their sizes and scope, but also due to the absence of previous experience which can lead and guide the implementation of this kind of policies (S. Kozicki et al., 2011). Moreover, accordingly to L. Bini Smaghi (2009), there are two main "exceptional time" scenarios. The first situation refers to the so called zero lower bound. In such a case indeed, the interest rate usually used by the central bank[4] as a steering tool for the economy is so close or even equal to 0, that lowering it in order to provide more stimulus would be ineffective. Therefore, zero lower bound results to constrain central bank actions, with this latter that can solely resort to unconventional policy instruments in order to further stimulate economy (M. Cecioni et al., 2011). In fact, as we will see better later, the central bank usually copes with zero lower

[3]These definitions directly stems from Eurosystem sources.
[4]FED rate for US Federal Reserves and ECB refi rate in Euro area.

bound by guiding medium and long-term rates expectations and by altering and/or expanding its own balance sheet. Both these measures are aimed at improving financing market conditions without going through interest rates (L. Bini Smaghi, 2009). Secondly, there are other situations where these rates are not at a zero level but the use of unconventional monetary instruments is still required. This refers to an economic context characterized by financial crisis where the canonical transmission *"can be severely impaired by disruptions in the financial markets"* (M. Cecioni et al., 2011). In conclusion thus, in this work we will consider as unconventional monetary policies those measures which reflect what said so far. Therefore, measures aimed at stimulating economy in a zero lower bound context, improving the market liquidity during the global financial crisis and, helping the market functioning through specific communication strategy are here conceived to be unconventional instruments.

3.2 Unconventional Monetary Policies from a historical perspective

3.2.1 Unconventional instruments: the Japanese experience

In this section we will emphasize the historical path of unconventional monetary policies in order to have a 360 degree view regarding the evolution and the use of these unconventional policy tools. The starting point here lays in Asia. In the middle of the 1990s, Japan was experiencing a particular economic situation. In fact, in those years the Asian country was still suffering from financial distress and economic stagnation following the asset bubble burst of the late 1980s (M. Shizume, 2018). In addition, there also was a problem of "excess" relative to employment, production capacity, and debt (H. Kuroda, 2017). In parallel, banks were instead facing non performing loans issues. To deal with all these problems, because of a policy interest rate already almost equal to 0, in 1995, the BoJ was forced to resort for the first time to alternative ways in order to try to better off an economic scenario still difficult. The first unconventional measure brought about by Japanese central bank was the so called ZIRP (Zero Interest Rate Policy). For the first time in history thus, a central bank kept a zero rate level as a policy tool for a given period of time (M. Shizume, 2018). Even more relevant is the adoption of a new QE policy in 2001 in order to tackle a new economic downturns after a brief recovery experienced in the previous years. The main goal here was that one to bring Consumer Price Index (CPI) inflation back to zero or even positive levels (S. Shiratsuka, 2017) by committing to achieve the operating target of current account balances (CAB) held by banks through the purchase of Japanese Government Bonds (P. Berkmen, 2012). Even though this first pioneering QE ended in 2006 when inflation started to get back up, this was not the only and last QE initiatives taken in Japan. In fact, in 2013 a new QE policy named Quantitative and Qualitative easing (QQE) was launched. As explained by H. Kuroda, who also was the Governor of the BoJ at that time, QQE differs enough from the typical QE. Kuroda in his paper of 2017 explains how there were two main pillars behind it. First, there was the will to directly affect market's expectations by targeting a given inflation rate (i.e. 2 percent), and by a clear commitment to further interventions to support the economy if needed. Second, the BoJ wanted to lower long term interest rates through a heavy purchase of long term Japanese government bonds in order to increase in turn the liquidity in the market. Empirical evidences concerning this policy show how the mere expansion of BoJ's balance sheet size (i.e. the QE part of the policy) is not able alone to robustly increase inflation and output. In such a context, qualitative easing can be an important complement but at the cost of unwinding QE (J. Kuroda, 2018).

3.2.2 Federal Reserve's non-standard monetary policy measures

Considering the USA, in the end of 2007 with the beginning of the Great Recession of 2007-2009, the FED was forced to decrease the policy interest rate in order to deal with the economic downturns. Nevertheless, this first measure was not enough to cope with such a terrific crisis. In fact, soon enough, with the zero lower bound the FED could solely resort to unconventional policy instruments. More specifically, the FED opted for two specific measures to provide further stimulus to U.S. economy: forward policy guidance and large-scale asset purchases (LSAPs)(J. Williams, 2012). Starting from the first one, in 2008 the FED decided to carry out a forward policy guidance in order to deal with the downturns experienced by the economy at that time. This was not the first time in which the FED adopted forward guidance. Indeed, in 2003 this kind of instrument was already used to anticipate a possible deflation risk. However, with respect to this case, the main FED's goal here was *"to affect longer-term bond yields and other financial asset prices directly by providing forward guidance about future short-term interest rates"* (G. Rudebusch, 2018). In doing so, as we will see better later (see Par 3.3.1.), forward guidance directly involves the market expectations with regard to the future monetary policy path (C. Plosser, 2013). Anyway, the FED decided to use again forward guidance to restate market expectations which at that time had foreseen a further increase in long term rates. By communicating that *"economic conditions...are likely to warrant exceptionally low levels for the federal funds rate at least through late 2014"*, the FED was able to lower the expected yields on Treasury securities by approximately one- and two-tenths of a percentage point (J. Williams et al., 2011). Even if through a different mechanism, the ultimate goal of the QE is the same of that one of forward guidance: steering long-term interest rates in order to stimulate economy. In fact, the idea behind is that *"it puts direct upward pressure on the price of the targeted assets, thereby lowering their yields"* (S. Kozicki et al., 2011). For what concerns the specific U.S. case, at the beginning of the crisis the FED decided to launch new unconventional balance sheet policies by buying Treasuries and mortgage-backed securities. In doing so, the FED enlarged its own balance sheet size, switching from a total holdings accounted for almost 800 billion dollars to an amount higher than 4 trillion dollars. Only when economic conditions started to sharply improve in 2017, the FED decided to scale down the size of its own balance sheet. This reduction has been carried out through a limited replacement of maturing securities in its portfolio (G.

Rudebusch, 2018).

3.2.3 The development of Unconventional Monetary Policies in the Eurozone

To conclude this general historical overview we need to present the unconventional policies within the eurozone. Between October 2008 and May 2009 the ECB lowered the interest rate on its main refinancing operations by 325 basis points, it also implemented several non-conventional measures in order to prevent possible problems relative to the transmission mechanism as explained by ECB itself in the bulletin of July 2011. Conversely to U.S. FED, indeed, ECB approached unconventional policy instruments as complement rather than substitute to the conventional measures to deal with these *"exceptional times"* (P. Cour-Thimann and B. Winkler, 2013). Few time later the Lehman Brothers bankruptcy, the spread between the three-month Euribor and the overnight interest rate EONIA peaked to 156 basis points, the highest value ever recorded before (L. Bini Smaghi, 2009). At this stage, once that conventional policies had already been rehearsed with, new non standard measures also known as *"credit enhanced support"* were implemented in order to further support banks' flow of credit (J. Trichet, 2009). For instance, the ECB opted for implementing the so called fixed rate tenders and full allotment (FRFA) measure in order to tackle the lack of liquidity that was hitting the market. Moreover, always to cope with these difficult market conditions, the ECB decided also to widen the different types of asset suitable to be used as collateral (S. Collignon, 2012). In this way, refinancing the less liquid assets through central bank's intervention consisted to a sort of first patch to be up against liquidity market shortage (P. Cour-Thimann and B. Winkler, 2013). Nevertheless, all said so far was not enough to limit one of the most important financial crisis that the global economy has ever faced. Accordingly, the ECB did not limit itself to implement just FRFA and looser collateral requirements. In 2009, in parallel to an extension in the maturity of its longer-term refinancing operations (LTROs) to 12 months[5], the ECB also launched the Covered Bond Purchase Program (CBPP) to favor the activity in the euro area covered bond market (J. Bernie et al., 2011). In this market indeed, such a kind of fixed income instruments consists in long-term debt securities, traded by banks to refinance their loans provided to both public and private sectors (P. Cour-Thimann and B. Winkler, 2013). It entails that for banks this specific market is one of the main sources where gathering funds. However, a new wave of unconventional measures was required when in 2010 the debt sovereign crisis started to affect the Euro area. A first response by the ECB was on 10 May 2010, when it implemented for the first (but not least) time[6] the so called Securities Market Program (SMP). This type of unconventional instrument refers to interventions in the form of outright secondary market purchases

[5] *"This one-year operation, by further alleviating the liquidity risk faced by banks, fulfils one of the conditions necessary in order for banks to increase their provision of credit."* (Monthly Bulletin, ECB, August 2009)

[6] When new financial tensions arose in 2011, this unconventional policy was newly relaunched after the first positive outcomes achieved in the first implementation of the previous year.

(F. Eser and B. Schwaab, 2016). As explained by S. Manganelli in the winter research bulletin of ECB in 2012, through SMP, the ECB wanted to address several goals. Firstly, there was the will to tackle the severe tensions in certain specific market segments such as the Italian and Spanish ones which were mostly suffering the lack of liquidity at that time. Secondly, SMP was implemented in order to enhance market liquidity and, at the same time, to fix also the functioning policy transmission mechanism. After a first immediate reduction in the spread between German bond and the targeted government bonds (i.e. Italian bonds), this started to rise again (F. Eser and B. Schwaab, 2016). Therefore, the ECB decided to react by introducing further unconventional measures (P. Cour-Thimann and B. Winkler, 2013):

I. two LTROs with a maturity of 3 years each;

II. lower reserve ratio requirement (from 2 to 1 percent);

III. higher collateral availability due to the acceptance of additional credit claims by national central banks;

IV. development of alternative credit assessment sources for use in the selection of eligible collateral.

Despite the interventions just described, the sovereign debt crisis did not stop affecting eurozone. It follows that in August 2012, after a famous speech of the ECB president in charge Mario Draghi where he said to be prepared to put in place any solution would be necessary[7], the ECB announced the so called Outright Monetary Transactions (OMTs) program. Even if it has not been adopted yet, this instrument was successful thanks to the credibility and the potential 'fire-power' of the ECB itself (V. Constâncio, 2017). However, practically speaking, OMT is conceived to *"preserve the singleness of the ECB's monetary policy and to ensure the proper transmission of the monetary policy stance to the real economy throughout the area"* (P. Cour-Thimann and B. Winkler, 2013). Then, other relevant measures were adopted in 2014. Indeed, in the month of October the ECB undertook both the CBPP3 program (after the first two carried out respectively in 2009-2010 and in 2011-2012) and the Asset-Backed Security Purchase Program (ABSPP) in order to *"further enhance the transmission of monetary policy, facilitate credit provision to the euro area economy, generate positive spillovers to other markets and, as a result, ease the ECB's monetary policy stance, and contribute to a return of inflation rates to levels closer to 2 percent"* (M. Melms et al., 2017). However, all these measures were not able to make inflation reach the desired level (i.e. lower but close to 2 percent). As a consequence, the ECB decided to rise the monthly amount of asset purchases up to 60 billion of euros. Despite the implementation of all these policies, the economic results were not good enough yet. To deal with these difficulties, another wave of unconventional measures were designed by the ECB. The first of these refers to the so called Public Sector Purchase Program (PSPP). By launching this policy, the ECB wanted to intervene in the market through purchases but without affecting the price formation mechanism. This program consisted in the

[7] *"Within our mandate, the ECB is ready to do whatever it takes to preserve the euro. And believe me, it will be enough."* (M. Draghi, July 2012).

purchasing of assets such as euro-area government bonds and other types of debt instrument issued by other European agencies and institutions. A second type of non standard policy were also introduced few months later in 2015: the Targeted Long-Term Refinancing Operations (TLTROs). These (i.e TLTRO and later TLTRO II) were aimed at facilitating the access to bank lending sources (at the net of mortgages) to enterprises and households by allowing lending banks to have access to extra liquidity through extra credit provision (H. Balfoussia and H. Gibson, 2015). It entails that in some specific cases, due to negative interest rates, the ECB *de facto* pays banks in order to stimulate the credit offer. At first glance, to a certain extent TLTROs can appear quite similar to the previously described LTRO. However, in contrast to this latter, this kind of policy focuses only on financing enterprises and households. In addition, the ECB simultaneously extended the duration of APP program. All in all, the measures here described have led to a huge expansion of the ECB balance sheet. This can be also seen by looking at Fig. 3.1. As we can notice, the main driver of this evolution refers to the asset held for policy purposes, actually equal to more than the 55 percent of the total asset side. Indeed, through CBPP3 before, and ABSPP - Public Sector Purchase Program (PSPP) later, the ECB enlarged its balance sheet asset side from 185.3 (2014) to 447.1 billion euros (2018) which corresponds to a relative increase of almost 242 percent. From a pure annual perspective, even last year there was a balance sheet size increase of 23.3 billion euros (i.e. 7.9 percent) mainly due to the influence of PSPP.

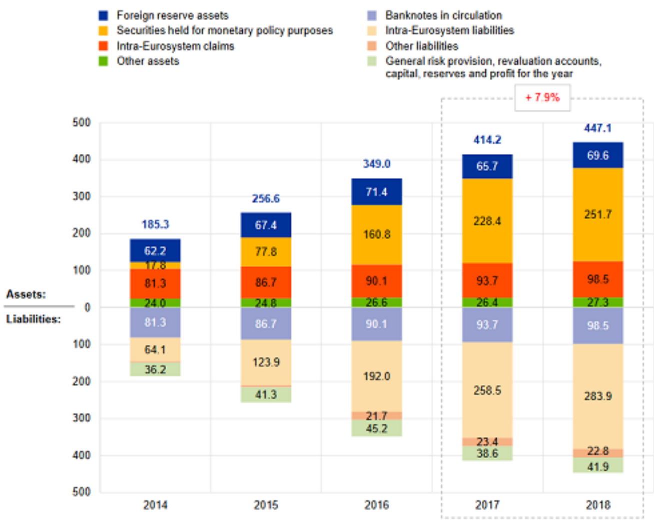

Figure 3.1: Evolution of the main components of the ECB's balance sheet (EUR billions) *(source: Eurosystem annual consolidated balance sheet)*

In conclusion, all these policies are now part of the ECB's policy toolkit ready to be used (again) whenever necessary. These additions make the ECB *a central bank more modern, effective and prepared to serve the goals of monetary union* (V. Constâncio, 2018).

3.3 Unconventional Monetary Policies: types and methodologies

So far we have simply cited and briefly introduced different types of unconventional instruments used by several central banks in the past years. In doing so, however, we have not spent much time on investigating the specific features and mechanics of each of these unconventional instruments. This paragraph will provide a detailed description of the most relevant non-standard policies. The first step here will be presenting what forward guidance is and why it has been used. Then we will move our focus on the so called balance sheet policies. Broadly speaking, this term refers to all those unconventional measures based on adjustments of central bank's balance sheet in terms of either size or composition (or both) (R. Perotti, 2016). Under this category we distinguish between credit and quantitative easing. As we will see better later on, the difference between these two instruments refers to the greater relative importance of each balance sheet side in the policy implementation, respectively the asset side for the first and the liability side for the second one. Then, we conclude this paragraph by emphasizing and showing the main characteristics concerning the last instrument that we have decided to present here: the negative interest rates measures.

3.3.1 Features and functioning of Forward Guidance

As we have anticipated above, forward guidance is one of the non standard policy measures which has been taken by most central banks worldwide in the recent past, especially with interest rates at the zero lower bound level[8] (A. McKay et al., 2016). Indeed, we refer to forward guidance whenever a central bank decides to communicate to the private sector their own intentions relative to the future evolution of policy rates. In other words, it is nothing more than a sort of *"advance communication form about future policy orientations"* (P. Praet, 2013). More specifically, according to J. Campbell et al. (2012), we can distinguish between "Odyssean" and "Delphic" forward guidance. The first refers to a public commitment made by the central bank just like Odysseus *"committed himself to staying on his ship by having himself bound to the mast"*. Particularly, this means that central bank fully discloses its "reaction function" and in turn its own policy objectives (P. Praet, 2013). Instead, "Delphic" forward guidance is also defined as implicit forward guidance since it is based on central banks' communications relative to forecasts concerning macroeconomic environment developments. Therefore, here it is supposed to improve macroeconomic outcomes just by reducing private sector's uncertainty (J. Campbell et al., 2012). Recalling also what said through Par. 3.2, all what we have described above is usually aimed at two possible different policy goals. Firstly, calling up the "Odyssean" aspect, in such a case central bank by carrying out

[8]It is important to point out that not only in such a situation central banks disclose to public some relevant information in order to affect private sector's expectations (i.e. the announcement made by the Reserve Bank of New Zealand about its own the policy rate's expected path)(R. Perotti, 2016). However, forward guidance becomes more relevant in a zero lower bound context.

this policy primarily wants to converge public's expectations to its own rather than to provide further stimulus to economy. Instead, to reach this latter goal, the central bank can commit to maintain low interest rates even in the future due to the impossibility of further cuts when liquidity trap starts to matter. Namely, it *"promises above-target inflation in the future, which is a promise to deviate from its usual reaction function"* (R. Harrison et al., 2017). However this commitment is not always easy to be unbroken when the time comes. As explained by J. Williams (2012) based on the work done by Adam and Billi (2007) it might be difficult to not increase interest rates earlier than promised in order to tackle an inflation rise. This is quite important because it touches public's expectations which are the key gear for the success of this kind of unconventional policy. In fact, as we will also see when we will present the different transmission channels of unconventional tools, forward guidance effectiveness strictly depends on two different channels. The first one works affecting public's expectations of inflation (i.e. signaling channel, Par. 3.4.2), whereas the second related channel operates through influencing the public's confidence about future economic prospects (i.e. confidence channel, Par. 3.4.4.)(C. Plosser, 2013). It entails that if the private sector is not able to clearly understand the central bank's intended policy path, then the effectiveness of this kind of instrument could be heavily reduced (J. Williams, 2012). To better understand this, we can again consider as example the US case where the FED wanted to reduce long-term interest rates by implementing (also) a forward guidance measure. To do so, we need to decompose the two components which together form a long-term interest rate: the expectations component and the term premium. The first one concerns the average of expected rates with a total maturity equals to that one of the long-term bond, whereas the second one reflects the additional premium required by investors in order to compensate the higher risk related to longer holding periods. Intuitively, forward guidance targets the first of these. Indeed, this varies accordingly to the integration of the additional information provided by the central bank. Therefore, by hitting the expectations of future short term rates FED was able to lower long-term rates and in turn to enhance financial market conditions (G. Rudebusch, 2018). To conclude our forward guidance discussion we believe it is important to present here the so called "forward guidance puzzle". This phenomenon has been introduced in the literature for the first time by M. Del Negro et. al (2015). Here, authors demonstrate through their model how there is an excessive impact of forward guidance measure on the macroeconomic environment. These unreasonably large effects would depend on the lack of discounting of future economic outcomes. However, this puzzle theory has been recently questioned. In fact, according to R. Harrison et al. (2017), there would be a paradox at the basis of this argument. Indeed, they demonstrated that in a puzzle setup (i.e. under perfect credibility) we would have stronger policy transmission channel with less credible forward guidance promises. This results to be completely counterintuitive and in contrast to the theoretical foundations of forward guidance policy.

3.3.2 Balance Sheet Policies: Quantitative and Credit Easing

Following the taxonomy introduced by C. Borio and P. Disyatat (2009), we can distinguish among four different types of balance sheet policies. However, before listing their taxonomy, we need to point out a clarification considered essential by authors themselves. Indeed, they assert how what makes a balance sheet policy unconventional is "how" and not "which" crucial elements in the policy transmission mechanism are involved. This is the case, for example, of the first type of policy here considered: the exchange rate policy. In this case the central bank targets the exchange rate in terms of both level and/or volatility, through operations in the foreign exchange market aimed at altering the net exposure to foreign currencies of the private sector. Looking at the second type of these policies, it is concerned to affect the public sector market (i.e. government bonds or also bank reserves) acting at a private sector level. Even if the ultimate goal concerns government yields, because of the objectives here can be also different from the mere debt management, we usually call such a measure as quasi-debt management policy. However, in this section we will focus more on the remaining two categories, which are respectively the credit and the bank reserves policies. The first, which also includes credit easing, concerns changes in the central bank's exposure profile towards private sector claims, in order to ease the access to funding for the private sector. This can usually be achieved in several different ways, ranging from *"modifications of collateral, maturity and counterparty terms on monetary operations"* to purchases of private sector claims (C. Borio and P. Disyatat, 2009). In contrast to this, bank reserves policies are instead based on a reserves target which is set regardless the composition of the central bank's asset side. Consistently to what said so far, QE is a sort of mix between quasi debt management and reserves policies since it involves both reserves targets and government bonds acquisition. In Tab. 3.1., we sum up the classification presented above by highlighting the different policy categories in terms of impact on private sector balance sheet and targeted market per each of these categories:

		Impact on private sector balance sheets		
		Change in net FX exposures	Change in the composition of claims on the public sector	Change in profile of claims on private sector and/or composition of claims on public vs private sector
Market targeted	Foreign exchange	★		
	Public debt/securities		⊡	
	Private credit/securities			◆
	Bank reserves	(shaded)	(shaded)	(shaded)
Exchange rate policy (★); Quasi-debt management policy (⊡); Credit policy (◆); Bank reserves policy (shaded area)				

Table 3.1: Impact on private sector's balance sheets of different monetary policy policies *(source: C. Borio and P. Disyatat, 2009)*

Nevertheless, even if quantitative (or large asset scale purchases, LSAPs) and credit easing (or qualitative easing) present both different characteristics and goals, sometimes little confusion could be made in the attempt to distinguish these two non standard monetary policy instruments. Therefore we need now to go more into details. In 2009, a first clarification regarding the differences between these two policies was provided. This refers to the former FED chairman B. Bernanke who wanted to make clear the difference between the policies undertook by Japan and recognized as QE (see Par. 3.2.1) and those implemented by the FED itself. Indeed, these latter *"all involve lending or the purchase of securities"* and *"allow to continue to push down interest rates and ease credit conditions in a range of markets, despite the fact that the federal funds rate is close to its zero lower bound"* (B. Bernanke, 2009). As a consequence, we usually define as credit easing those measures consisting in purchases of private sector assets in certain impaired credit markets (S. Kozicki et al., 2011). Moreover, conversely to QE, this asset side change made by the central bank is not carried out in parallel to a targeting of bank reserves. Therefore here the monetary base remains untouched. However, M. Lenza et al. (2010) goes deeper in this respect by providing a distinction between pure quantitative and credit easing. Related to this, Fig. 3.2. illustrates the distinct impacts of these policies on a generic central bank's balance sheet:

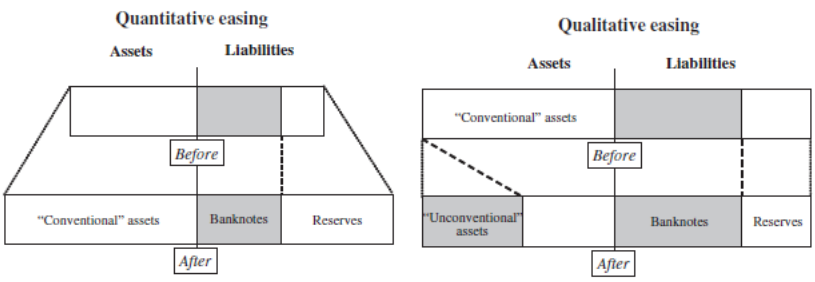

Figure 3.2: Impact on a central bank's balance sheet of quantitative and qualitative easing policies *(source: M. Lenza et al., 2010)*

As we can notice here, in contrast to the asset side expansion involved in a QE process, with pure credit easing the central bank just modifies the composition (but not the size) of its own asset side by introducing new unconventional assets in exchange for conventional ones (M. Lenza et al., 2010). In doing so, the central bank can address three main goals: improving market liquidity in certain specific segments, decreasing interest rates, and especially easing funding conditions for firms and financial institutions .
Considering now pure QE, what we said above regarding credit easing can only be partially picked up here. Indeed, the common point with the previous policy is that also QE refers to purchases of securities[9] performed by the central banks in order to lower interest rates and increase market liquidity. However, in this case part of government debt is massively bought by the central banks. More specifically, as we have previously anticipated, the central bank just enlarges its asset side by purchasing in the market more "conventional" assets (i.e. govern-

[9]This is the reason since C. Borio and P. Disyatat consider both these policies sharing a quasi debt management nature.

ment bonds) rather than "unconventional" ones like mortgage-backed-securities. Nevertheless, here the focus must be more on the liability side and particularly on the role played by bank reserves. Indeed, under the assumption of fiat money perfect elasticity, what happens is that central bank increases the monetary base through an accumulation of reserves (M. Lenza et al., 2010). As a consequence, it is able to buy more government or other type of securities in order to ease market liquidity conditions[10]. In conclusion, then, in literature we cannot find a unique and comprehensive definition of quantitative (and credit) easing. Nevertheless, in this thesis we will refer to this kind of measures according to M. Lenza et al. (2010) and his definitions of pure credit and pure QE described above.

3.3.3 Negative Interest Rate Policy

So far we have discussed a lot about what happens in a zero lower bound context. Particularly, we have said that once that the short-term interest rate reaches its lowest value, the central bank shall rely on other non standard monetary policy measures such as forward guidance or QE. In this way, we have implied that there are no chances for interest rates to go below 0. Is that always true? In this section we will answer to this question by disclosing another unconventional instrument used in the past by many central banks (i.e. Swiss National Bank): the so called negative interest rate policy. Starting from a pure theoretical perspective, interest rates can never be below 0 since *"if the costs of holding money can be neglected, it will always be profitable to hold money rather than lend it out"* (J. Hicks, 1937). However, the key word in this last sentence is "neglected". Indeed, asserting that holding currency is costless is at the same time a strong but incorrect assumption that we are making. In the real world in fact, there are several costs affecting it such as theft, physical destruction, and safeguarding. It entails that *"currency does not provide even a logical zero floor for market interest rates"* (R. Anderson and Y. Liu, 2013). However, a new question arises: how this practically can be translated into an unconventional monetary tool? To answer to this question, we provide here the explanation provided by R. Perotti (2016). Starting from the possibility to modify bank reserves requirements whenever is necessary, the central bank can impose a sort of tax on them by charging negative interest rates. It follows that, in the attempt to avoid to bear this tax, banks will spread to other rates (i.e. deposit rates) these below 0 rates by exploiting an arbitrage relationship[11]. Consequently, this can push banks to increase their lending activity and spur the private sector to consume more rather than paying this sort of tax on deposits. In other words, in a zero lower bound situation, if the aggregate demand is considered insufficient by the central bank, this latter can set a negative rate policy in order to stimulate consumption and investment, and thereby increasing aggregate demand (J. McAndrews,

[10] Note that how pointed out by B. Fawley and C. Neely (2013), the characteristics of the different QE programs launched by many central banks all around the world strictly depend on peculiar economic conditions and the specific motivations for each of these non standard actions.

[11] Note that there are some constraints that limit central bank in doing that. However, since here our purpose is different, we simply state that central bank cannot decide any negative interest rate level it wants.

2015). Moreover, as illustrated in Tab. 3.2., negative interest rate policy has usually been adopted in these years in order to cope with other issues such as low inflation, spillover effects from other unconventional measures, and ultimately to address currency appreciation pressure (A. Jobst and H. Lin, 2016).

			Policy Rates *(in basis points)* 1/			
	FX regime	**Objective**	Overnight Lending 2/	Open Market Operations	Deposit Facility	**Date of Introduction**
Denmark	Conventional peg (to euro)	Countering safe-haven inflows and exchange rate pressures	5	0	-65	July 2012-April 2014, Sept. 2014
Euro Area	Free floating, inflation-targeting framework	Price stability and anchoring inflation expectations	25	0	-40	June 11, 2014
Hungary	Floating, inflation-targeting framework	Price stability and countering exchange rate pressures	115	90	-5	March 23, 2014
Japan	Free floating, inflation-targeting framework	Price stability and anchoring inflation expectations	10	0	-10	Feb. 16, 2016
Norway	Free floating, inflation-targeting framework	Price stability 3/	150	50	-50	Sept. 24, 2015
Sweden	Free floating, inflation-targeting framework	Price stability and anchoring inflation expectations	25	-50	-125	Feb. 12, 2015
Switzerland	Free floating 4/	Reducing appreciation and deflationary pressures 5/	50	n.a.	-75	Jan. 15, 2015

Source: National central banks and authors. Note: 1/ effective policy rate are highlighted with a red background, as of end-July 2016; 2/ refers to special rate (liquidity-shortage financing facility) in the case of Switzerland; 3/ Norway has not adopted NIRP, and the negative interest rate on bank deposits at the central bank ("reserve rate") has had little or no influence on market rates. The reserve rate is one percentage point below the sight deposit rate (key policy rate). On average, NB has kept reserves in the banking system at around NOK 35 billion (and below the aggregate quota of NOK 45 billion). Thus, a bank with reserves in excess of the quota will always be able to deposit reserves with a bank with room on its quota.; 4/ conventional peg (to euro) before January 15, 2015); 5/ in conjunction with the exit from the exchange rate ceiling.

Table 3.2: Overview of central banks with Negative Policy Rates *(source: A. Jobst and H. Lin, 2016)*

However, one of the most important issues related to negative rate policies refers to its transmission to real economy. In fact, as pointed out by J. Harriet (2015), there is an inverse relation between transmission effectiveness and interest rates negativeness. It follows that the more negative interest rates are, the less effective the monetary transmission results to be. This mechanism is well explained by A. Jobst and H. Lin (2016). According to them, with stickier loan rates stemming from the difficulty for banks to *"offset lower interest margins by substituting wholesale funding for more expensive deposit funding"*, both monetary policy transmission and negative rate policy's effectiveness can be impaired. To conclude this section then, it is worthy to disclose some important concerns that can affect the ultimate results of a negative rate policy. In fact, as explained by J. McAndrews in his speech at Federal Reserve Bank of New York, there are seven main issues usually related to a negative rate policy. However, since some of these have already been cited above (i.e. currency costs), whereas others are less consistent to our purpose (i.e. legal issues), here we just focus on the most relevant of these which are: the health of financial intermediaries and the deflationary signal. Starting from the first, if the ultimate goal for a negative rate policy is to ease financial conditions in order to stimulate the economy, then such a policy must be carefully designed. In fact, as anticipated before, banks can be put under pressure once that the spread between their returns on assets and liabilities is sharply reduced. Therefore, this can negatively affect the financial sector as whole. Moreover, not only banks but also other financial intermediaries such as pension and insurance funds are involved. Indeed, with negative rates, they could try to undertake risky strategies to achieve a positive return. Turning now to the second concern, by implementing a negative rate policy central bank can affect the private sectors' expectations in an undesired way. More specifically, individuals could perceive this policy as a reflection of the low expectations for inflation of the central bank. This could impact on the ultimate central bank's goal since it can unintentionally lead the private sector to anticipate a deflation.

3.4 The Transmission Channels for non standard monetary policies

In Chapter 2 we have presented the interest rate channel which is at the base of the traditional economic literature. However, when we talk about unconventional monetary policies, this channel alone cannot explain the transmission mechanisms involved in a non standard monetary policy implementation. As a consequence, we entirely devote this section to better explain how unconventional instruments stimulate the economic environment. Accordingly, we describe here the main channels such as the portfolio balance and the signaling ones. In addition, we also provide a brief explanation relative to both liquidity and confidence channels. Then, we end up the section and in turn the chapter, by presenting the BLC inherently to unconventional monetary policies[12]

3.4.1 The Portfolio-Balance Channel

The first channel for unconventional measures that we analyze is the so called portfolio-balance channel. This channel comes into play whenever both banks and private sector's asset side composition and size change following certain central bank's actions such as outright purchases of securities or liquidity injections (K. Kuttner, 2018). To better illustrate its theoretical foundations and practical functioning, we can start from presenting one of the most important speeches of B. Bernanke, who in 2012 used the following words to describe how LSAPs' stimuli were supposed to be transmitted to the economy:

"The channels through which the FED's purchases affect longer-term interest rates and financial conditions more generally have been subject to debate. I see the evidence as most favorable to the view that such purchases work primarily through the so-called portfolio balance channel, which holds that once short-term interest rates have reached zero, the FED's purchases of longer-term securities affect financial conditions by changing the quantity and mix of financial assets held by the public."

[12]For the general overview on BLC see Par 2.5.1 and 2.5.2

As we can notice, here B. Bernanke emphasizes the key role played by this channel, providing at the same time a first general definition of it. Across this section we will resume and further develop both these aspects. In fact, we will firstly propose an overview of the theoretical roots behind the channel before shifting the focus to its related empirical evidences. In the first Bernanke's definition of portfolio balance channel there is a strong and fundamental assumption which we have to point out: the imperfect substitutability among private sector's balance sheet components. Thanks to this latter, by modifying the relative supplies of assets, central banks are able to directly affect investors' portfolios compositions and behaviour (C. Borio and P. Disyatat, 2009). More specifically, purchases of long-term assets by the central bank causes a subsequent increase in their price (and decrease in yields) pushing investors to look for alternative similar assets with higher returns. This means that through a supply-induced portfolio balance effect, the central bank is able to further lower yields and in turn to ease financial market conditions. However, in order to accept the imperfect substitutability assumption, we need to justify it. Starting from considering assets imperfect substitutability, this finds its theoretical foundations on the so called preferred-habitat view (F. Modigliani and R. Sutch, 1966). According to this theory, heterogenic groups of investors allocate their resources consistently to their own "habitat" or, in other words, their relative preferences in terms of both expected return and risk of a specific asset class (J. Janus, 2016). Moreover, further developments of this theory were provided by D. Vayanos and JL. Vila in 2009. Indeed, they demonstrated how in a context with different groups of investors characterized by different preferences in terms of asset maturity, shocks on asset demand can directly influence the term structure as well. Turning now to liabilities imperfect substitutability, this arises if asymmetric information or limited commitment affect the economic context (M. Cecioni et al., 2011). In such an environment, as we have also seen in the previous chapter, the external funds becomes more expensive relatively to the alternative internal sources of funding. As a consequence thus, liabilities cannot be perfect substitutes. Nevertheless, in recent times not only imperfect substitutability but also the empirical effectiveness of the portfolio balance channel as a whole has been questioned. Indeed, market segmentation has been source of skepticism since it implies the presence of yield differentials which in turn provide arbitrage opportunities for investors (D. Thornton, 2014). Consistent to this, several relevant empirical works have been done in order to assess the effective empirical relevance of this channel. One of the most significant refers to D. Thornton (2012). According to him, the decreases in long-term rates and in term premiums in the US environment are totally due to the presence of signaling rather than portfolio-balance channel. Consistent to these findings, K. Hausken and M. Ncube (2013) showed how portfolio balance channel played a secondary role with respect to the signaling one in the transmission of QE policy (see next section). Moreover, they also demonstrated how this is not valid for the UK case. In fact, in line with other relevant works such as M. Joyce et al. (2015), institutional investors has changed their portfolio composition moving from government to corporate bonds but without affecting equities. Yet, the literature also presents many empirical analysis focusing on eurozone. For instance, according to G. Bua and P. Dunne (2017), even if the investment fund mostly touched by QE showed a portfolio rebalancing phenomenon, the overall effect still appears to be not so large. All in all thus, we can state that even if the portfolio-balance channel seems to work, its effectiveness has been tested to be lower than what it was supposed to be at the time of the Bernanke's speech reported above, especially for what concerns US context. Finally, this channel does not work just for balance sheet policies. Bottero et al. (2018) emphasize how also negative rate policies activate this channel. Particularly, they demonstrated that banks tend to modify their portfolios composition, from low yield short-term assets to higher-yield longer-term assets, consequently to the expansionary effects on economy and credit supply triggered from negative rates.

3.4.2 The Signaling Channel

The second very important transmission channel that we present here is the signaling channel, alternatively known also as inflation risk channel (A. Krishnamurthy and A. Vissing-Jorgensen, 2011). From a pure theoretical perspective, this channel presents more than one similarity with respect to the expectation channel of interest rate policy (see Par. 2.2) since its functioning is based on the public's inflation expectations (J. Janus, 2016). More specifically, its effectiveness is based upon three main elements: central bank's credibility, its communication strategy, and the adequacy of the monetary policy in order to target inflation appropriately. However, the big difference between these two channel refers to the way through which the expectations are affected. Considering the case of balance sheet policies, central bank activates the signaling channel through communications involving key topics such as future policy developments and paths or risk and liquidity of different classes of assets. In other words, all those issues relative assets' market valuation (M. Cecioni et al., 2011). For instance, by largely purchasing different classes of long-term assets, central bank shows a credible commitment to keep low levels of interest rates in the future (K. Hausken and M. Ncube, 2013). In the literature we find many studies concerning the effectiveness of the signaling channel relative to the adoptions of balance sheet policies. For example, one of the most known refers to M. Bauer and G. Rudebusch (2013). They took into consideration the QE implemented in US, analyzing through dynamic term structure models the changes either in risk premia or expected short rates following its announcement. Their findings reinforce what said in the previous section about the economic and statistic relevance of the signaling channel in the transmission of the first wave of LSAP US program. According to them, its announcement signaled to market participants an easy stance in terms of monetary policy for a longer while than what was anticipated. Not only with unconventional instruments such as quantitative and credit easing, but also with forward guidance the functioning of this channel becomes relevant for central bank in order to achieve its targets. In fact, considering for instance the European financial markets, strong evidence has been found relative to the impact of the ECB forward guidance announcement in the decline of the term structure of short-term rates (i.e. P. Hubert and F. Labodance, 2018).

3.4.3 The Liquidity Channel

Although the two previous channels described above are considered the most important ones for what concerns unconventional monetary policies (M. Cecioni et al., 2011), there are also other transmission channels that can play a nsignificant role. Among these we find the so called liquidity channel. In pure economics terms, liquidity can be defined as *"an asset characteristic that reflects how quickly an asset can be sold when sellers charge the equilibrium price"* (J. Krainer, 2001). Consistent to this, investors will require a liquidity premium for a given asset whenever this can be difficultly converted into cash. This kind of assets is usually said to be illiquid. In bad times for financial markets, as at the beginning of the Great Recession, market investors tend to require higher liquidity premium in order to cope with the increasing lack of liquidity. According to J. Christensen and J. Gillan (2016), who partly resume the definition of liquidity channel provided by J. Gagnon et al. (2011), QE introduces a large committed buyer (i.e. central bank) which is able to lower liquidity risk and in turn liquidity premiums and yields by putting additional liquidity to the market. In simpler terms, the liquidity channel is a sort of “liquidity buffer” provided by the central bank which permits to recover financial markets in periods of crisis (J. Janus, 2016). Nevertheless, since to be really effective this channel needs abnormally high liquidity premia in the market (A. Elbourne et al., 2018), it follows that it could have been an important instrument in the central bank's hands just for the very first months of the 2008 financial crisis (S. Bhattarai and C. Neely, 2016).

3.4.4 The Confidence Channel

In parallel to the channels presented so far, there is another one which can work under unconventional policies: the confidence channel. This latter, conversely to the previous ones, is based on the public's perceptions of uncertainty and risk. For this reason it is also called uncertainty channel (A. Elbourne et al., 2018). In the scope of unconventional monetary policies, its functioning strictly depends on the ability of these measures to boost consumers' confidence in order to increase their ability to spend (M. Joyce et al., 2011). Moreover, at the same time a higher confidence level in the market can lead to higher asset prices by reducing risk premium (K. Hausken and M. Ncube, 2013).

3.4.5 Bank Lending Channel and Unconventional Monetary Policy: functioning and main empirical findings

The last channel that we treat here refers to the already mentioned bank lending. Even if we have presented the majority of its related economics literature in Chapter 2, we still miss to explain how it works and which are the main relevant empirical findings in unconventional policies contexts. As in the case of conventional policies, behind its functioning there are always bank loans and their no substitutability with respect to other funding sources. Considering for instance the case of balance sheet policies, this channel is supposed to works due to the fact that banks will be more willing to increase their aggregate loan supply thanks to the parallel rise in prices of their assets on balance sheet. Here we can notice that even if the way through which this channel is activated is different compared to what presented in Chapter 2, the other mechanics related to how this effectively works remain unchanged. Consistent to this, the relevance of other features such as firms' size and banks' liquidity still persists. At first glance, it would appear to be not such a big difference from conventional and unconventional policies in terms of BLC. However, a worthwhile analysis in this respect is given by U. Albertazzi et al. (2016). By analyzing bank level data, they demonstrated how both conventional and unconventional monetary policies worked (also) via BLC. In particular, for conventional measures, asymmetric information seems to be a relevant issue, since it reduces the transmission effectiveness for those banks relatively sounder. For those unconventional, instead, they found that less capitalized banks resulted to be less effective in the monetary transmission. In this regard, Albertazzi et al. also point out how in contrast to what established by the conventional bank lending literature, since unconventional policies are brought forth in "hard times", the banks' capitalization level influence in terms of monetary policy stimulus may be overturned. In other words, banks presenting lower capitalization levels usually feel more regulatory constraints and, in turn, they could be less effective in the monetary transmission process due to the limited lending ability. Recently, other many economists have been studying the implications of this channel for the transmission of unconventional policies. Among these there are also G. Dell'Ariccia et al. (2018). Conversely to Albertazzi et al., they considered the US banking system rather than the European one. Despite the different subject of study, even in this case the results seem to justify the presence of a credit channel and in turn also of a banking lending one. Indeed, always by using bank data level, they were able to demonstrate how QE provides a positive stimulus to loan supply, decreasing in parallel intermediation costs. At the same time, the bank capitalization issue was found to be more aligned with the traditional bank lending thought rather than with the findings of Albertazzi et al. previously described. However, we also find many other research focusing on specific country context. For instance, C. Cahn et al. (2018) emphasizes in their paper the implications for the ECB's non standard actions for French banking sector. In particular, they find a strong evidence of a positive impact (i.e. 10 percent) on bank credit supply in France stemming from LTROs policies. Even more relevant is the role played by bank relationships to achieve this positive outcome. Indeed, the transmission of monetary shocks resulted to be a function of firm-bank relationships. More specifically, firms relying just in one bank show an increase in longer-term lending and in their investments whereas multi-bank firms are characterized by no rise in investment and shorter-term lending funding. M. Marchetti and M. Garcia-Posada (2015) investigated instead on the effects of the two VLTROs measures in Spain. Again, their results are consistent to the functioning of a BLC in the monetary shock transmission. Indeed, according to their study, the aggregate loan supply experienced a growth between 0.8 and 1 percent within the first year from the first VLTRO implementation. Moreover, they also confirmed how the banks mostly affected by these policies were those presenting more illiquid balance sheet asset sides. In addition to these empirical works, many studies also treat the so called international BLC. This latter is based on the propagation of the transmission of monetary shocks through international bank linkages. For example, a domestic bank could increase its own reservable deposits amount following a foreign loose monetary policy thanks to an increased foreign intra-group funding (J. Gräb and D. Żochowski, 2017). In this respect, B. Morais et al. (2018) studied the case of Mexico for the very extensive presence of European and US banks in this country. The evidences here are all in support of an international BLC presence. Nevertheless, this model did not distinguish between conventional and unconventional monetary measures. Therefore, a more consistent paper to our purposes is that one of A. Filardo and P. Siklos (2018). By considering only the unconventional policies, they confirm the presence cross-border monetary policy spillovers in terms of domestic bank lending. In particular, two important empirical results deserve to be mentioned. Firstly, these effects appear to be more relevant in the eurozone rather than USA. This is probably due to the more relevant role played by the banking system in the European economy. Secondly, even if QE leads to lower credit standard requirements, such a policies provided, on the one hand, an increase in credit supply but, on the other hand, a negative signaling effect on its demand.

Chapter 4

Bank Lending Channel in unconventional times: an empirical work

In this chapter we finally consider the credit channel described in Chapter 2 together with unconventional monetary policies. We focus on how non standard policies impact on real economy through BLC. This chapter can be decomposed in two main parts. In particular, we will dedicate the first one to the evolution of the credit market from the period prior to the Great Recession to nowadays. Here we will provide a mere qualitative and general overview on the credit market evolution which will permit us to have a better base to understand the results. In the second part, instead, we provide a pure empirical analysis regarding the impact of unconventional monetary policies on the real economy and the role played here by the BLC. In order to do so, we use a VAR methodology which has been widely used in recent time in the literature. Once defined VAR models, we provide a combination of impulse response functions and variance decomposition analyses to show the most relevant evidences stemming from these models. We conclude the chapter by presenting a robustness check for the findings presented in the variance decomposition analysis.

4.1 Trends and evolution of the European Credit Market in the twenty-first century

Before moving to the empirical part of this work, we firstly need to understand how the credit market has evolved and changed during these years. This aspect is quite important in order to have a first general idea on the context that we are analyzing. Two main sources of data will help us to provide a robust description of the credit market trends: the ECRI statistical Package[1] and Euro area statistics source. Following the country taxonomy of the first of these, across this overview we will distinguish among:

- **EU28 countries**: all the European Union (EU) member states as of 1 January 2017 (United Kingdom included);

[1]All the data here disclosed are in real terms.

- **EU15 countries**: those countries that joined the EU before the 2004 enlargement;
- **NMS countries**: the 13 countries that joined the EU as part of 2004 enlargement and subsequently;
- **EA19 countries**: refer to the 19 member states of the Euro Area as of 1 January 2017.

We firstly describe the credit market from a broader consolidate perspective before moving on each specific type of credit. Indeed, we can categorize credit based on who effectively benefits from it. This distinction is depicted on the following scheme[2]:

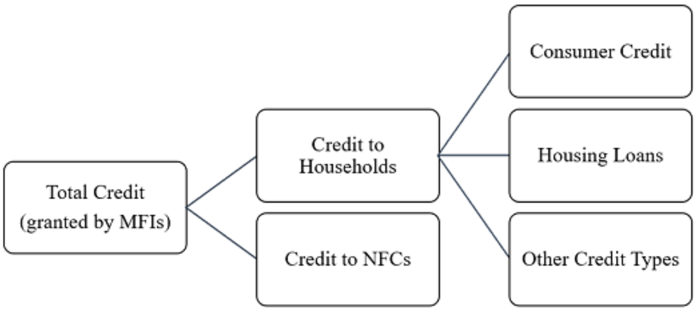

Figure 4.1: Credit divided by borrowers category

where MFIs and NFCs respectively stand for monetary financial institutions and non financial corporations. Starting our discussion from the whole European credit market, it sticks out how the growth of the total credit aggregate have started becoming positive since 2015 after several years of declining trends mainly due to the global financial crisis. By considering the different country groups, we can notice how the fastest recovering group is the EA19 which sets out a growth rate of 1.5 percent in 2018 improving the 0.04 percent of 2016. By the way, similar results are also reported by the other categories. In particular, it turns out that the growth rate for total lending activity in 2018 is 0.8 percent for EU28 (from the 0.6 of 2016) and 0.9 percent for EU15 (from the 0.6 of 2016). In spite of these positive data, if we compare the present situation to the pre-crisis one, it emerges that the market has not fully recovered yet. Namely, in absolute terms this means that the total outstanding credit are lower in 2017 with respect to 2008. More specifically, we have a decrease of more than 9 percentage point for EU28, 10 for EU 15, and 9.5 for EA19. However, for what concerns NMS, what described so far must be totally reversed. In fact, such countries show negative growth rate (i.e. -0.2 percent in 2017) but higher absolute credit levels: 16.3 percent more if compared to 2008. Despite these opposite positions, as emphasized by S. Bouyon and P. Gagliardi (2018), the convergence process for the total lending as a percentage of GDP concerning NMS countries and the other European countries had gone on until 2017 when a divergent trend took

[2]Definitions provided by *"Lending to European Households and Non-Financial Corporations: Growth and Trends in 2017"* (S. Bouyon and P. Gagliardi, 2018)

place. Once presented this rough macro data, we can further investigate which are those countries that more than others contribute to these results in terms of total credit outstanding growth. In this respect, considering the EU28 aggregate, countries such as Germany (+1 percent), France (about +0.60 percent) and the Netherlands (more than +0.20 percent) are those that have contributed most to these positive trends. On the opposite side, we find that the worst three countries are Spain, the United Kingdom, and Italy with this latter presenting a negative growth rate barely lower than 0.60 percent. Nevertheless, to understand better of how the credit market has been evolving in recent times we need to decompose these results not only in terms of aggregate and single country levels but also looking at the different types of credit cited above in Fig. 4.1.

4.1.1 Evidences in Credit to Households in Europe

Starting from looking at the whole picture, it follows that in 2017 the total aggregate of credit intended for households (i.e. consumer credit, housing loans and other credits all together) was equal to the 62.3 percent of the total lending exposures of banks improving the 58.2 percent pre-crisis[3]. In absolute terms, we can look at the following graph (Fig. 4.2) in order to understand the evolution of the total credit to households in the past years. In particular, considering for example the period of time from October 2007 to October 2018, it turns out an overall increase from 4.76 to 5.74 trillion euros.

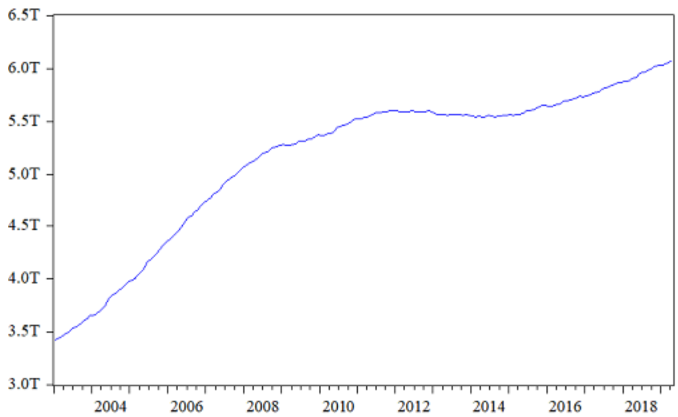

Figure 4.2: Total loans to euro area households from MFIs *(source: Euro area statistics)*

By analyzing these results from a country-level perspective, as expected, we have that in February 2019 the top 4 in Europe refers to Germany (almost 1.7 trillion euros), France (1.415 trillion euros), Spain (687 billion euros) and Italy (628 billion euros). In the last ranking positions, instead, we find countries of NMS such as Latvia, Malta and Slovenia. Despite that, what is more interesting is the growth rate. Overall, in 2017 the total households lending activity YoY growth rate was about 0.9 percent for what concerns EU28. To have a deeper

[3]Even though these data refer to EU28 aggregate, the results for the other country groups are aligned to this positive trend.

insight to this result, again we have to decompose it in terms of different countries contribution. Particularly, France, the Netherlands and Germany are the fastest growing countries, in contrast to Spain, Italy, and the United Kingdom which instead are at the opposite side of the ranking presenting all of them even negative results. NMS also presents different and opposite trends among its state members. For instance, even if Slovakia and Czech Republic show positive percentage aligned with the best EU28 performers, countries such as Poland and Lithuania are affected by the worst growth rate in the whole Eurozone. Once disclosed the data in general, country-aggregate, and country-specific terms, we can now focus on how each households credit type has contributed to these results over the past years. Accordingly, we can look at the following graphs which show the evolution of the total loans to households per category in Europe:

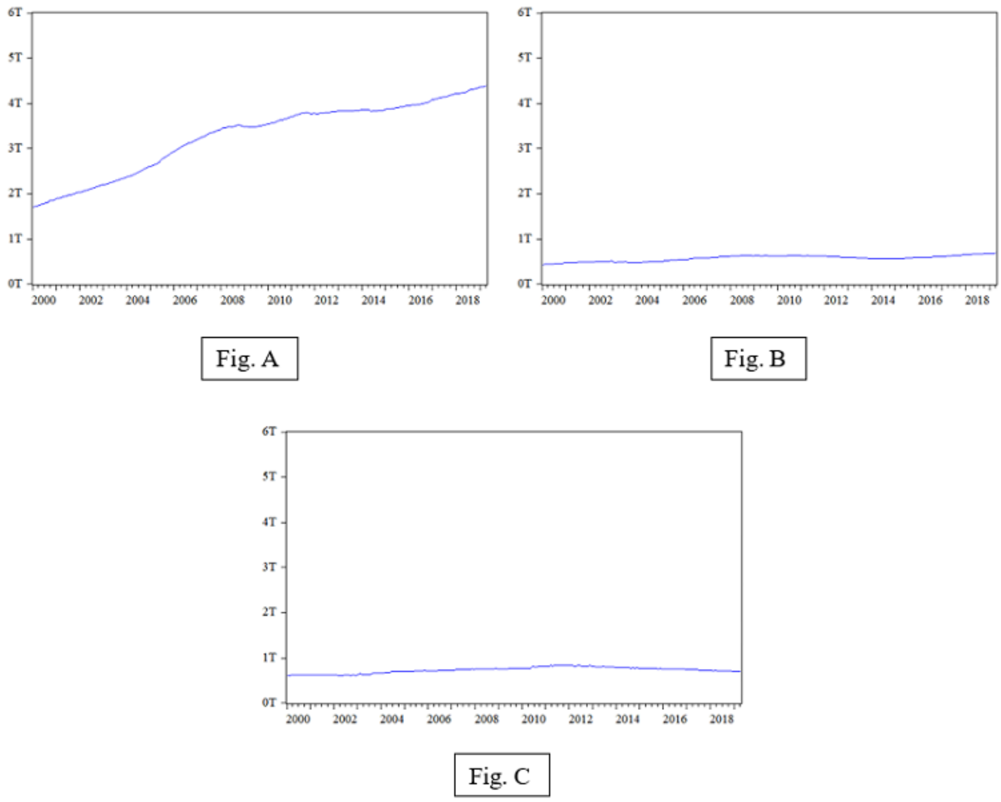

Figure 4.3: A. Total house loans; B. Total consumer credit; C. Other credit types *(source: Euro area statistics)*

If viewed graphically, the difference among the three categories becomes immediately striking. In panel B and C, we can notice how overall the stocks of consumer and other credit types have remained steady over time. It entails that the increase in the house loans is the real driver behind the growth in the households credit aggregate. This latter has been crucial to boost the overall growth since it is also the component with the highest relative weight concerning the households credit types. More specifically, house loans account for more than two third of the total credit to households (i.e. 78.1 percent in EU28 and 67.4 percent in NMS in 2017). Comparing the absolute levels pre and post crisis, it turns out that all the country aggregates experienced an overall growth considering the decade 2007-2017. In detail, we have the following increases: +4.1 percent for EU15, +5.8 percent for EU28, +7.8 percent for EA19 and +102.7 percent for NMS. Despite this terrific increase for NMS countries, if analyzed on a pro capita base, these latter still report an amount of house loans 30 percent lower than the EU28 average. The country-specific trends described above are valid also for this credit category. Indeed, considering EU28, the most significant house loans growth rate are reported by the Netherlands, France and Germany whereas the worst one refers to the United Kingdom with a significant negative rate. Nevertheless, although in a less significant way, also consumer credit has supported the positive trend of households credit. In fact, even though from Fig. 4.3. (B) it is not so glaring, since 2015 consumer credit has started to show a plus sign in its own growth rate after few years of decrease. This change of course is supporting the purchases of durable goods (i.e. furniture and motor vehicles). As explained in the ECB Economic Bulletin (issue 7, 2017), this recovery is due to the loosening monetary policy which have facilitated the recovery of the economic context and the labour market.

4.1.2 Statistics on loans to NFCs in Europe

The loans to NFCs represent a part of the total credit aggregate slightly lower than the credit to households. For instance, considering EU28 aggregate, this kind of credit contributes for the 37.7 percent to the total credit aggregate. As done in the previous section, we start the discussion with the evolution of the total loans to NFCs which is graphically depicted in Fig. 4.4:

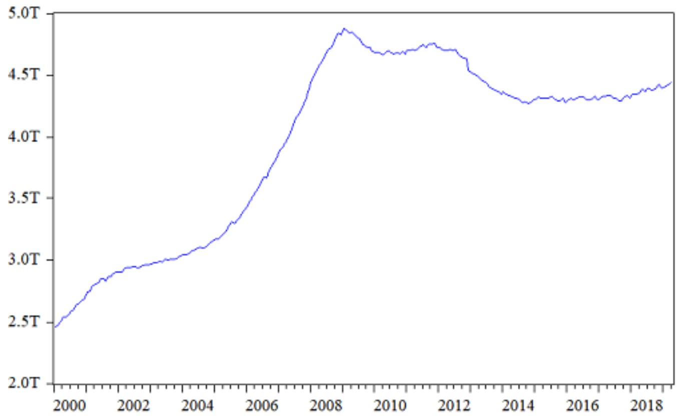

Figure 4.4: Total loans to euro area NFCs from MFIs (*source: Euro area statistics*)

From this graph it is possible to notice two main trends. The first refers to the period 2000-2009 where the amount of loans provided to NFCs consistently grew until its peak of January 2009 (4.88 trillion euros). The second period corresponds to those years affected by financial crisis which strongly influenced the whole economic system leading to a decrease in the credit outstanding to NFCs. This negative trend stopped only in 2017 when for the first time after several years the growth rate turned back to be positive. In spite of this trend inversion, the recovery is still quite slow. More specifically, we have the following growth rates: 0.8 percent for EU28, 0.9 percent for EU15, and 1.4 percent for EA19. In contrast, instead, the NMS countries present an opposite trend with a negative growth rate of 0.8 percent after a 2016 of stagnation. However, if analyzed at a country level, we can have a thorough understanding of how the recovery concerning loans to NFCs is still struggling. In fact, only twelve EU members show positive growth rates whereas the others still register below zero values. In this respect, looking at EU28 aggregate, the best performer is Germany with a +2.1 percent whereas Italy is at the bottom of the ranking with a -1.1 percent.

4.2 Data and Methodology

In this section we will disclose data and methodology used in our analysis. Here we will explain why we made certain choices rather than another and what are their implications for our models. In general, we opted for partially melting other empirical works in function of our purposes. For instance, our VAR models have been inspired by R. De Santis and M. Darracq-Paries (2015) and G. Di Giorgio and G. Traficante (2014), whereas the variable blocks are similar to M. Guth (2018). Even the choice of Bank Lending Survey (BLS) as main data source is quite common in this research field (i.e. C. Altavilla et al., 2018). For what concerns the choice of which countries analyzing, we decided to consider Italy and Spain since their credit markets faced many troubles after being impaired not only by the 2008 financial crisis but also by sovereign debt crisis. In other words, we want to test if in these countries BLC has assumed a relevant role in the monetary policy transmission regardless of these difficulties. Then we also include in our analysis Germany and Austria which are among those European countries showing the best or above average credit market results in the past years.

4.2.1 Loans Aggregate and Bank Lending Survey (BLS) block

As in many other empirical works in this literature, our main data source is the so called Bank lending survey (BLS). This is a survey run by ECB in order to gather additional information on credit market dynamics and trends which will be used as input by ECB Governing Council to better design the monetary policy path. The sample group consists of 150 banks euro area with data reported quarterly from 2003 to nowadays. However, thanks to a cubic spline interpolation procedure performed in the Matlab, we were able to transform these data from a quarterly to a monthly basis making in this way possible to have all monthly data. Following M. Guth (2018), we used this kind of interpolation rather than others (i.e. Chow-Lin), since *"the development of the index on the adjusted loans to euro area non-financial corporations does not correlate with the BLS data on loan supply"*. As a result, our dataset is based on 113 monthly observations from September 2004 to January 2014. In this way our dataset includes three main periods: pre-crisis, financial crisis and debt crisis.

This permits to address our purpose because we consider in this way those years characterized by both conventional and unconventional policies in order to look for possible difference in terms of BLC between these two kinds of measures.

BLS is based on 22 merely qualitative questions which can be split in backward (18) and forward looking (4). The answers are instead five-point intensity scale. In addition, these questions concern all the different types of credit described above apart from consumer credit. In our model, among these we will use only the first and the sixth since they will permit us to disentangle the relative effects on credit to NFCs demand and supply. In the literature several papers (i.e. P. Del Giovane et al., 2011) demonstrate the reliability of credit standards questions as proxy for the credit availability in the euro area (M. Guth, 2018). In particular, for what concerns credit supply, question n.1 is structured as follows: *"Over the past three months, how have your bank's credit standards as applied to the approval of loans or credit lines to enterprises changed?"*. On the other hand, with respect to credit demand question n.6 asks: *"Over the past three months, how has the demand for loans or credit lines to enterprises changed at your bank?"*. In this respect, Fig. 4.5 represents the time series of both loan to NFCs demand and supply results (computed as net percentage) stemming from the BLS data in the countries subject of study.

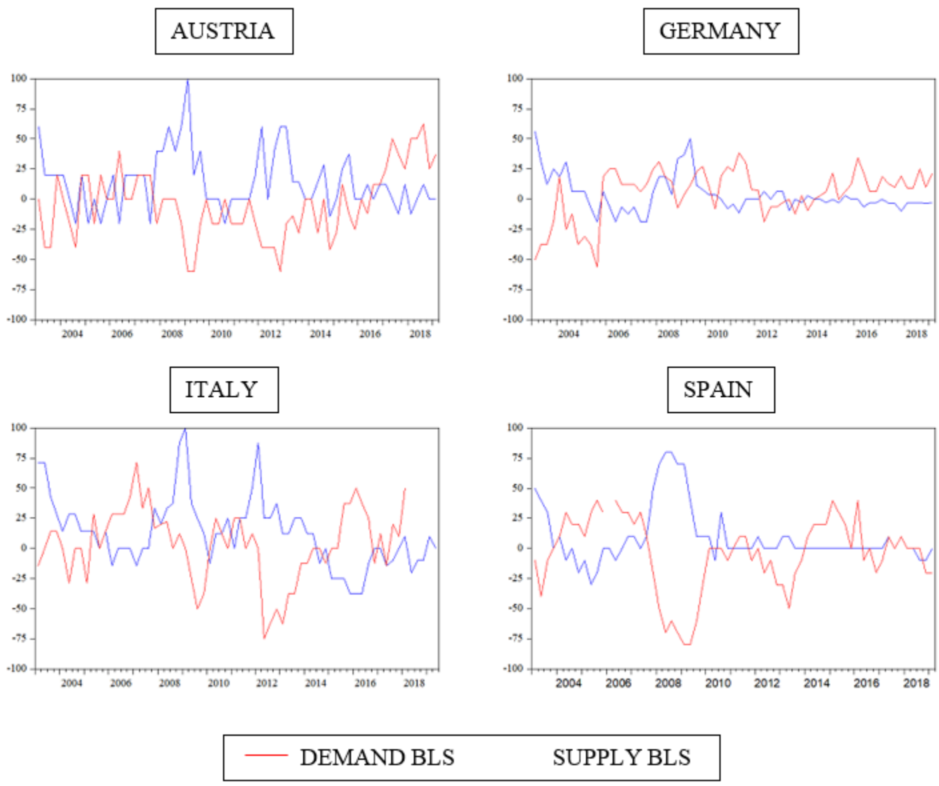

Figure 4.5: Time series of BLS variables over the period 2003-2019 *(source: ECB Data warehouse)*

Even though the responses are five-point scaled, these can be approximated by two measures such as the diffusion index and the net percentage, which differ to each other in how they are computed. Diffusion index is a weighted average of values from $-1, -0.5, 0, +0.5, +1$ which are matched to the answers of the respondents and weighted to reflect their observed frequency. It results an index variation range of $[-1, +1]$. Considering the net percentage, this is instead computed as the difference between the sum of the percentages for answers with a given sign and the sum of the percentages for those answers presenting the opposite sign. As a consequence, the variation range is in this case $[-100, +100]$. For instance, taking into account credit standards, this measure stems from the difference between the sum of "tightened considerably" and "tightened somewhat" and the sum "eased considerably" and "eased somewhat" (in a percentage basis). Following M. Guth (2018) and G. Di Giorgio and G. Traficante (2014), we opted for this latter as measure to be embedded in our models. In addition, before considering these BLS data in our models, we also introduce a variable to account for the total loans aggregate provided by all banks of a given nationality towards all Euro area counterparties. Since the unavailability of finding loan data specific to Non-Financial Corporation (NFC)s we use an aggregate variable which consider all the different kinds of credit per borrower.

4.2.2 Macroeconomic and monetary policy variables

In line with G. Di Giorgio and G. Traficante (2014), we use two macroeconomic variables (in a logarithmic scale) in the VAR model development, one as price evolution indicator and another for representing the total output aggregate. In this way we are able to control the general economic development for each country analyzed. For what concerns the output aggregate and its growth, we will plug the real GDP in our model to account for it. As done previously for BLS variables, in order to deal with the quarterly time frame of GDP observations, we perform a Chow-Lin interpolation to transform data on a monthly basis. Moreover, concerning price variables, we have opted for Harmonised Index of Consumer Prices (HICP) that excludes energy and unprocessed food. Therefore, in so doing we can avoid possible bias due to the the fluctuations of commodity prices. In our VARs we will also use two variables to account for monetary policy effects. The first refers to Euro OverNight Index Average (EONIA) rate which is computed as a weighted average of all overnight unsecured lending transaction undertaken in the interbank market. Nevertheless, this rate is not suitable to be used as a sort of proxy for unconventional monetary policy. In fact, as explained by B. Rossi (2018), there are several different methods being used in the recent VAR literature to account for the unconventional tools of central banks among which we do not find EONIA rate. Among these different alternatives, we opted for the so called shadow rate developed by J.C. Wu and F.D. Xia (2013). This is equal to the policy rate whenever the zero lower bound is not binding yet or negative to consider the effects stemming from the implementation of unconventional policies (J.C. Wu and J. Zhang, 2016). In other words, considering for instance a new unconventional policy more expansionary than a zero short-term policy rate, in this case the shadow rate will present a negative sign in order to reflect the impact of such a policy on longer-term rates (B. Rossi, 2018). In this work, we use a monthly dataset of shadow rate values computed accordingly to the Wu and Xia's methodology published on UC San Diego Economics website.

4.2.3 Vector Autoregression (VAR) Model

VAR model is usually widely used (in different variants) for analysis as such brought fourth in this work. This can be described as an extension of AutoRegressive Moving Average (ARMA) models into a multivariate framework (U. Triacca). A generic p-lags VAR model can be represented in a regression form as follows:

$$Y_t = a + A_1 Y_{t-1} + A_2 Y_{t-2} + ... + A_p Y_{t-p} + \epsilon_t$$

where $Y_t = (y_{1t}, y_{2t}, ..., y_{nt})'$ is a n-dimensional vector of time series variables, a is a n-dimensional vector of intercepts, A_i with $i = 1, 2, ..., p$ is an nxn coefficient matrix, where p denotes the lags, and ϵ_t is a n-dimensional vector of unobservable i.i.d. zero mean error term or, in other words, white noise errors. Once structured the model, we also need to perform certain tests in order to assess the hypotheses in support of the model. First of all, we need to control if there is stationarity or not. A VAR(p) process is stationary if and only if all the np roots of the characteristic polynomial lie in absolute value the unit circle. Secondly, it is important to test whether the first lag length chosen initially is effectively optimal for our model. To do so, Eviews provides several different tests. Among these, in our work we resort more on Akaike's Information Criterion (AIC), Schwarz-Bayesian Information Criterion (SBIC), and Hannan-Quinn Criterion (HQ). In general, we opt for the smallest lag length arising from these three statistics (see tables in Appendix A). However this is not enough since we have also to perform residuals diagnostic checks in order to test if a stationary VAR(p) process is correctly specified (i.e. error terms are effectively white noises). More precisely, according to VAR model characteristics, ϵ_t must present a variance-covariance matrix $\sum_t$ as follows (M. Guth, 2018):

$$\sum_t = H^{-1} S (H^{-1})'$$

with H^-1 lower triangular matrix with unit diagonal and S diagonal matrix of variances. Again, Eviews helps us with a range of different instruments to verify this. For instance, we can graphically look at the residuals pattern and, additionally, check if the the off diagonal elements of the correlation covariance matrix of residuals are equal 0. Moreover, always in this respect, we will also use other test tools such as correlogram specification and the Lagrange multiplier (LM) test. Regardless of all these controls, in our models we will expect to find serial correlation in some lags since we do not impose any kind of restrictions on parameters implied by theory. In other words, we use simple unrestricted VAR instead of a so called Structural VAR (SVAR). From a pure macroeconomic perspective, this means that our models do not consider all the explanatory variables making in this way the residuals correlate to the variables embedded in VAR models. This would be an issue in the case of structured analyses on the estimated parameters since serial correlation directly affects the residuals and in turn all the statistics tests' meaning. By the way, here we do not focus on statistics coefficients but rather on impulse responses and variance decomposition in order to capture the main trends and effects stemming from a possible linkage between monetary policies and the credit market. Finally, before to run impulse response functions and variance decomposition we need to imply orthogonalized residuals. To do so, we resort to the so called Cholesky decomposition as usually done in the literature. This process permits us to make errors uncorrelated across equations. All in all, such a model gives us the possibility to simulate an impulse response on a given number of variables in order to understand the effects following a monetary policy shock (G. Di Giorgio and G. Traficante, 2014). For example, by looking at impulse responses, we can try to answer question like "what will happen to GDP after k periods if today central bank decides to launch a new tightening monetary policy?". Finally, even though we will simulate a tightening monetary policy, since impulse responses are symmetric we can read these outcomes also from an opposite point of view without making any conceptual mistake.

4.3 Econometric Analysis

In this section we will describe our empirical analysis which is based on 5 different VARs:

$$\begin{aligned}
\textbf{Model 1}: Y_t &= (P_t, Y_t, L_t^T, r_t) \\
\textbf{Model 2}: Y_t &= (P_t, Y_t, L_t^T, s_t) \\
\textbf{Model 3}: Y_t &= (Y_t, L_t, L_t^S, r_t) \\
\textbf{Model 4}: Y_t &= (Y_t, L_t, L_t^S, s_t) \\
\textbf{Model 5}: Y_t &= (L_t, L_t^S, L_t^D, s_t)
\end{aligned}$$

where P is the HICP at the net of energy and unprocessed food, Y the real GDP, L^T the total amount of loans outstanding of a national banking system, L^S and L^D the BLS proxy measures respectively for credit supply and demand, r the EONIA rate and s the shadow rate. As anticipated above, here only outputs, prices and loans are in log basis whereas all other variables have not been transformed. This structure permits us to proceed step by step. In the first VAR model we investigate the effects on loans and the general economic environment of a positive shock on the EONIA rate. Then, in Var number 2, we check if the results of the previous model are consistent or different with respect to a shock on the shadow rate. Model 3 and 4 are designed in order to look at the effects of interest rates shocks also in terms of loans supply and not only from an aggregate perspective. In all these models we simulate a tightening monetary policy shock identified by an increase in the policy rates (EONIA and shadow). However, since impulse response function analysis is symmetric, we can also interpret our results from an upside-down perspective in order to consider the impact of a loosening monetary policy implementation. Finally, in the fifth VAR we plug an additional variable to account for the credit demand responses following a shock in the shadow rate. More specifically, the aim of this latter model is to try to disentangle the relative effects of monetary shocks respectively on credit supply and demand. To do so we rely in this case on variance decomposition. This technique enables us to understand the proportion of the variability in a given dependent variable explained by each independent variables over time.

4.3.1 Model 1 : $Y_t = (P_t, Y_t, L_t^T, r_t)$

As anticipated above, the aim of this first VAR is to provide a general overview on the effects of a EONIA rate shock, as a proxy of a monetary policy shock. Indeed, here we consider macroeconomic variables such as outputs, prices and loans in aggregate terms. All the single country VARs performed for this model are 2-lags order accordingly to the SBIC and HQ results[4]. These VARs are all stationary, however Germany and Italy present serial correlation according to LM test. The Cholesky ordering here refers to prices, GDP, loans and ultimately EONIA rate. Starting from considering the positive EONIA shock's effects on prices, we can notice two opposite trends amongst countries. Indeed, from one hand Austria and Germany shows a decrease in the HICP index as a result of a positive monetary policy shock respectively equal to -0.176 percent and -0.065 percent after one year. This is in line with the main macroeconomic literature since an increase in short-term interest rate leads to a subsequent rise in the unemployment rate and to an overall decrease in prices over time. Even if Austria and Germany are affected by the same trend, they still differ in the magnitude. In fact, as the reader can notice from Fig. 4.6 and 4.7., Austria experiences a deep and constant decrease until period 10 (-0.176 percent) where the HICP stabilizes before a slight recovery (-0.157 percent at period 20). HICP in Germany instead sharply decreases in the very first periods (-0.056 percent after two months) and then rebounds before showing a steady negative trend. Nevertheless, these results are statistically significant in Austria only for the periods after the fourth month whereas for Germany this is almost completely lacking of significance. On the other hand, the impulse responses relative to Italy and Spain are more puzzling. In contrast to what said for Germany and Austria, the two Mediterranean countries are characterized by growing inflation in the first months followed by a slow decay as a consequence of a positive shock on EONIA rate. For instance, prices in Italy peak after three months (+0.2 percent) and then decay very fast. This opposite trend is significant for Spain only between months 5 and 9 where prices prior stabilize and then start to decrease while Italy's results are not significance at all. Despite this low significance, these results can be traced back to the so called price puzzle phenomenon introduced in the literature for the first time by C. Sims (1986). This refers to *"a rise in the aggregate price level in response to a contractionary innovation to monetary policy"* which usually occurs in VAR and SVAR models (M. Hanson, 2004). This concern has been treated many times in the literature with different possible solutions provided to fix this counterintuitive outcome. For instance, many papers suggest to introduce additional variables to mitigate this effect. According to P. Giordani (2004), the source of the problem is the omission of the output gap in the models which can lead to price puzzle despite the VAR triangular identification or the optimal forecasts stemming from the model itself. Nonetheless, in the literature the most common way to overcome this problem is to include the commodities prices in the inflation variable or to add a com-

[4]Only Italy shows a lag-5 order as first choice outlined in the tests. However, since the difference between a lag-5 and lag-2 order was very slight and to maintain all VAR(2), we decide to use a lag-2 order. Anyway this choice does not imply any change in the VAR's trends and impulse response curves.

modity price index as suggested also by C. Sims (1992)[5]. Looking at GDP, all countries show a homogeneous trend characterized by an overall hump shaped decrease very similar both in terms of amount (i.e. -0.23 percent for Germany at period 15 before to stabilize in the next periods) and timing except for Spain which shows a lower reduction (-0.11 percent at period 12). Here significance is a concern since only Germany shows significant results at least for the second half of the 20 months period considered. For what concerns the evolution of the aggregate levels of loans, all countries experience similar slightly negative trends which are mostly not significant. In particular, following a positive EONIA shock, we register an initial increase in the total loans for Germany and especially for Austria (+0.05 percent after six periods). Such an outcome has also been found out by G. Di Giorgio and G. Traficante, (2014). As they explain, this initial increase could stem from a positive economic phase which has required an increase in the interest rate as a sort of central bank response. Finally, from the third month onwards, EONIA decreases over time probably to cope with the economic downturns.

[5]In order to verify that this is effectively a VAR price puzzle phenomenon, we have also tried to replace the HICP index at the net of energy and unprocessed food for the overall HICP. Following a tightening monetary policy, results evidence how in this case prices effectively decrease in Italy whereas in Spain the puzzle still persists but in a reduced form.

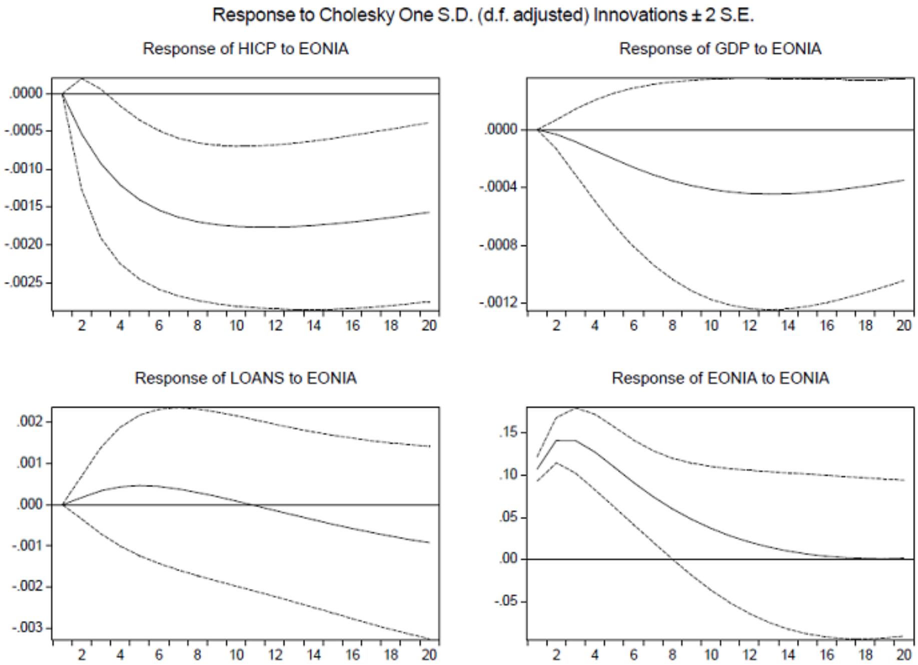

Figure 4.6: Impulse responses for Austria VAR(2) with prices, output, loans and EONIA rate

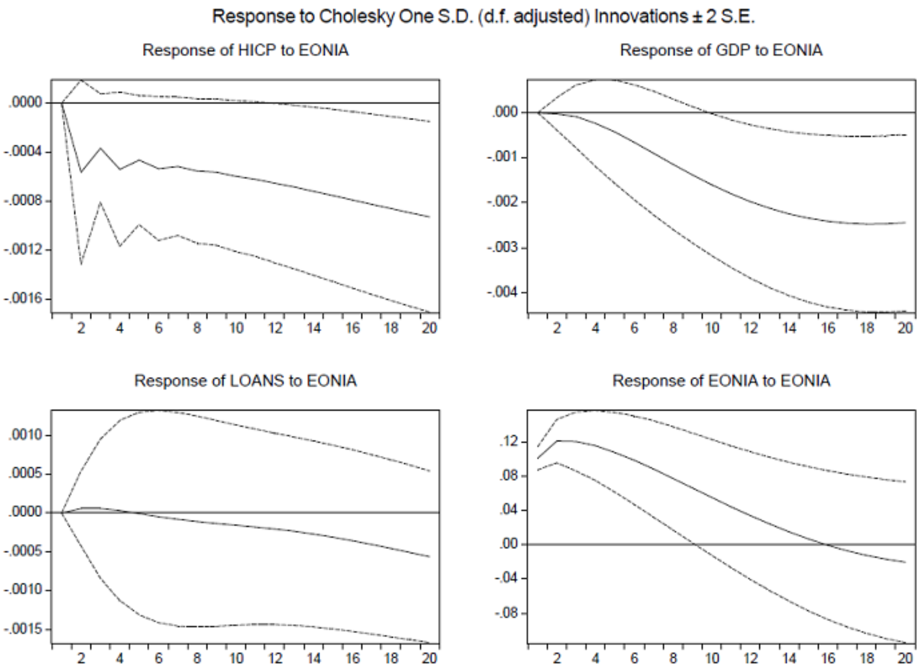

Figure 4.7: Impulse responses for Germany VAR(2) with prices, output, loans and EONIA rate

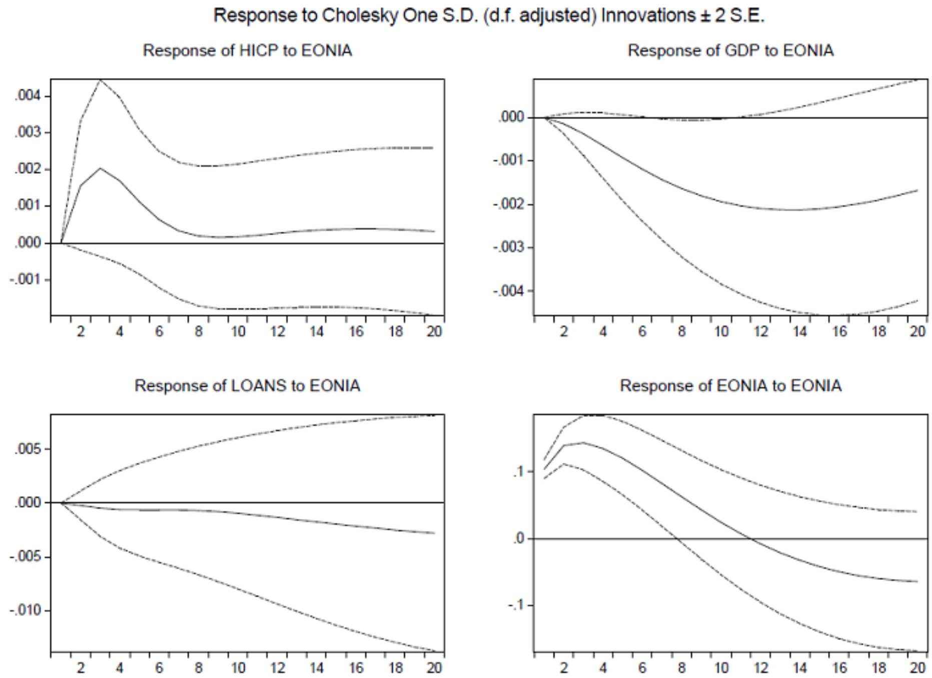

Figure 4.8: Impulse responses for Italy VAR(2) with prices, output, loans and EONIA rate

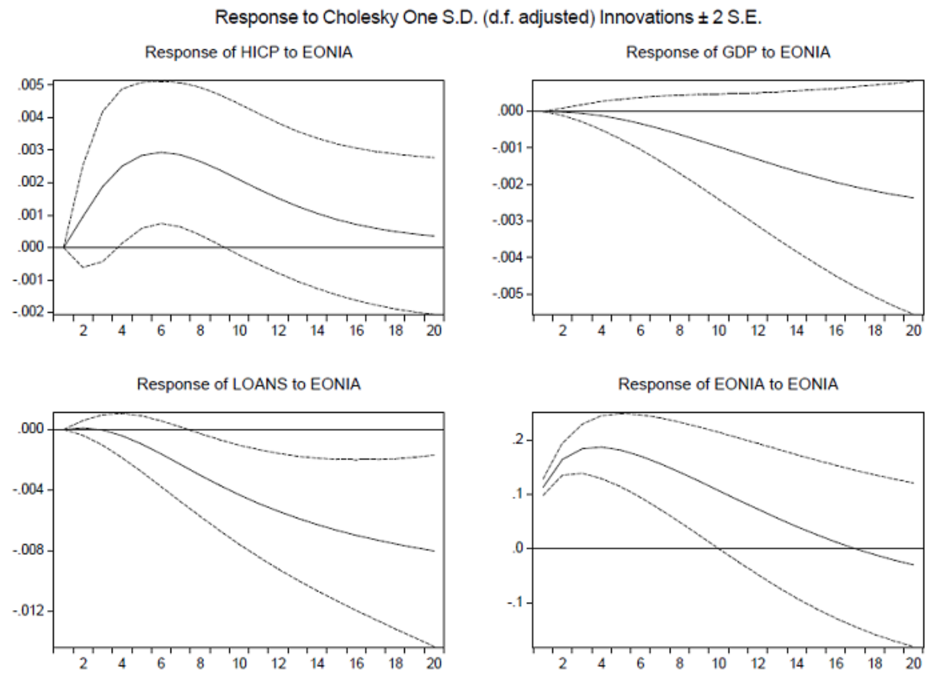

Figure 4.9: Impulse responses for Spain VAR(2) with prices, output, loans and EONIA rate

4.3.2 Model 2 : $Y_t = (P_t, Y_t, L_t^T, s_t)$

Once presented the main results of Model 1, here we want to look for any difference emerging from the same VAR model with a positive shock on the shadow rate instead of the EONIA rate. In this way, we account for the impact that also tightening unconventional monetary policies can have on the economic environment and loans. As done in the previous model, here all VAR models are 2-lags ordered and stationary. The Cholesky ordering is the same of Model 1, with the policy rate (shadow rate in this case) as last variable. Yet, Germany and Italy (for the first lag) show serial correlation. From the impulse responses below, it turns out how most results emphasized in Model 1 are still valid. However, some emerging differences must be better analyzed. Starting from Austria (Fig. 4.10), we can notice how the response of GDP to a shadow rate shock is less strong than what observed with the EONIA rate in the previous model (Fig. 4.6) (-0.017 instead of -0.044 percent after twelve months). Nonetheless, the most relevant difference here refers to the loans' response. As we can see from Fig. 4.10, in contrast to what registered in the previous model, the aggregate loans do not experience any increase in the first months. In fact, after three months we register a decrease of -0.03 percent. Such a result is consistent to the explanation relative to Model 1 provided above. In fact, as we have also mentioned along this work, unconventional monetary policies are usually a sort of residual tool in the central bank's hands to cope with distressed markets and economic context. Consistently, the hypothesis concerning an initial positive economic phase which has required a tightening policy is not plausible anymore. As a consequence, it turns out how the overall negative trend followed by loans after a positive shock on shadow rate is a quite logical outcome. Note how all results are not significantly different from zero except for prices. Even though the results for Germany (Fig. 4.11) are aligned to the previous VAR (Fig. 4.7) except for loans which seem to be impacted in a lower extent from the policy innovation (probably the credit market is influenced by other aspects different from the policy rate at least in the short run), the same cannot be said for Italy (Fig. 4.12). If we look at the upper left hand side corner, we can see how HICP behaves completely different with respect to Model 1. Indeed, we register a negative trend for the first 10 months where price level comes back to its starting value at month 10 after having touched a minimum point of -0.02 percent at the second month, before starting to show positive increments during the second half of the period. The overall trend is in fact quite flat and steady for the whole period contrarily to what seen above. It means that in this case the price puzzle experienced in the previous VAR is reduced even though it still persists for a certain extent. All other variables show the same trend while differing slightly in terms of magnitude. For instance, GDP has a very brief small increase before starting to decrease a little bit less than in the case of the EONIA shock (-0.16 instead of -0.21 percent after twelve months). Moreover, the negative response of loans appear to be more marked here (-0.024 against the -0.013 percent in Model 1 at the period 12). Also the Spain's Model 2 (Fig. 4.13) results to mimic what found in the previous VAR model (Fig. 4.9). Indeed, conversely to Italy, here price puzzle still persists (+0.38 percent at month 5). Not only that, this even shows a higher positive peak at the fifth month with respect to the of the sixth month in Model 1. These results are statistically significant between month 3 and 10. Moreover, the impact of a shadow rate shock is stronger than EONIA rate shock in terms of GDP since we can notice a relative higher magnitude in the negative trends followed by outputs in Fig. 4.13 (-0.31 percent at month 20) if compared to Fig. 4.9. (-0.24 percent at month 20). Despite this, in terms of loans the different magnitude is almost nil (difference of 0.02 percent on average between the two models). To sum up, in general we have that amongst the analyzed countries the main trends registered in Model 1 with EONIA rate are, as could have been expected, replicated also in Model 2 with shadow rate with some peculiar exceptions described above.

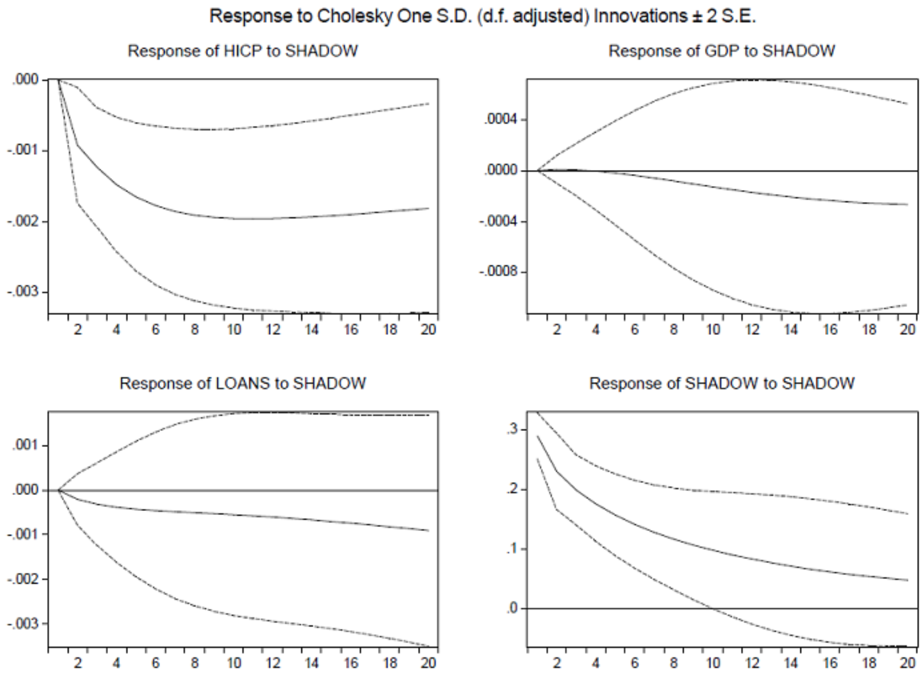

Figure 4.10: Impulse responses for Austria VAR(2) with prices, output, loans and shadow rate

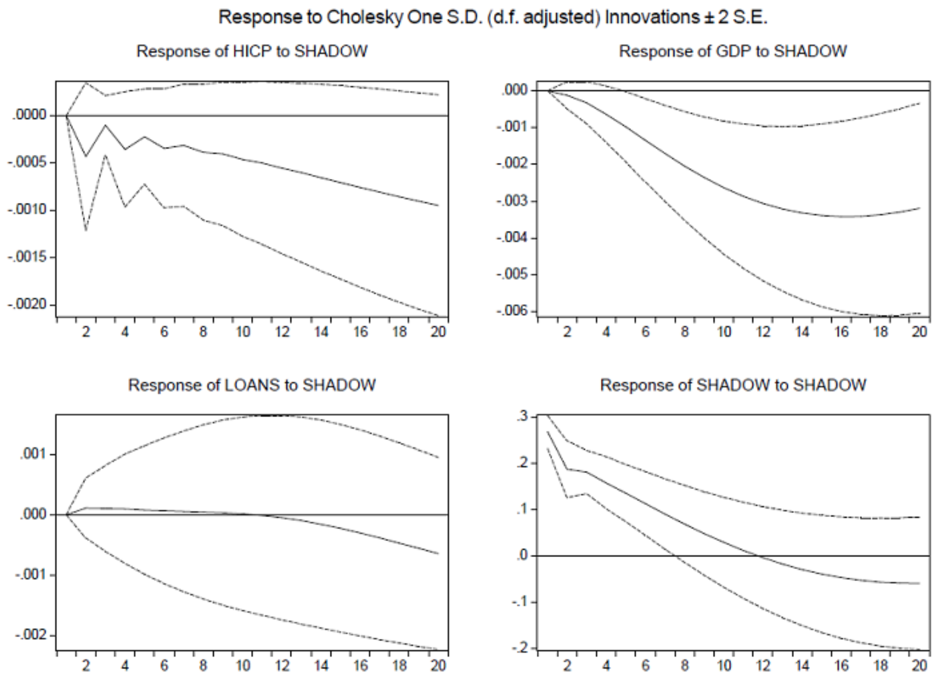

Figure 4.11: Impulse responses for Germany VAR(2) with prices, output, loans and shadow rate

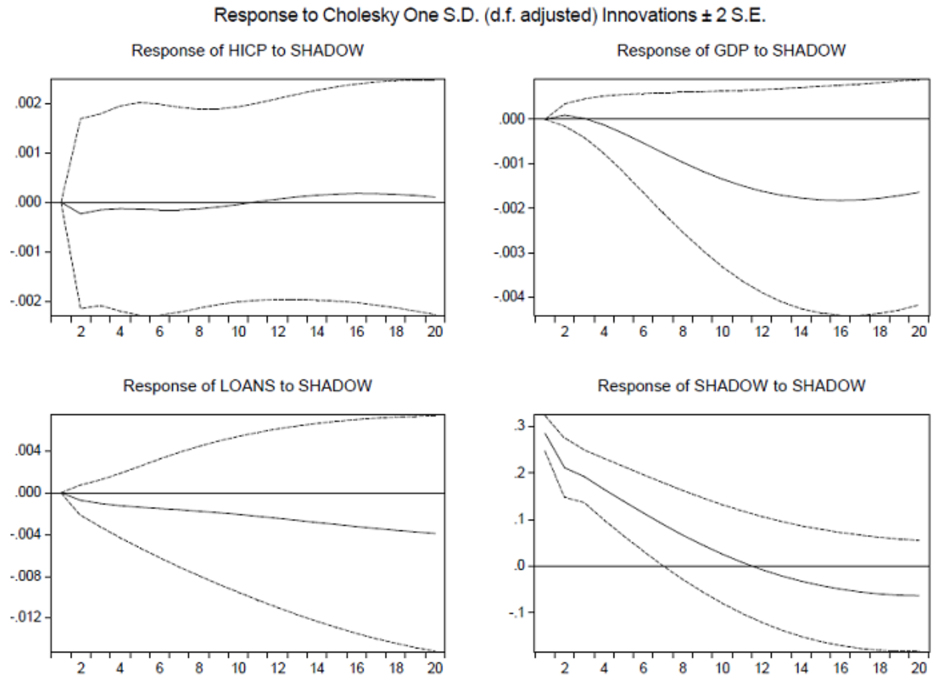

Figure 4.12: Impulse responses for Italy VAR(2) with prices, outputs, loans and shadow rate

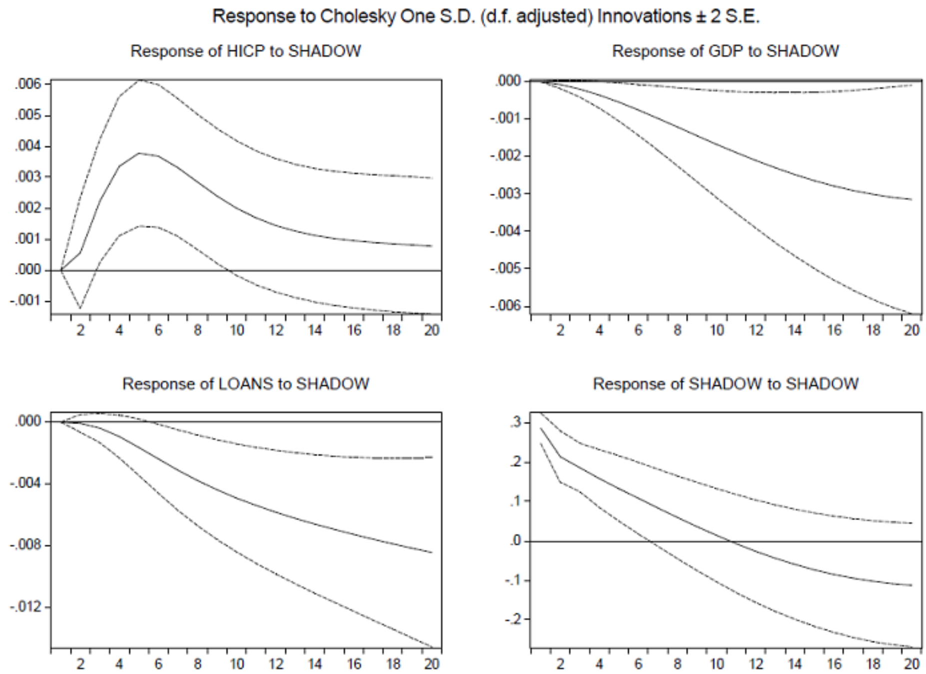

Figure 4.13: Impulse responses for Spain VAR(2) with prices, outputs, loans and shadow rate

4.3.3 Model 3 : $Y_t = (Y_t, L_t, L_t^S, r_t)$

In spite of the results disclosed by the first two VARs here considered, it remains still difficult to effectively understand if BLC has effectively played a significant role in the monetary policy transmission process. In fact, so far we have just considered loans in aggregate terms without focusing on the real impact of the supply. Here we recall previous models with the addition of a proxy variable for credit supply derived from BLS as described in Par. 4.2.1. In this stage, we start by taking into account just the activation of BLC under standard conventional monetary policy always using the EONIA rate as shocked variable. Accordingly to SBIC the lag-lengths of the VARs here presented are respectively 4 for Austria and Italy and 5 for Germany and Spain. All VARs are affected by serial correlation. In particular Austria and Spain present serial correlation only at lag 3 while Italy and Germany are strongly affected by it. The Cholesky ordering in this case refers to GDP, loans, BLS supply indicator and finally the EONIA rate. As said above, in order to create impulse responses all these models satisfy the stationarity condition. Below we report the impulse responses derived (from Fig. 4.14 to Fig. 4.17). As expected, GDP of all countries experience an overall decay over time following a policy rate increase showing again a hump shaped curve. For instance, Austria shows a minimum at period 16 equal to -0.086 percent before starting to slowly recover. These results are statistically significant for many periods just for Germany (Fig. 4.15) and Italy (Fig. 4.16). However, what is interesting here, are the panels depicting the impulse responses for loans and credit standards. In this respect, we have that Germany (Fig. 4.15) is the only country which departs from the other. More specifically, Germany's loans aggregate shows a first increase with a maximum at the fourth month (+0.06 percent) even more marked respect what emerged in Model 1. Nonetheless, in the medium long run also Germany mimics the trend of the other countries with a peak for credit standards at period 10 which is statistically significant. All other countries present a constant decrease over time in terms of loans aggregate (i.e. -0.16 percent for Austria), with Spain (Fig. 4.17) reporting the lowest point at period 20 (-0.86 percent). Turning to credit standards for NFCs, it emerges a general increase at least for the first six months followed by a fast decaying for all countries except for Germany. Intuitively, a positive shock on EONIA rate, by leading to more rigid credit standards required by banks and reduced investment levels, can effectively have a negative impact on the total loans granted and required. However, since this is a crucial point, we need to observe these outcomes more carefully. In particular, it turns out how all the positive peaks reported are statistically significant. Once reached their maximum points, all responses start to quickly decrease, especially for Italy (Fig. 4.16). In Italy only credit requirements show a statistically significant increase (at least for few months) conversely to the loans aggregate suggesting that probably other aspects influence the total credit outstanding even more than the supply side. As anticipated, Germany shows a quite different path. Indeed, from Fig. 4.15, we can see how credit standards becomes looser in the first months in parallel to a loans rise (+0.05 percent after five months). We register then a fast increase in the credit standards rigidity until the peak at month 10 (statistically significant) before a new fast decay. In our opinion, this different trend depends on a credit supply initially influenced by other aspects rather than the policy rate. However, even if delayed, after several months the EONIA rate innovation seems to impact on the loan offering. Despite this case, overall all countries here analyzed seem to show a BLC functioning quite similar to each other since a rise in the policy rate leads to a stiffening in credit requirements by banks which hits the credit supply.

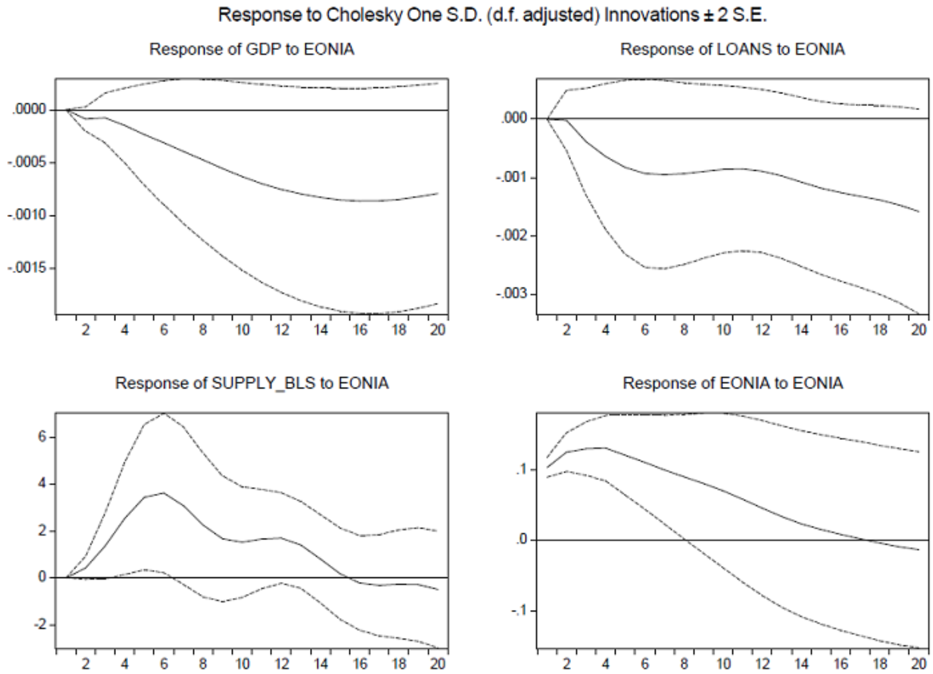

Figure 4.14: Impulse responses for Austria VAR(4) with prices, loans, credit supply and EONIA rate

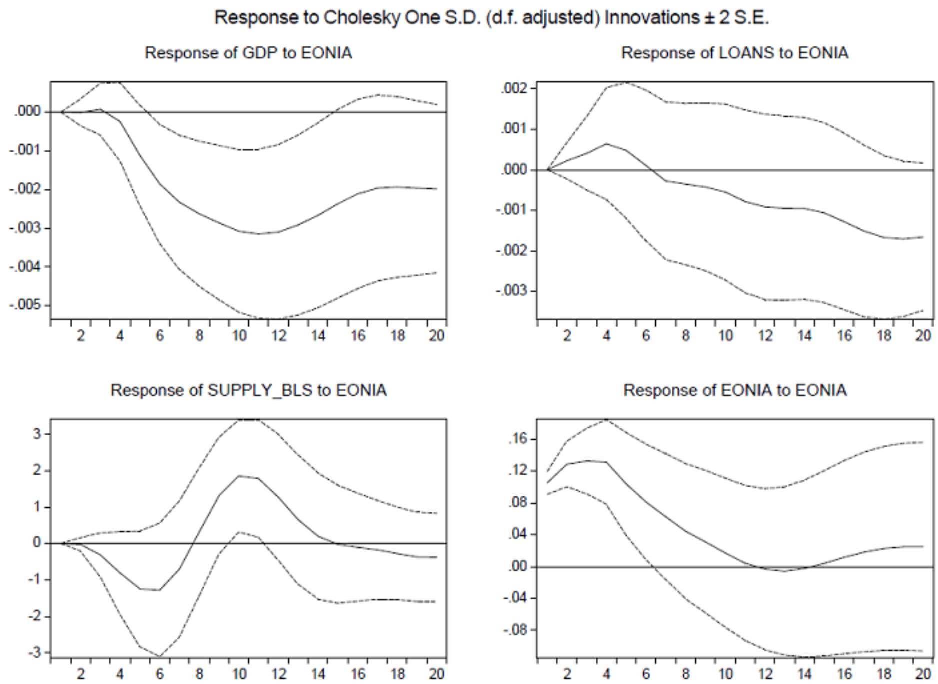

Figure 4.15: Impulse responses for Germany VAR(5) with prices, loans, credit supply and EONIA rate

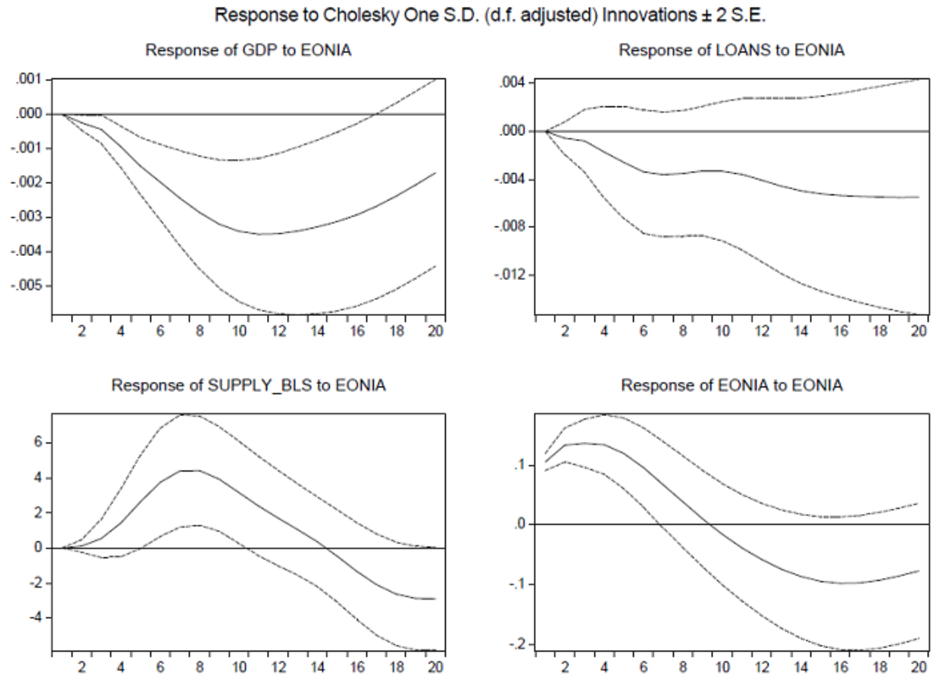

Figure 4.16: Impulse responses for Italy VAR(4) with prices, loans, credit supply and EONIA rate

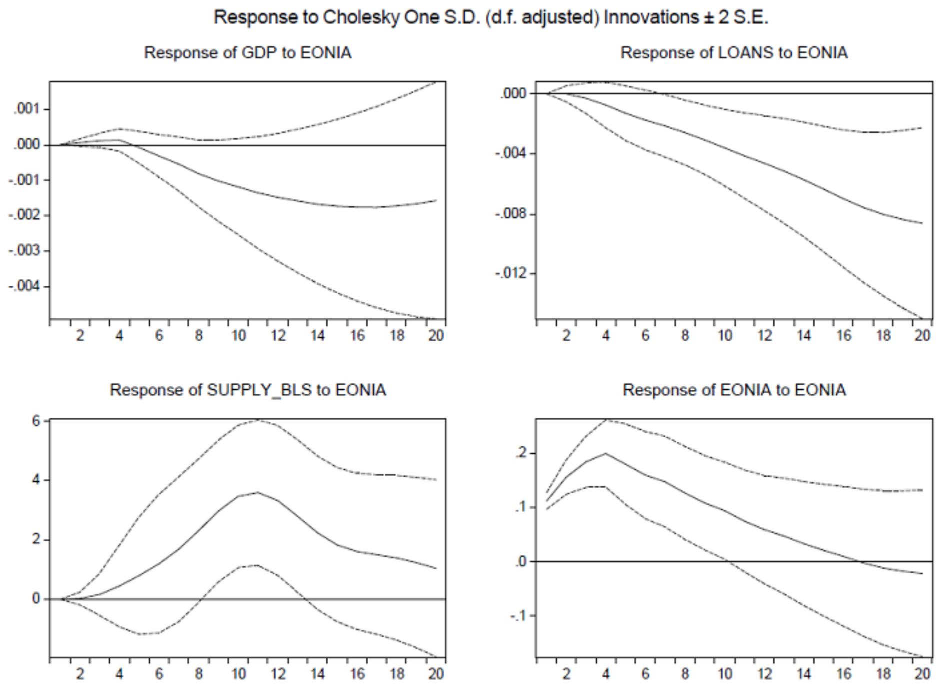

Figure 4.17: Impulse responses for Spain VAR(5) with prices, loans, credit supply and EONIA rate

4.3.4 Model 4: $Y_t = (Y_t, L_t, L_t^S, s_t)$

Once demonstrated the presence of BLC for conventional policies, we finally reach the core of this empirical work, namely looking for the presence of a linkage between this channel and unconventional monetary policy. In order to do so, we replicate the VAR used for Model 3 substituting EONIA with shadow rate to account for such a kind of policy measures. In this case all VARs present 4 lags except for Germany with 5. Yet, these VARs show the same characteristics in terms of stationarity and correlation of Model 3 VARs. As it emerges from the impulse responses representations (from Fig. 4.18 to Fig. 4.21), a positive shock on shadow rate leads as expected to an overall decrease in outputs level for all countries. These results are statistically significant for Spain (Fig. 4.21) and in part for Italy (Fig. 4.20) and Germany (Fig. 4.19) but not for Austria (Fig. 4.18) at all. However, the most interesting outcomes here are those relative to the credit market. Starting from Austria, looking at Fig. 4.18, loans show a higher sensitiveness to shadow rather than EONIA rate. Before to stabilize, loans decrease in the first 5 periods (minimum of -0.14 percent) very fast with respect to what emerges from Model 3 (Fig. 4.14). However, credit requirements become less rigid if compared to the previous model suggesting that this negative trend is more driven by other factors as for instance credit demand trends. Instead, Italy presents trends for credit market almost equal either in Model 3 (Fig. 4.16) or in Model 4 (Fig. 4.20). In fact, loans aggregate shows a difference of -0.1 percent on average between Model 4 and 3, while credit requirements are almost equal. For what concerns Germany, total loans experience a path very similar both in Fig. 4.19 and 4.15. In fact, both figures show a peak equal to +0.06 percent at month 4 even though the decay is faster in the case of shadow rate shock. However, the same is not completely true for credit supply standards. Indeed, in the shadow rate case the first loosening of credit requirements is less sharp than in the previous case. At this stage a new positive trends starts before decaying again from the tenth month onward. However, this decrease is both less strong and slower than what registered in the model where EONIA was used as policy instrument where after 16 periods credit standards start to become looser again. Ultimately, Spain (Fig. 4.21) shows no different behaviour in terms of total aggregates at all. Nevertheless, the impact of the shadow rate shock on credit requirements seems to be different. In fact, as illustrated in Fig. 4.21, in the long run credit standards start to be less rigid after a tightening policy than in Model 3. Moreover, conversely to the previous model, here credit standards outcomes are not statistically different from zero. This suggests that BLC is more important in the transmission of conventional rather than unconventional monetary policies in Spain. As a result, for example we may expect a loans aggregate more dependent on the demand rather than supply side with non standard policy measures. All in all, from the impulse response functions presented so far it turns out how the BLC seems to be present in all countries analyzed regardless of the type of monetary policy. Both models 3 and 4 show the impact of a monetary shock on the credit standard requirements and in the total loans amount which is consistent to the presence of this channel. To sum up, thus, some differences emerge in a cross-country analysis. Austria presents a unique "two-waves-trend" in credit standards which does not loose neither in the short or in the long run. Germany experiences a brief short run standard loosening probably driven by other variables different from the policy rate. Then Italy and Spain show a similar main trend but with some peculiarities. Indeed, Italy has a greater standard stiffening in the first 10 months and a faster decaying trend in the long run with respect to Spain which instead is affected by less fluctuations. Despite these differences in magnitude what is worthy to be emphasized here is that only Spain shows a decrease in total credit outstanding significantly different from 0 both in Model 3 and 4. However credit requirements are statistically significant only in Model 3. As a result, Spain is the only country showing a quite different behaviour of BLC in function of the type of policy innovation. Recalling the findings of U. Albertazzi et al. (2016), this can be due to the poor bank capitalization which may reduce the effectiveness of BLC for unconventional monetary policies transmission. As he explained, since unconventional policies are brought forth in "hard times", the banks' capitalization level influence in terms of monetary policy stimulus may be overturned. In other words, banks presenting lower capitalization levels usually feel more regulatory constraints and, in turn, they could be less effective in the monetary transmission process due to the limited lending ability. In fact, Spain experienced a steady decrease in the aggregate bank capital to total assets ratio during the period of our analysis (i.e. switching from 6.7 in 2004 to 5.7 in 2012[6]).

[6]Data from FRED St. Louis FED database.

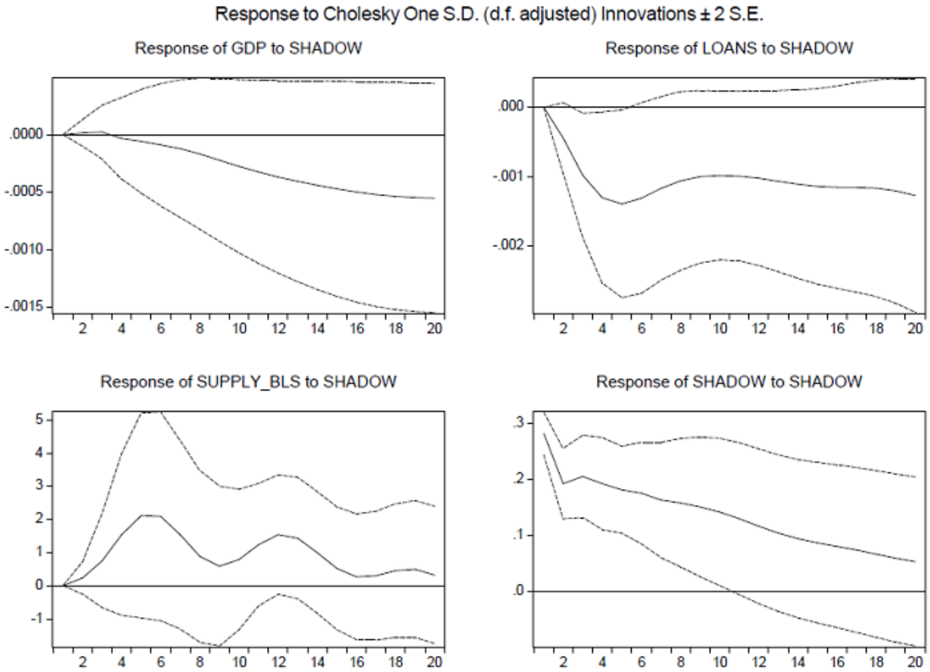

Figure 4.18: Impulse responses for Austria VAR(4) with prices, loans, credit supply and shadow rate

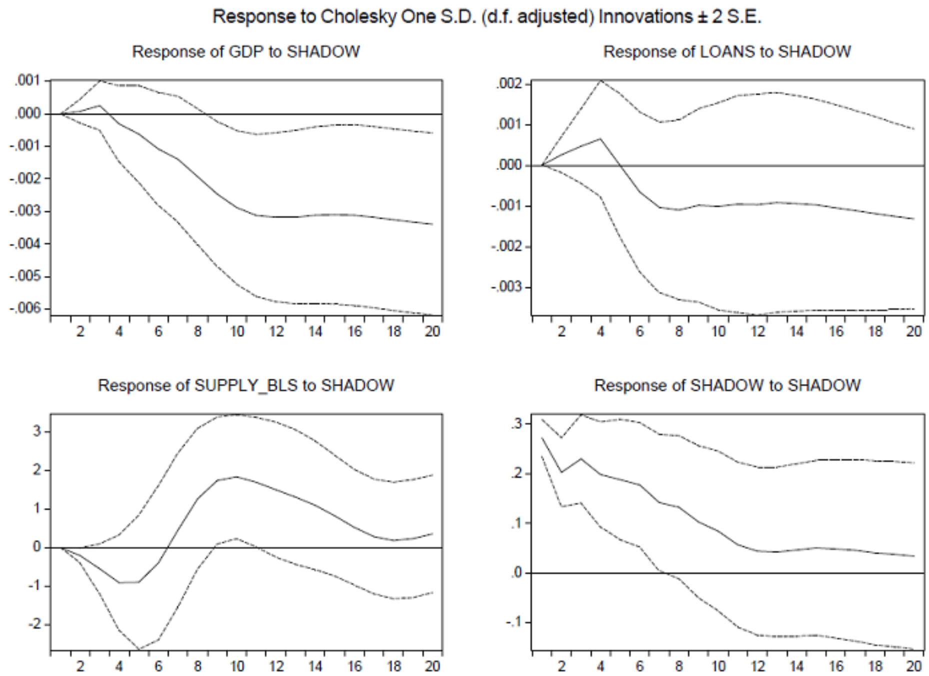

Figure 4.19: Impulse responses for Germany VAR(5) with prices, loans, credit supply and shadow rate

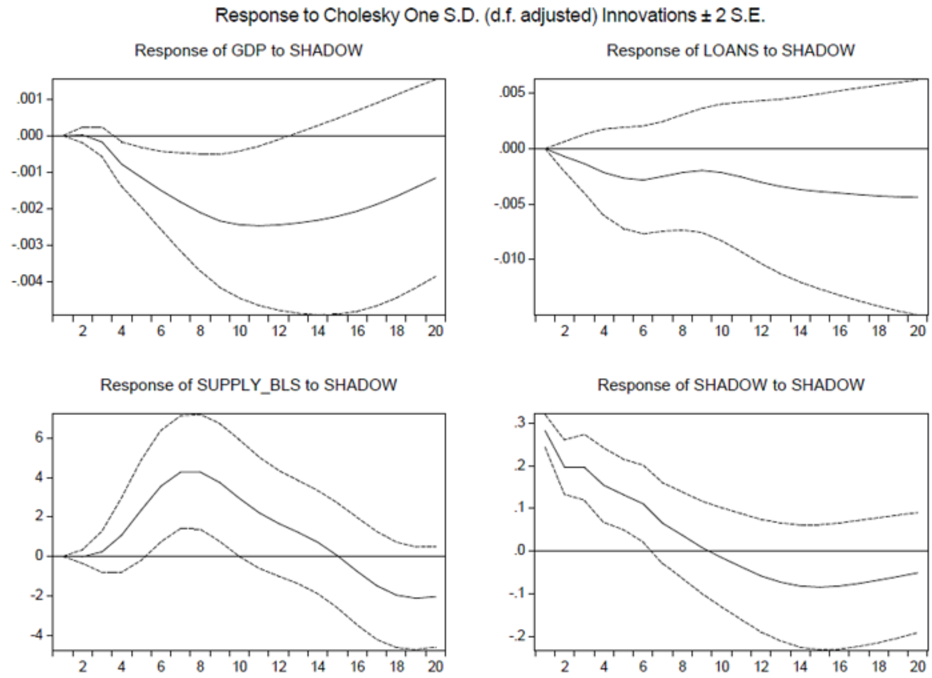

Figure 4.20: Impulse responses for Italy VAR(4) with prices, loans, credit supply and shadow rate

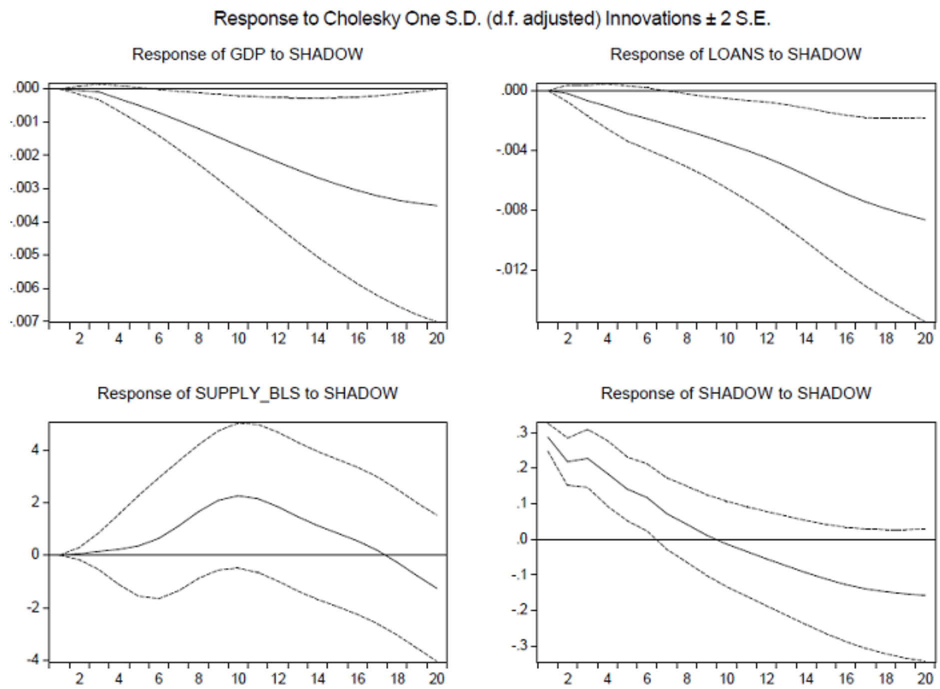

Figure 4.21: Impulse responses for Spain VAR(5) with prices, loans, credit supply and shadow rate

4.3.5 Model 5: $Y_t = (L_t, L_t^S, L_t^D, s_t)$

One of the main problem faced in the literature concerning BLC refers to the difficulty to identify the effective contribute to the total loans aggregate given respectively by credit supply and demand. To overcome this issue we are going to perform a variance decomposition analysis on a VAR considering not only total loans and bank credit standards, but also a proxy variable accounting for credit demand. Variance decomposition is widely used in economics studies since it permits to understand how much of a variation of a given dependent variable is explained by each of the independent variables. In our case we resort to this process in order to assess if the variation on loans aggregate depends more on supply or demand side. All country VARs here presented are stationary, lag-ordered according to the usual criteria, and with a Cholesky ordering as L_t, L_t^S, L_t^D, and s_t. Once performed the decomposition, we obtain the outcomes reported on the tables at the bottom of this section. As we can notice from these outcomes, the role played by supply and credit side varies amongst the analyzed country. In particular, in Germany supply seems to have a greater impact between the eighth (about 4.5 percent) and sixteenth (3.62 percent) lag before balancing with the demand. Only Italy shows a relevant dependence on supply side (more than 10 percent of explanation provided by credit requirements from the month 14 onward)(Tab. 4.3), whereas the loans aggregates of the remaining countries are more dependent on the demand side. This difference could be due by different aspects such as the structure of the industrial fabric and banking market itself. In particular, during the sovereign debt crisis, Italian bank system was between a rock and a hard place. To cope with the rising of the government bond spread on one hand and to fulfill the banking regulatory requirements on the other, Italian banks were forced to reduce their credit offers leading to a credit crunch scenario. Moreover, Italian economy is mainly based on SMEs which are usually riskier than bigger size companies and therefore are more likely to be credit rationed or charged with higher loan rates. Instead, Austria (Tab. 4.1) and Spain (Tab. 4.4) show how the demand side and also the policy rate are relevant for total loans while the supply of loans explains the variation of the total aggregate for less than 1 percent on average both in the short and long term. This leads to two important considerations. Firstly, in these countries loan demand drives the credit market more than loan supply. For instance, it is plausible that due to the financial crisis Spanish and Austrian companies reduced their overall investment level leading to a decrease in the loans aggregate. Secondly, given the higher relevance of the shadow rate in the explanation of a shock on loans, in these countries other channels (see Par. 3.4) seem to have played more important roles in the unconventional monetary policy transmission. For what concerns Spain, this confirms thus what emerged in the previous model analysis (Fig. 4.21)[7].

[7] Note that we have also performed a variance decomposition on credit supply proxy (based on the same VAR) in order to check if effectively shadow rate impacts on it. The results suggest that shadow rate is the most relevant variable for the loan offering for all countries regardless of the importance of the BLC in the country itself.

Period	S.E.	LOANS	SUPPLY_...	DEMAND...	SHADOW
1	0.002595	100.0000	0.000000	0.000000	0.000000
2	0.004786	99.13305	0.108399	0.372183	0.386369
3	0.006882	97.85015	0.170202	0.848440	1.131208
4	0.008270	96.84007	0.142839	1.246358	1.770734
5	0.009152	96.08077	0.134857	1.347421	2.436954
6	0.009688	95.65276	0.241343	1.228224	2.877676
7	0.010087	95.35637	0.335287	1.247903	3.060440
8	0.010463	94.91547	0.325084	1.801141	2.958308
9	0.010893	94.04560	0.319654	2.905103	2.729647
10	0.011390	92.80137	0.354353	4.184169	2.660105
11	0.011923	91.44909	0.346542	5.251065	2.953301
12	0.012448	90.12249	0.321591	5.992171	3.563747
13	0.012924	88.85264	0.357827	6.508998	4.280531
14	0.013333	87.68102	0.429522	6.942056	4.947399
15	0.013677	86.63389	0.471060	7.359627	5.535418
16	0.013980	85.69349	0.476802	7.743424	6.086288
17	0.014265	84.85013	0.473184	8.042325	6.634357
18	0.014546	84.10653	0.484550	8.241116	7.167809
19	0.014826	83.43584	0.541005	8.383875	7.639281
20	0.015101	82.77831	0.654379	8.549334	8.017979

Table 4.1: Variance decomposition for Austria VAR(4) with loans, credit supply, credit demand and shadow rate

Period	S.E.	LOANS	SUPPLY_...	DEMAND...	SHADOW
1	0.002287	100.0000	0.000000	0.000000	0.000000
2	0.004531	99.70012	0.089438	0.017192	0.193253
3	0.006810	99.40833	0.069396	0.010938	0.511333
4	0.008245	99.06682	0.057658	0.020760	0.854759
5	0.009296	98.78987	0.387646	0.094966	0.727522
6	0.010169	97.47606	1.544651	0.351226	0.628064
7	0.011185	95.35723	3.215644	0.682412	0.744716
8	0.012215	93.67938	4.567652	0.853261	0.899706
9	0.013172	93.00360	5.123054	0.832252	1.041098
10	0.013924	93.02286	5.105495	0.771830	1.099812
11	0.014537	93.32451	4.824960	0.743816	1.106715
12	0.015054	93.58779	4.519210	0.832451	1.060552
13	0.015543	93.63256	4.239956	1.129023	0.998461
14	0.016001	93.45395	4.000825	1.603016	0.942210
15	0.016430	93.18630	3.795562	2.124379	0.893764
16	0.016826	92.88557	3.621437	2.635000	0.857993
17	0.017211	92.51854	3.463794	3.170885	0.846777
18	0.017592	92.01561	3.317915	3.804194	0.862285
19	0.017967	91.35762	3.183960	4.553573	0.904851
20	0.018316	90.59843	3.067978	5.355006	0.978585

Table 4.2: Variance decomposition for Germany VAR(5) with loans, credit supply, credit demand and shadow rate

Period	S.E.	LOANS	SUPPLY_...	DEMAND...	SHADOW
1	0.006803	100.0000	0.000000	0.000000	0.000000
2	0.012870	99.15208	0.000595	0.603269	0.244055
3	0.018669	98.10621	0.025118	1.383932	0.484741
4	0.022582	96.81605	0.155646	2.147328	0.880974
5	0.024978	95.87722	0.509356	2.588247	1.025182
6	0.026408	95.05271	1.120091	2.765898	1.061302
7	0.027540	94.22735	1.998328	2.759908	1.014410
8	0.028760	93.28991	3.118188	2.642316	0.949592
9	0.030303	92.26170	4.437354	2.420711	0.880236
10	0.032172	91.16905	5.841400	2.147667	0.841879
11	0.034223	89.98573	7.182546	1.969830	0.861895
12	0.036269	88.66746	8.352551	2.033067	0.946921
13	0.038193	87.26311	9.346350	2.322224	1.068312
14	0.039959	85.87601	10.25149	2.680814	1.191681
15	0.041605	84.54986	11.18205	2.976130	1.291960
16	0.043203	83.23826	12.20709	3.189195	1.365455
17	0.044811	81.89224	13.30630	3.378288	1.423170
18	0.046445	80.52616	14.37675	3.614093	1.482998
19	0.048078	79.20701	15.30245	3.930465	1.560077
20	0.049656	78.00816	16.03489	4.296863	1.660083

Table 4.3: Variance decomposition for Italy VAR(4) with loans, credit supply, credit demand and shadow rate

Period	S.E.	LOANS	SUPPLY_...	DEMAND...	SHADOW
1	0.002704	100.0000	0.000000	0.000000	0.000000
2	0.005599	99.48575	0.222051	6.95E-05	0.292128
3	0.008946	98.71191	0.814631	0.190449	0.283009
4	0.011708	97.75457	1.223724	0.490168	0.531539
5	0.014299	97.45893	1.109175	0.777295	0.654596
6	0.016781	97.40857	0.808032	0.864070	0.919329
7	0.019536	97.19312	0.658006	0.964728	1.184149
8	0.022440	96.54729	0.571715	1.294878	1.586114
9	0.025467	95.48141	0.456164	2.067255	1.995175
10	0.028480	94.03806	0.365091	3.135544	2.461302
11	0.031509	92.61133	0.298501	4.166484	2.923687
12	0.034536	91.38184	0.258977	4.918520	3.440663
13	0.037604	90.31525	0.271508	5.427081	3.986159
14	0.040667	89.28446	0.316993	5.822175	4.576368
15	0.043684	88.28512	0.349336	6.192774	5.172766
16	0.046604	87.34413	0.356726	6.527539	5.771601
17	0.049420	86.51443	0.353342	6.778679	6.353548
18	0.052132	85.79018	0.355143	6.926803	6.927869
19	0.054750	85.13856	0.369946	6.998663	7.492837
20	0.057271	84.51775	0.395345	7.031175	8.055729

Table 4.4: Variance decomposition for Spain VAR(5) with loans, credit supply, credit demand and shadow rate

4.4 Robustness check: a different Cholesky Ordering

Before to draw the conclusions of this work, in order to assess the consistency of our findings we are going to perform a robustness check. More specifically, we check the reliability of Model 5 by modifying the variable ordering. When we use structural VAR models the input matrix for impulse responses is given according to certain economic criteria (usually aligned with the main literature) overshadowing in this way the ordering relevance. However this is not true for unrestricted VAR models. In such a case variable ordering is relevant since impulse response functions are built on a Cholesky decomposition which leads to a lower triangular matrix. As a consequence, since all the resulting test statistics depend on the ordering of the variables in the VAR (H. Lütkepohl, 1991), we need to order with an exogeneity criterium. More specifically, we should follow a decreasing exogeneity criterium by putting first the most exogenous variable and last the most endogeneous one. In our models we have followed the order chosen by G. Di Giorgio and G. Traficante, (2014) for the first four VARs. Instead here we want to check if changing the order of supply and demand in VAR model 5 leads to new outcomes aligned (or not) with what presented in the previous section. Yet, variance decomposition tables (see Appendix B) confirm again the previous results. It entails that considering credit demand or supply proxy more exogenous rather than the other one does not affect the outcomes.

Conclusion

This thesis has the aim to analyze the role played by the so called BLC in the unconventional monetary transmission during the financial and debt crises in Europe. We structure this in two different parts. We start by presenting the theoretical base behind credit market and its functioning, with a focus on asymmetric information and credit rationing. Then we compare the more traditional money view to the credit view in order to present the literature environment where the credit channel has its roots. In Chapter 3 we provide a general overview on the difference between conventional and unconventional monetary policies, describing all the different types of non standard measures and all channels through which they are supposed to work. In the second part we report our empirical analysis based on VAR models. More specifically, once specified these models and checked for some conditions such as stationarity, we develop impulse response functions and variance decomposition tables which are the instruments used to carry out our analysis. Here we study the effects of unconventional monetary policies on four different European countries which are: Austria, Germany, Italy and Spain. We use monthly data relative to the period between September 2004 and January 2014. We develop five models in order to analyze the role played by BLC in the countries subject of studies, looking for possible differences between conventional and unconventional policies. In order to do so we use output, prices, aggregate loans, BLS survey results in terms of both credit supply and demand. To account for monetary policies we use EONIA rate as proxy for conventional measures and shadow rate for unconventional ones as usually done in the literature.
Our results suggest how BLC is activated by both types of monetary policies. By simulating a tightening monetary policy through a policy rate innovation we also point out how inflation does not respond as expected in Italy and Spain since it strongly rises in the first periods. In our opinion this is a typical case of price puzzle affecting VAR models. As expected, GDP is negatively affected by the increase of the policy rate and it shows a typical hump shaped curve. In terms of loans aggregate, we register negative trends in response to a tightening policy innovation. Then we go deeper by considering not only loans as a whole but also a BLS variable accounting for credit supply. In particular our variable refers to credit standards which becomes rigid with positive values and vice versa. By looking at the derived impulse response functions, we find out different responses in the countries analyzed with Italy and Spain showing a loosening in the long run. In general, all countries seem to present the functioning of a BLC. However, some differences emerge amongst the countries analyzed. In particular, Austria presents outcomes with the expected signs (negative response in terms of loans and an increase in credit standards) which are both

almost not statistically significant at all. The credit supply in Germany loosens in the first months after the policy innovations instead of tightening immediately as for the other countries. This suggests that at least for this initial period the loans offering depends more on other aspects rather than the policy rate. However, after six months credit requirements start to increase reaching peaks which are also statistically significant. In Italy credit supply is strongly affected by the policy shock despite a decrease in the total loans which is not statistically significant. Probably also other aspects influence the loan market in addition to the BLC. Only Spain shows a statistically significant reduction in the loans aggregate besides a significant increase in the credit requirements (in Model 3), suggesting that in this country BLC could be important for the conventional policy transmission. Nevertheless, in Model 4, the rise in credit standards completely loses its statistically significance. This suggests that BLC becomes less strong in the transmission of unconventional policies probably because of a poor banking market capitalization. Recalling U. Albertazzi et al. (2016), in contrast to what established by the conventional bank lending literature, since unconventional policies are brought forth in "hard times", the banks' capitalization level influence in terms of monetary policy stimulus may be overturned. In other words, banks presenting lower capitalization levels usually feel more regulatory constraints and, in turn, they could be less effective in the monetary transmission process due to the limited lending ability. Except for Spain, all other countries show quite similar impulse responses if we compare conventional and unconventional policy with some differences mostly in quantitative terms. Since one of the most important issue in this literature is the difficulty to disentangle demand and supply side in the credit market, we also provide a variance decomposition of loans aggregate. In this way we highlight how only Italy shows a greater sensitiveness on supply rather than demand side. According to us, this is a consequence of the impact of the Italian credit crunch phenomenon experienced during the economic downturns of the period here considered. On the other side, German credit market seems to depend on supply and demand side almost in the same way, whereas in Austria and Spain credit demand appears to be more relevant as determinant of the total credit outstanding amount. To check for these outcomes, we perform as a robustness check a change in the variable ordering which confirms again the results provided.

All in all, our results demonstrate how loosening monetary policies implemented by ECB during the crisis were supportive to the economic contexts of the countries analyzed. We also find out that overall BLC participates in the monetary policy transmission regardless of its kind. This finding is aligned with other empirical works such as U. Albertazzi et al. (2016). Despite this contribute to the monetary transmission process, BLC does not seem to have played a so crucial role during the financial and debt crises. Yet, such a result is shared with most of the literature described on Par. 3.4.5. However, based only on these outcomes is not possible to quantify the relative importance of each different unconventional policy and transmission channel as well.

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Appendix A

Lag	LogL	LR	FPE	AIC	SC	HQ
0	1130.290	NA	8.46e-15	-21.05216	-20.95224	-21.01165
1	2093.695	1836.770	1.72e-22	-38.76065	-38.26105	-38.55812
2	2188.887	174.3706	3.93e-23	-40.24087	-39.34160*	-39.87632*
3	2203.333	25.38188	4.06e-23	-40.21183	-38.91288	-39.68525
4	2218.783	25.99056	4.13e-23	-40.20154	-38.50292	-39.51295
5	2248.790	48.23677	3.21e-23	-40.46337	-38.36508	-39.61275
6	2274.623	39.59339*	2.71e-23*	-40.64715*	-38.14918	-39.63451

Table A.1: Lag length criteria for Austria Model 1

Lag	LogL	LR	FPE	AIC	SC	HQ
0	1143.847	NA	6.56e-15	-21.30556	-21.20564	-21.26505
1	1950.325	1537.584	2.51e-21	-36.08085	-35.58125	-35.87832
2	2044.524	172.5509	5.84e-22	-37.54251	-36.64324*	-37.17795*
3	2065.788	37.36162	5.31e-22	-37.64091	-36.34196	-37.11433
4	2084.936	32.21054	5.04e-22	-37.69973	-36.00111	-37.01114
5	2117.228	51.90814*	3.75e-22*	-38.00425*	-35.90596	-37.15363
6	2127.488	15.72625	4.24e-22	-37.89697	-35.39900	-36.88433

Table A.2: Lag length criteria for Germany Model 1

Lag	LogL	LR	FPE	AIC	SC	HQ
0	963.9904	NA	1.89e-13	-17.94375	-17.84383	-17.90324
1	1789.773	1574.389	5.06e-20	-33.07987	-32.58027	-32.87734
2	1882.203	169.3105	1.21e-20	-34.50846	-33.60919	-34.14391
3	1904.211	38.66888	1.09e-20	-34.62077	-33.32182	-34.09419
4	1932.732	47.97905	8.66e-21	-34.85480	-33.15618	-34.16620
5	2004.992	116.1573	3.06e-21	-35.90640	-33.80811*	-35.05578
6	2036.966	49.00584*	2.30e-21*	-36.20497*	-33.70700	-35.19232*

Table A.3: Lag length criteria for Italy Model 1

Lag	LogL	LR	FPE	AIC	SC	HQ
0	968.6098	NA	1.74e-13	-18.03009	-17.93017	-17.98958
1	1925.644	1824.625	3.99e-21	-35.61951	-35.11991	-35.41698
2	2067.975	260.7183	3.77e-22	-37.98083	-37.08156*	-37.61628
3	2079.897	20.94713	4.08e-22	-37.90461	-36.60566	-37.37803
4	2107.502	46.43972	3.30e-22	-38.12154	-36.42292	-37.43294
5	2168.363	97.83241	1.44e-22	-38.96006	-36.86177	-38.10944
6	2210.738	64.94877*	8.94e-23*	-39.45305*	-36.95508	-38.44041*

Table A.4: Lag length criteria for Spain Model 1

Lag	LogL	LR	FPE	AIC	SC	HQ
0	1123.084	NA	9.68e-15	-20.91746	-20.81754	-20.87695
1	1982.627	1638.755	1.37e-21	-36.68461	-36.18502	-36.48208
2	2082.039	182.1010	2.90e-22	-38.24372	-37.34445*	-37.87917*
3	2096.679	25.72322	2.98e-22	-38.21831	-36.91936	-37.69173
4	2112.262	26.21370	3.02e-22	-38.21051	-36.51189	-37.52191
5	2140.662	45.65266	2.42e-22	-38.44229	-36.34399	-37.59166
6	2162.773	33.88917*	2.19e-22*	-38.55650*	-36.05853	-37.54386

Table A.5: Lag length criteria for Austria Model 2

Lag	LogL	LR	FPE	AIC	SC	HQ
0	1140.429	NA	7.00e-15	-21.24167	-21.14175	-21.20116
1	1837.611	1329.206	2.07e-20	-33.97403	-33.47444	-33.77150
2	1940.083	187.7069	4.11e-21	-35.59035	-34.69108*	-35.22579
3	1969.722	52.07501	3.20e-21	-35.84527	-34.54632	-35.31869
4	1991.501	36.63703	2.89e-21	-35.95328	-34.25466	-35.26468
5	2023.249	51.03479*	2.17e-21*	-36.24764*	-34.14935	-35.39702*
6	2032.680	14.45459	2.49e-21	-36.12485	-33.62688	-35.11221

Table A.6: Lag length criteria for Germany Model 2

Lag	LogL	LR	FPE	AIC	SC	HQ
0	967.4692	NA	1.77e-13	-18.00877	-17.90885	-17.96826
1	1672.934	1344.998	4.49e-19	-30.89596	-30.39636	-30.69343
2	1771.578	180.6944	9.59e-20	-32.44071	-31.54144	-32.07616
3	1791.396	34.82061	8.96e-20	-32.51208	-31.21313	-31.98550
4	1823.432	53.89123	6.68e-20	-32.81180	-31.11318	-32.12321
5	1895.111	115.2228	2.38e-20	-33.85254	-31.75424*	-33.00192
6	1922.423	41.86231*	1.96e-20*	-34.06399*	-31.56602	-33.05135*

Table A.7: Lag length criteria for Italy Model 2

Lag	LogL	LR	FPE	AIC	SC	HQ
0	976.4727	NA	1.50e-13	-18.17706	-18.07714	-18.13655
1	1831.724	1630.573	2.31e-20	-33.86400	-33.36441	-33.66147
2	1971.372	255.8033	2.29e-21	-36.17518	-35.27591*	-35.81062
3	1983.937	22.07714	2.45e-21	-36.11097	-34.81203	-35.58440
4	2010.168	44.12670	2.04e-21	-36.30221	-34.60358	-35.61361
5	2060.402	80.74968	1.08e-21	-36.94209	-34.84379	-36.09147
6	2101.813	63.47140*	6.84e-22*	-37.41707*	-34.91909	-36.40442*

Table A.8: Lag length criteria for Spain Model 2

Lag	LogL	LR	FPE	AIC	SC	HQ
0	220.9499	NA	2.04e-07	-4.055139	-3.955220	-4.014633
1	1072.490	1623.498	3.36e-14	-19.67272	-19.17312	-19.47019
2	1186.772	209.3391	5.36e-15	-21.50976	-20.61049	-21.14521
3	1273.084	151.6503	1.44e-15	-22.82400	-21.52505	-22.29742
4	1321.951	82.20681	7.86e-16	-23.43834	-21.73972*	-22.74975
5	1352.417	48.97258	6.06e-16	-23.70873	-21.61043	-22.85811
6	1379.353	41.28568*	5.01e-16*	-23.91315*	-21.41517	-22.90050*

Table A.9: Lag length criteria for Austria Model 3

Lag	LogL	LR	FPE	AIC	SC	HQ
0	389.2048	NA	8.77e-09	-7.200090	-7.100171	-7.159584
1	1219.178	1582.378	2.17e-15	-22.41454	-21.91494	-22.21201
2	1353.850	246.6887	2.36e-16	-24.63270	-23.73343	-24.26815
3	1433.526	139.9921	7.20e-17	-25.82292	-24.52397	-25.29634
4	1479.579	77.47229	4.13e-17	-26.38465	-24.68603	-25.69606
5	1526.368	75.21165	2.35e-17	-26.96014	-24.86185*	-26.10952*
6	1548.559	34.01351*	2.12e-17*	-27.07588*	-24.57791	-26.06323

Table A.10: Lag length criteria for Germany Model 3

Lag	LogL	LR	FPE	AIC	SC	HQ
0	200.9838	NA	2.96e-07	-3.681940	-3.582021	-3.641434
1	1098.653	1711.445	2.06e-14	-20.16175	-19.66215	-19.95922
2	1240.464	259.7649	1.97e-15	-22.51334	-21.61407	-22.14879
3	1312.631	126.7988	6.90e-16	-23.56320	-22.26426	-23.03663
4	1380.697	114.5022	2.62e-16	-24.53638	-22.83776*	-23.84779
5	1406.702	41.80273*	2.20e-16*	-24.72340*	-22.62510	-23.87278*
6	1420.703	21.45934	2.31e-16	-24.68603	-22.18806	-23.67339

Table A.11: Lag length criteria for Italy Model 3

Lag	LogL	LR	FPE	AIC	SC	HQ
0	228.1746	NA	1.78e-07	-4.190180	-4.090261	-4.149674
1	1259.581	1966.420	1.02e-15	-23.16974	-22.67014	-22.96721
2	1460.060	367.2322	3.24e-17	-26.61794	-25.71867	-26.25339
3	1526.776	117.2211	1.26e-17	-27.56591	-26.26696	-27.03933
4	1585.928	99.50770	5.66e-18	-28.37248	-26.67386	-27.68389
5	1628.290	68.09625*	3.49e-18*	-28.86524*	-26.76694*	-28.01461*
6	1640.083	18.07497	3.83e-18	-28.78660	-26.28863	-27.77395

Table A.12: Lag length criteria for Spain Model 3

Lag	LogL	LR	FPE	AIC	SC	HQ
0	201.0915	NA	2.95e-07	-3.683954	-3.584035	-3.643448
1	976.8817	1479.077	2.01e-13	-17.88564	-17.38604	-17.68311
2	1079.021	187.0954	4.02e-14	-19.49571	-18.59644	-19.13116
3	1167.707	155.8223	1.04e-14	-20.85433	-19.55538	-20.32775
4	1215.332	80.11740	5.77e-15	-21.44546	-19.74684*	-20.75686
5	1246.155	49.54699	4.42e-15	-21.72252	-19.62422	-20.87190
6	1271.904	39.46669*	3.73e-15*	-21.90476*	-19.40678	-20.89211*

Table A.13: Lag length criteria for Austria Model 4

Lag	LogL	LR	FPE	AIC	SC	HQ
0	378.6745	NA	1.07e-08	-7.003261	-6.903342	-6.962755
1	1111.616	1397.384	1.62e-14	-20.40404	-19.90445	-20.20151
2	1246.897	247.8038	1.74e-15	-22.63359	-21.73432	-22.26903
3	1330.815	147.4453	4.91e-16	-23.90309	-22.60414	-23.37651
4	1382.092	86.26005	2.56e-16	-24.56247	-22.86385	-23.87387
5	1423.159	66.01461	1.62e-16	-25.03101	-22.93272*	-24.18039*
6	1444.192	32.23730*	1.49e-16*	-25.12509*	-22.62712	-24.11244

Table A.14: Lag length criteria for Germany Model 4

Lag	LogL	LR	FPE	AIC	SC	HQ
0	192.7398	NA	3.45e-07	-3.527847	-3.427928	-3.487341
1	989.8245	1519.676	1.58e-13	-18.12756	-17.62797	-17.92503
2	1132.717	261.7470	1.47e-14	-20.49938	-19.60011	-20.13483
3	1201.766	121.3201	5.48e-15	-21.49096	-20.19201	-20.96438
4	1275.002	123.2007	1.89e-15	-22.56079	-20.86217*	-21.87219
5	1300.212	40.52381*	1.61e-15*	-22.73293	-20.63463	-21.88231*
6	1316.263	24.60211	1.63e-15	-22.73389*	-20.23592	-21.72125

Table A.15: Lag length criteria for Italy Model 4

Lag	LogL	LR	FPE	AIC	SC	HQ
0	222.7368	NA	1.97e-07	-4.088537	-3.988619	-4.048032
1	1169.088	1804.258	5.52e-15	-21.47828	-20.97868	-21.27575
2	1360.787	351.1500	2.07e-16	-24.76237	-23.86310	-24.39782
3	1426.619	115.6680	8.19e-17	-25.69382	-24.39487	-25.16724
4	1484.956	98.13681	3.74e-17	-26.48516	-24.78654*	-25.79656
5	1514.669	47.76232*	2.92e-17*	-26.74147*	-24.64318	-25.89085*
6	1524.762	15.46943	3.31e-17	-26.63106	-24.13309	-25.61841

Table A.16: Lag length criteria for Spain Model 4

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-524.4487	NA	0.229017	9.877546	9.977465	9.918051
1	191.3052	1364.615	4.78e-07	-3.201967	-2.702373	-2.999438
2	388.9299	362.0041	1.61e-08	-6.596821	-5.697551	-6.232269
3	515.9794	223.2272	2.02e-09	-8.672513	-7.373568	-8.145938
4	605.7188	150.9634	5.13e-10	-10.05082	-8.352199*	-9.362221
5	626.2523	33.00711	4.76e-10	-10.13556	-8.037262	-9.284936
6	657.1435	47.34720*	3.65e-10*	-10.41390*	-7.915926	-9.401252*

Table A.17: Lag length criteria for Austria Model 5

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-337.2584	NA	0.006923	6.378662	6.478581	6.419168
1	284.9587	1186.283	8.31e-08	-4.952498	-4.452904	-4.749969
2	433.3133	271.7525	7.01e-09	-7.426417	-6.527148	-7.061865
3	576.0920	250.8634	6.57e-10	-9.796111	-8.497166	-9.269536
4	661.1582	143.1021	1.82e-10	-11.08707	-9.388449	-10.39847
5	699.1129	61.01133	1.22e-10	-11.49744	-9.399142*	-10.64682
6	726.3059	41.67889*	1.00e-10*	-11.70665*	-9.208681	-10.69401*

Table A.18: Lag length criteria for Germany Model 5

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-623.3280	NA	1.453903	11.72576	11.82568	11.76626
1	91.95871	1363.724	3.06e-06	-1.345023	-0.845428	-1.142494
2	252.4275	293.9428	2.06e-07	-4.045374	-3.146104	-3.680822
3	386.2363	235.1032	2.29e-08	-6.247407	-4.948462	-5.720832
4	472.3764	144.9086	6.20e-09	-7.558437	-5.859817*	-6.869839*
5	493.6485	34.19435	5.67e-09	-7.656980	-5.558685	-6.806359
6	513.8652	30.98649*	5.32e-09*	-7.735799*	-5.237828	-6.723155

Table A.19: Lag length criteria for Italy Model 5

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-566.3819	NA	0.501495	10.66134	10.76126	10.70185
1	244.1011	1545.220	1.78e-07	-4.188806	-3.689212	-3.986278
2	458.1954	392.1726	4.40e-09	-7.891503	-6.992233	-7.526951
3	563.1711	184.4433	8.37e-10	-9.554600	-8.255655	-9.028025
4	672.1789	183.3777	1.48e-10	-11.29306	-9.594444	-10.60447
5	709.6988	60.31223	1.00e-10	-11.69530	-9.597008*	-10.84468
6	739.2134	45.23745*	7.88e-11*	-11.94791*	-9.449944	-10.93527*

Table A.20: Lag length criteria for Spain Model 5

* indicates lag order selected by the criterion
LR: sequential modified LR test statistic (each test at 5% level)
FPE: Final prediction error
AIC: Akaike information criterion
SC: Schwarz information criterion
HQ: Hannan-Quinn information criterion

Appendix B

Period	S.E.	LOANS	DEMAND...	SUPPLY_...	SHADOW
1	0.002595	100.0000	0.000000	0.000000	0.000000
2	0.004786	99.13305	0.478643	0.001939	0.386369
3	0.006882	97.85015	0.997496	0.021146	1.131208
4	0.008270	96.84007	1.286901	0.102296	1.770734
5	0.009152	96.08077	1.223334	0.258944	2.436954
6	0.009688	95.65276	1.094110	0.375458	2.877676
7	0.010087	95.35637	1.225806	0.357384	3.060440
8	0.010463	94.91547	1.687809	0.438415	2.958308
9	0.010893	94.04560	2.316177	0.908580	2.729647
10	0.011390	92.80137	2.957729	1.580793	2.660105
11	0.011923	91.44909	3.572262	2.025344	2.953301
12	0.012448	90.12249	4.181842	2.131920	3.563747
13	0.012924	88.85264	4.793351	2.073474	4.280531
14	0.013333	87.68102	5.373675	1.997903	4.947399
15	0.013677	86.63389	5.869575	1.961112	5.535418
16	0.013980	85.69349	6.249212	1.971014	6.086288
17	0.014265	84.85013	6.527912	1.987597	6.634357
18	0.014546	84.10653	6.760553	1.965112	7.167809
19	0.014826	83.43584	7.017919	1.906961	7.639281
20	0.015101	82.77831	7.362697	1.841016	8.017979

Table B.1: Variance decomposition for Austria VAR(4) with loans, credit demand, credit supply and Shadow rate

Period	S.E.	LOANS	DEMAND...	SUPPLY_...	SHADOW
1	0.002287	100.0000	0.000000	0.000000	0.000000
2	0.004531	99.70012	0.010558	0.096072	0.193253
3	0.006810	99.40833	0.006387	0.073948	0.511333
4	0.008245	99.06682	0.019798	0.058620	0.854759
5	0.009296	98.78987	0.126855	0.355757	0.727522
6	0.010169	97.47606	0.492709	1.403168	0.628064
7	0.011185	95.35723	0.974120	2.923936	0.744716
8	0.012215	93.67938	1.245843	4.175070	0.899706
9	0.013172	93.00360	1.242832	4.712473	1.041098
10	0.013924	93.02286	1.165496	4.711829	1.099812
11	0.014537	93.32451	1.119024	4.449751	1.106715
12	0.015054	93.58779	1.191017	4.160644	1.060552
13	0.015543	93.63256	1.465621	3.903357	0.998461
14	0.016001	93.45395	1.917510	3.686331	0.942210
15	0.016430	93.18630	2.421813	3.498128	0.893764
16	0.016826	92.88557	2.920377	3.336060	0.857993
17	0.017211	92.51854	3.445798	3.188881	0.846777
18	0.017592	92.01561	4.068824	3.053285	0.862285
19	0.017967	91.35762	4.808924	2.928609	0.904851
20	0.018316	90.59843	5.604137	2.818847	0.978585

Table B.2: Variance decomposition for Germany VAR(5) with loans, credit demand, credit supply and Shadow rate

Period	S.E.	LOANS	DEMAND...	SUPPLY_...	SHADOW
1	0.006803	100.0000	0.000000	0.000000	0.000000
2	0.012870	99.15208	0.594819	0.009045	0.244055
3	0.018669	98.10621	1.400977	0.008072	0.484741
4	0.022582	96.81605	2.224213	0.078761	0.880974
5	0.024978	95.87722	2.749802	0.347801	1.025182
6	0.026408	95.05271	3.011542	0.874447	1.061302
7	0.027540	94.22735	3.075217	1.683019	1.014410
8	0.028760	93.28991	3.010006	2.750497	0.949592
9	0.030303	92.26170	2.811791	4.046274	0.880236
10	0.032172	91.16905	2.510527	5.478540	0.841879
11	0.034223	89.98573	2.237455	6.914920	0.861895
12	0.036269	88.66746	2.151039	8.234578	0.946921
13	0.038193	87.26311	2.268634	9.399940	1.068312
14	0.039959	85.87601	2.463696	10.46861	1.191681
15	0.041605	84.54986	2.616783	11.54140	1.291960
16	0.043203	83.23826	2.706424	12.68986	1.365455
17	0.044811	81.89224	2.778853	13.90574	1.423170
18	0.046445	80.52616	2.893219	15.09762	1.482998
19	0.048078	79.20701	3.082548	16.15037	1.560077
20	0.049656	78.00816	3.326239	17.00551	1.660083

Table B.3: Variance decomposition for Italy VAR(4) loans, credit demand, credit supply and Shadow rate

Period	S.E.	LOANS	DEMAND...	SUPPLY_...	SHADOW
1	0.002595	100.0000	0.000000	0.000000	0.000000
2	0.004786	99.13305	0.478643	0.001939	0.386369
3	0.006882	97.85015	0.997496	0.021146	1.131208
4	0.008270	96.84007	1.286901	0.102296	1.770734
5	0.009152	96.08077	1.223334	0.258944	2.436954
6	0.009688	95.65276	1.094110	0.375458	2.877676
7	0.010087	95.35637	1.225806	0.357384	3.060440
8	0.010463	94.91547	1.687809	0.438415	2.958308
9	0.010893	94.04560	2.316177	0.908580	2.729647
10	0.011390	92.80137	2.957729	1.580793	2.660105
11	0.011923	91.44909	3.572262	2.025344	2.953301
12	0.012448	90.12249	4.181842	2.131920	3.563747
13	0.012924	88.85264	4.793351	2.073474	4.280531
14	0.013333	87.68102	5.373675	1.997903	4.947399
15	0.013677	86.63389	5.869575	1.961112	5.535418
16	0.013980	85.69349	6.249212	1.971014	6.086288
17	0.014265	84.85013	6.527912	1.987597	6.634357
18	0.014546	84.10653	6.760553	1.965112	7.167809
19	0.014826	83.43584	7.017919	1.906961	7.639281
20	0.015101	82.77831	7.362697	1.841016	8.017979

Table B.4: Variance decomposition for Spain VAR(5) loans, credit demand, credit supply and Shadow rate

Appendix C

Summary

Introduction

From the financial turmoils of 2008 onward, many aspects of our economy has changed. Central banks of all around the world had to design new monetary policy instruments to cope with one of the biggest global financial crisis ever faced by our society. In such a context, the usual conventional monetary tools were not able alone to manage such a terrific economic crisis. Once in the liquidity trap, with short term rates close or almost equal to zero, central banks needed to look for new ways to tackle the economic downturns and provide further stimulus to the whole economy. Therefore the Federal Reserve System (FED) prior, and the ECB then, had to resort for the first time in their history on the so called unconventional monetary policies which had been pioneered in Japan during 1990s. Even if there is not a unique consistent definition for such non standard policy measures, in this group it is possible to identify different types of policies such as Quantitative Easing (QE) and forward guidance. These are unconventional not only for their features but also for the ways by which their impulses are transmitted to the economy. In fact, in a zero lower bound situation, the "standard" interest rate channel is inhibited. As a consequence, these policies operate through other channels: portfolio-balance, signaling, liquidity, confidence, and bank lending channel (BLC). In recent times, unconventional monetary policies have been increasingly studied in economics research. In the literature we can find lots of empirical works looking for the effects of this kind of policies on various economic aspects and variables such as real estate markets, equity capital markets, exchange rates and many others. However, just few of these take into account the implications for the credit market (i.e. C. Cahn et al., 2018). Here, we want to shed light on the functioning of the BLC in an unconventional monetary policy context. In order to do so, in line with the most empirical works focusing on this topic, we use a Vector AutoRegression (VAR) methodology. In this way, we can investigate on the evolution of certain endogenous variables of our interest following a monetary shock. To account for the credit market, inspired by C. Altavilla et al. (2018), we mainly resort on Bank Lending Survey (BLS). Through this data source, we can firstly analyze the overall effect on the credit market and, then, try to disentangle the relative contribute of both credit supply and demand which is usually the trickiest part of this kind of studies. In particular, we focus on loans to enterprises rather than considering all credit types as a whole. We derive impulse responses for each country taken into account in this analysis (Austria, Germany, Spain, and Italy) which will permit us to look for possible heterogenous transmission of unconventional monetary policies within the European Monetary Union. Finally, this thesis will test for the presence and, in turn, the active role played by BLC in the transmission of non standard measures. The thesis structure can be divided in two main parts. On one side, in Chapter 1, 2, and 3, we provide all the theoretical foundations needed to better understand the credit market and unconventional monetary policies in economics terms. On the other side, Chapter 4 is entirely dedicated to disclose the empirical analysis at the core of this work. More specifically, Chapter 1 describes the asymmetric information nature of the credit market through the most relevant models in the literature. Accordingly, we present the concept of credit rationing pointing out under which conditions this phenomenon can occur. Chapter 2 discusses the difference between the so called money and credit views. Here we highlight the criticisms of money view which have led to the birth of the credit view and, in turn, the conceptualization of credit channel. Here, we describe both bank lending and balance sheet channels with an additional focus on concepts as financial-accelerator and flight to quality as chapter conclusion. Chapter 3 provides a complete overview on unconventional monetary policy and their transmission channels. In doing this, we start by explaining the difference between conventional and unconventional policies to the description of how BLC is supposed to be activated by these measures, passing through the list of the main unconventional policy tools. Chapter 4 differs from the previous since it concerns the econometric models and their issues. In particular, at the beginning of the chapter we provide the main descriptive statistics on the credit market in terms of country and credit product type. Then we clarify our choices in terms of methodology and data before actually disclosing the different VAR models used for our analysis and their main findings. Here we develop both impulse response functions and variance decomposition in order to run our analysis. Finally, before to conclude, we also perform a robustness check.

Chapter 1 – Imperfect Information in the Credit Market

The credit market has always been center of discussions and studies in the macroeconomics literature. One of the main characteristics of this market is that it is far from being a perfect market. Both adverse selection and moral hazard issues arise in a typical credit market context. Generally speaking, in the economics literature we find two different categories of asymmetric information: adverse selection (ex ante) and moral hazard (ex post). In the credit market there are two main agents: the lender and the borrower. The first, ordinarily a bank, by making loans is usually concerned to two important aspects: the interest rate relative to the loan and the riskiness (or the probability of repayment) of the loan itself (J. Stiglitz and A. Weiss, 1981). The latter is strictly related with the project that the borrower wants to bring about. However, at this point an adverse selection issue arises since we are in a borrower-advantaged asymmetry (C. Ofonyelu, 2013), namely the borrower has better information about the variables that impact on the success of the project and on its related riskiness. Since not all borrowers are equal to each other, it entails that bank has to implement a system by which it can distinguish "bad" from "good" borrower (i.e. screening activity). Unfortunately, these measures alone are not sufficient for the lender to prevent possible opportunistic behaviors of the borrower. In fact, it still persists a moral hazard issue due to the fact that bank is not able to directly control the behavior changes of the borrower. One of the most interesting phenomenon stemming from the asymmetric information nature of the credit market is the so called credit rationing. Related to this, we find a very large literature which usually considers two type of credit rationing:

- **Pure credit rationing** refers to the situation in which some individuals obtain loans, while apparently identical individuals, who want to borrow exactly the same loan amount at the same terms, do not.
- **Redlining** is defined as that situation in which, in front of a certain loan supply curve, there are identifiable groups of individuals which are unable to borrow at any interest rates, whereas with a larger supply of credit they would.

Credit rationing has its theoretical roots on the so called "Availability Doctrine" designed by A. Rosa (1951). Few years later I. Scott (1957), starting from the availability model of A. Rosa, clearly defines for the first time the credit rationing as that situation where the borrower is not able to borrow the amount desired at the ongoing rate. Nevertheless, this early literature "*lacked a solid theoretical foundation upon which empirically testable hypotheses could be built and its assumptions validated*" (T. Devinney, 1986). In 1960, Hodgman demonstrated for the first time how credit rationing can persist in a rational equilibrium framework. His work was mainly based on the role played by the risk of default in the credit market. His model was strongly criticized for two main reasons. Firstly, assuming risk-neutral banks was against the main thought of that time relative to the "conservative tastes of bankers". The second source of criticism arose from the position of the demand curve considered to be too much optimistic. Miller (1962) continued on the line developed by Hodgman taking into account these issues. He integrated the Hodgman's model asserting how the existence of bankruptcy costs (both direct and indirect) can justify rational expectations for credit rationing. Another important contribute in this literature stems from Freimer and Gordon (1965). By assuming an exogenous interest rate in addition to a monopolist lender, they demonstrated that credit rationing can occur even with risk neutral lenders at condition that borrowers ask for fixed-sized funds (C. Calomiris and S. Longhofer, 2008). In their model, the credit offer curve is depicted for the first time as backward-bending. Another important model which is focused on the pure credit rationing rather than redlining refers to D. Jaffee and F. Modigliani (1969). In addition to the backward-bending offer curve developed by Freimer and Gordon, they assumed that a monopolist bank was able to discriminate borrowing entrepreneurs on the base of objective factors such as industry affiliation and firm size. In their paper, they found out how banks will ration those group of borrowers whose loan demand exceeds the loan offer. Moreover, they also show why in the credit market a perfect discrimination could not occur. In particular, this is due to the presence of usury laws in the banking system which prevents the banker from charging any rate greater than the legal limit. This aspect combined to "social mores" would stop banks to charge widely different rates to different customers. Given the competitive nature of the banking market it is difficult for a perfectly collusive system to exist. However, one of the most important models in this literature field refers to Jaffee and Russell (1976). Thanks to a two-period Fisherian consumption set up, by distinguishing between honest and dishonest borrowers and assuming a cost of default they showed three possible market outcomes: no rationing equilibrium with single loan contract, rationing equilibrium with single loan contract and multiple contract equilibria. Nevertheless, the authors here lack to provide a consistent evidence for credit rationing in the long run. Starting from this issue, the Stiglitz and Weiss' model (1991) developed a model which results in a non-monotonic lender's profit function through which they were able to demonstrate the presence of credit rationing. This was the first model able to fully endogenize contract choices with stable rationing equilibrium. They also consider in the same paper the impact of moral hazard. More specifically, they analyze the role of interest rate played in the market as an incentive mechanism. Starting by assuming that borrowers' behavior cannot be monitored without costs by the lender, they developed a lender's net return function not monotonic which implies the possible presence of credit rationing.

Chapter 2 – The "traditional" Money View vs. Credit View

The monetary policy transmission mechanism to the real economy has always been a central topic of discussion among economists. The traditional literature refers to the so called "money view" contribute. This relates to the transmission of monetary policy through changes in monetary aggregates via interest rate channel. The main idea behind this view is that "it's the money that matters" (B. Bernanke). In fact, in the money (or transactions) view, we consider only two different classes of asset: money and all other assets (V. Ramey, 1993). Thus, assuming the Walras' law, the equilibrium in the money market implies the equilibrium in the asset market as well (which results in bonds and bank deposits that are perfect substitutes). In this way, with just one single portfolio equation to pool all asset markets, no role is played by the credit market (K. Brunner and H. Meltzer, 1988). There are also other two fundamental assumptions behind the money view. First, the central bank directly manages money supply (for which alternative assets are all imperfect substitutes) by which it is able to affect the short-term interest rate. The second assumption concerns the relation between investment and consumption level from one side, and real interest rates from the other. More specifically, if both are particularly elastic relative to the interest rates, we will expect a greater impact on the economy arising from a monetary policy change. The key channel here is the interest rate channel which is assumed to work as follows:

$$\boldsymbol{M} \downarrow \Rightarrow \boldsymbol{i} \uparrow \Rightarrow \boldsymbol{r} \uparrow \Rightarrow \boldsymbol{I} \downarrow \Rightarrow \boldsymbol{Y} \uparrow$$

Generally, this process could also be illustrated through a standard IS-LM model. However, starting from the 90s, this theory has been questioned: *"any simple model may sometimes be too simple"* (B. Bernanke and A. Blinder, 1988). In fact, the starting point of the so called credit view is the rejection of the idea that all non-monetary assets are perfect substitutes (V. Ramey, 1993). For instance, B. Bernanke and A. Blinder (1998) argue that macroeconomic models based on only two classes of asset (as that one described above) are not correct because there is no distinction neither between bank versus non-bank financing sources or, more generally, between internal and external funds. In fact, they elevate the role played by loans and banks to a sort of "special status" due to their ability to finance classes of people and legal entities that conversely would have not had access to the bond market. It entails that, as done in the money view, all debt instrument cannot be lumped together in a single "bond market". This means that not only bank liabilities but also bank assets are involved in the monetary transmission mechanism. Another important monetarists' assumption which has been strongly criticized and then revised in the credit view is the presence of perfect capital markets. According to the credit view literature, the information asymmetries among borrowers and lenders imply imperfect capital markets (V. Ramey, 1993). Because of imperfect monitoring there are some classes of borrowers (i.e. certain households and/or small firms) which difficultly could have access to other fund sources outside of bank loans. In fact, only banks can provide external finance to these actors (M. Gertler and S. Gilchrist, 1993). Due to the presence of agency costs, a wedge between the cost of internal and external finance arises. It follows that (once again) internal finance, bank loans, and other financing sources cannot be considered perfect substitutes (V. Ramey, 1993). Starting from these considerations, the Bernanke and Blinder's model of 1988 provides for the first time empirical evidence of the existence of a so called bank lending channel (BLC). This explains how a restrictive monetary policy does not limit to increase short term interest rates (as stated by monetarists), but it further influences availability and terms of bank loans (I. Hernando, 1998). More specifically, a reduction in deposits is followed by a subsequent fall in the overall lending volume *"if banks face frictions in issuing uninsured liabilities to replace the shortfall in deposits"* (P. Disyatat, 2011). Then, due to the imperfect substitution of credit relatively to the other financing sources, a monetary contraction will lead to a larger negative effect on the borrowing of bank dependent firms (A. Aschcraft and M. Campello, 2005). The literature relative to BLC is very large and it includes quite important empirical works such as: S. Oliner and G. Rudebusch (1995), M. Gertler and S. Gilchrist (1994), N. Cetorelli and L. Goldberg (2008), and P. Disyatat (2010). However, this is just one part of what is usually considered to be the whole credit channel. In fact, there is another channel here which is usually called broad credit channel (also known as balance sheet channel). Contrarily to the BLC, the focus here is on the role played by the imperfect information in credit markets and the consequent external finance premium (S. Oliner and D. Rudebusch, 1996). This latter can be defined as the difference between the cost to the borrower of raising external finance and the opportunity cost of using internally generated funds. Indeed, the presence of this premium makes these two types of funds imperfect substitutes (S. Brissimis et al., 2018). What is relevant to point out here is that external finance premium is negatively related to the borrower's collateralizable net worth relative to the amount of funds required (G. Hubbard, 1995). In general, the higher is the total borrowers' net worth the lower is the rate charged by the bank. As a result, there are two main ways through which a monetary stimulus can be transmitted thanks to this channel. Firstly, assuming a tightening monetary policy, following an increase in real interest rates the burdens of firm's debt-service or finance costs rise as well, reducing in turn the borrowers' net cash flows. Secondly, there is also a decline in asset prices which consequently shrinks the value of borrowers' collateralizable net worth (G. Hubbard, 1995). In this respect, we find in the literature also two related important concepts:

- The *financial-accelerator* which can be defined as *"the amplification of initial shock brought about by changes in credit-market conditions"* can occur as consequence of an economic recession that weakens a firm's sources of internal finance (C. Walsh, 2003). In such a situation a firm has to resort more to external financing resources which are more expensive because of the presence of agency costs and asymmetric information. Due to imperfect information there is a negative relation between the external finance premium and borrowers' net worth. Therefore financial-accelerator ends up enhancing the swings in borrowing and, in turn, all the macroeconomic variables dependent on it (B. Bernanke et al., 1999). Overall thus, the final effect of a change in monetary policy will result amplified.

- The *flight to quality* phenomenon refers to the situation where borrowers dealing with higher agency costs in credit markets will bear more the consequences of economic phases characterized by downturns and restrictive monetary policy. For instance, due to their informational opacity, SMEs are usually more subject to deal with credit restrictions under tightening policy periods, leading to a flight to quality phenomenon and consequently to a further fall in output (R. Troncoso, 2009).

Chapter 3 – A review of definitions and functioning of Unconventional Monetary Policies

In the economics literature we do not find a real and clear definition of what an unconventional monetary policy is. In fact, usually economists refer to unconventional monetary policies to categorize those *"measures that are not what is generally done, so they are not supposed to become the standard mode of monetary policy"* (L. Bini Smaghi, 2009). However, this may be somewhat vague. Sometimes this difference can be so subtle that it is very difficult to make a clear distinction. For instance, according to the common economic thought in the 1970s, some monetary policy interventions experienced during the last crisis would not be classified as unconventional (C. Borio and P. Disyatat, 2009). Despite the mere terminology, we usually consider as conventional monetary policy three main types of measures: standing facilities, open market operations, and reserve requirements. However, in serious economic contexts of crisis, conventional monetary policies result to be insufficient to permit the achievement of monetary policy's goals. It entails that *"exceptional times call for exceptional measures"* (M. Lenza et al., 2010). These measures are peculiar not only because their sizes and scope, but also due to the absence of previous experience which can lead and guide the implementation of this kind of policies (S. Kozicki et al., 2011). Moreover, accordingly to L. Bini Smaghi (2009), there are two main "exceptional time" scenarios. The first situation refers to the so called zero lower bound. In such a case indeed, the interest rate usually used by the central bank as a steering tool for the economy is so close or even equal to 0, that lowering it in order to provide more stimulus would be ineffective. Therefore, zero lower bound results to constrain central bank actions, with this latter that can solely resort to unconventional policy instruments in order to further stimulate economy. Secondly, there are other situations where these rates are not at a zero level but the use of unconventional monetary instruments is still required. This refers to an economic context characterized by financial crisis where the canonical transmission *"can be severely impaired by disruptions in the financial markets"* (M. Cecioni et al., 2011). The first country to rely on this kind of policy was Japan during the 1990s. In 1995, the Bank of Japan (BoJ) was forced to resort to alternative ways in order to try to better off a difficult economic scenario. The first unconventional measure brought about by the Japanese central bank was the so called ZIRP (Zero Interest Rate Policy). For the first time in history thus, a central bank kept a zero rate level as a policy tool for a given period of time (M. Shizume, 2018). Even more relevant was the adoption of a new QE policy in 2001 in order to tackle a new economic downturns. In the USA, with the beginning of the Great Recession of 2007-2009, the Federal Reserve System (FED) opted for two specific measures to provide further stimulus to U.S. economy: forward policy guidance and large-scale asset purchases (LSAPs) (J. Williams, 2012). The main FED's goal by adopting forward guidance was *"to affect longer-term bond yields and other financial asset prices directly by providing forward guidance about future short-term interest rates"* (G. Rudebusch, 2018). Even if through a different mechanism, the ultimate goal of the QE is the same of that one of forward guidance: steering long-term interest rates in order to stimulate economy. In fact, the idea behind is that *"it puts direct upward pressure on the price of the targeted assets, thereby lowering their yields"* (S. Kozicki et al., 2011). For what concerns the specific U.S. case, at the beginning of the crisis the FED decided to launch new unconventional balance sheet policies by buying Treasuries and mortgage-backed securities. In doing so, the FED enlarged its own balance sheet size, switching from a total holdings accounted for almost 800 billion dollars to an amount higher than 4 trillion dollars. Only when economic conditions started to sharply improve in 2017, the FED decided to scale down the size of its own balance sheet. Unconventional monetary policies have also been widely used in Europe. However, conversely to U.S. FED, European Central Bank (ECB) approached unconventional policy instruments as complement rather than substitute to the conventional measures to deal with these "exceptional times" (P. Cour-Thimann and B. Winkler, 2013). In fact, only once that conventional policies had already been rehearsed with, new non standard measures also known as "credit enhanced support" were implemented in order to further support banks' flow of credit (J. Trichet, 2009). For instance, the ECB opted for implementing the so called fixed rate tenders and full allotment (FRFA) measure in order to tackle the lack of liquidity that was hitting the market. The ECB did not limit itself to implement just FRFA and looser collateral requirements. In 2009, in parallel to an extension in the maturity of its longer-term refinancing operations (LTROs) to 12 months, the ECB also launched the Covered Bond Purchase Program (CBPP) to favor the activity in the euro area covered bond market (J. Bernie et al., 2011). Due to the beginning of the sovereign debt crisis, in 2012 the ECB also launched other policies such as:

I. two LTROs with a maturity of 3 years each;

II. lower reserve ratio requirement (from 2 to 1 percent);

III. higher collateral availability due to the acceptance of additional credit claims by national central banks;

IV. development of alternative credit assessment sources for use in the selection of eligible collateral.

In addition, in in August 2012, after a famous speech of the ECB president in charge Mario Draghi where he said to be prepared to put in place any solution would be necessary, the ECB announced the so called Outright Monetary Transactions (OMTs) program. Moreover, other relevant measures were adopted in 2014 such as the CBPP3 and the Asset-Backed Security Purchase Program (ABSPP). Despite all this historical review, in general the mostly known unconventional monetary policies are the following:

- **Forward Guidance**. We refer to forward guidance whenever a central bank decides to communicate to the private sector their own intentions relative to the future evolution of policy rates. In other words, it is nothing more than a sort of *"advance communication form about future policy orientations"* (P. Praet, 2013).

- **Balance Sheet Policies: Quantitative and Credit Easing**. Despite different definitions provided by Borio and Disyatat, or by Bernanke, in this work we primarily consider the distinction made by M. Lenza (2010) between pure credit and pure quantitative easing. According to him, through the first policy the central bank just modifies the composition (but not the size) of its own asset side by introducing new unconventional assets in exchange for conventional ones. In doing so, the central bank can address three main goals: improving market liquidity in certain specific segments, decreasing interest rates, and especially easing funding conditions for firms and financial institutions. This is also partially true for pure QE but with some differences. In this case part of government debt is massively bought by the central bank. More specifically, the central bank just enlarges its asset side by purchasing in the market more "conventional" assets (i.e. government bonds) rather than "unconventional" ones like mortgage-backed-securities. Nevertheless, here the focus must be more on the liability side and particularly on the role played by bank reserves.

- **Negative Interest Rate Policy**. This policy is usually used in a zero lower bound situation, if the aggregate demand is considered insufficient by the central bank. In fact, this latter can set a negative rate policy in order to stimulate consumption and investment, and thereby increasing aggregate demand (J. McAndrews, 2015)

In terms of transmission channels, unconventional policies are usually transmitted to a set of channels quite different from the traditional interest rate channel. The first of this is the so called portfolio-balance channel. This channel comes into play whenever both banks and private sector's asset side composition and size change following certain central bank's actions such as outright purchases of securities or liquidity injections (K. Kuttner, 2018). The main assumption behind its functioning refers to the imperfect substitutability among private sector's balance sheet components. Thanks to this latter, by modifying the relative supplies of assets, central banks are able to directly affect investors' portfolios compositions and behavior (C. Borio and P. Disyatat, 2009). More specifically, purchases of long-term assets by the central bank causes a subsequent increase in their price (and decrease in yields) pushing investors to look for alternative similar assets with higher returns. This means that through a supply-induced portfolio balance effect, the central bank is able to further lower yields and in turn to ease financial market conditions. The second very important transmission channel here is the signaling channel, alternatively known also as infation risk channel. In particular, its effectiveness is based upon three main elements: central bank's credibility, its communication strategy, and the adequacy of the monetary policy in order to target inflation appropriately. Considering the case of balance sheet policies, central bank activates the signaling channel through communications involving key topics such as future policy developments and paths or risk and liquidity of different classes of assets. In other words, all those issues relative assets' market valuation (M. Cecioni et al., 2011). The so called liquidity channel is instead based on liquidity premium. For instance, the launch of a new QE policy introduces a large committed buyer (i.e. central bank) which is able to lower liquidity risk and in turn liquidity premiums and yields by putting additional liquidity to the market. In simpler terms, the liquidity channel is a sort of "liquidity buffer" provided by the central bank which permits to recover financial markets in periods of crisis (J. Janus, 2016). In parallel to the channels there is also the confidence channel. This latter, conversely to the previous ones, is based on the public's perceptions of uncertainty and risk. Finally, also BLC is able to transmit monetary stimulus of unconventional policies. In addition, we also find a large economics literature in this respect. For instance, U. Albertazzi et al. (2016), by analyzing bank level data, demonstrated how both conventional and unconventional monetary policies work (also) via BLC. They also point out how in contrast to what established by the conventional bank lending literature, since unconventional policies are brought forth in "hard times", the banks' capitalization level influence in terms of monetary policy stimulus may be overturned. In other words, banks presenting lower capitalization levels usually feel more regulatory constraints and, in turn, they could be less effective in the monetary transmission process due to the limited lending ability.

Chapter 4 – Bank Lending Channel in unconventional times: an empirical work

In order to analyze the transmission of unconventional monetary policies through BLC we based our work on the VAR methodology as widely done in this literature field. For instance, our VAR models have been inspired by R. De Santis and M. Darracq-Paries (2015) and G. Di Giorgio and G. Traficante (2014), whereas the variable blocks are similar to M. Guth (2018). In particular we provide 5 different VARs:

$$\textbf{Model 1}: Y_t = (P_t, Y_t, L_t^T, r_t)$$
$$\textbf{Model 2}: Y_t = (P_t, Y_t, L_t^T, s_t)$$
$$\textbf{Model 3}: Y_t = (Y_t, L_t, L_t^S, r_t)$$
$$\textbf{Model 4}: Y_t = (Y_t, L_t, L_t^S, s_t)$$
$$\textbf{Model 5}: Y_t = (L_t, L_t^S, L_t^D, s_t)$$

From these equations we can identify two main variables blocks. The first refers to the credit market itself and it includes the loans aggregate in log basis (L) and the BLS variables (supply, L^S, and demand L^D). The choice of BLS as main data source is quite common in this research field (i.e. C. Altavilla et al., 2018). This is a survey run by ECB in order to gather additional information on credit market dynamics and trends which will be used as input by ECB Governing Council to better design the monetary policy path. The sample group consists of 150 banks euro area with data reported quarterly from 2003 to nowadays. However, thanks to a cubic spline interpolation procedure, we were able to transform these data from a quarterly to a monthly basis making in this way possible to have all monthly data. As a result, our dataset is based on 113 monthly observations from September 2004 to January 2014. In our model, among these we will use only the first and the sixth questions since they will permit us to disentangle the relative effects on credit to Non-Financial Corporation (NFC)s demand and supply. In the literature several papers (i.e. P. Del Giovane et al., 2011) demonstrate the reliability of credit standards questions as proxy for the credit availability in the euro area (M. Guth, 2018). In addition, we also introduce a variable to account for the total loans aggregate provided by all banks of a given nationality towards all Euro area counterparties. Since the unavailability of finding loan data specific to NFCs we use an aggregate variable which consider all the different kind of credits per borrower. The second block is instead focused on the macroeconomic and monetary policy variables. More specifically, in our VARs we consider two macroeconomic variables (in a logarithmic scale), one as price evolution indicator (P) and another for representing the total output aggregate (Y). In this way we are able to control the general economic development for each country analyzed. For what concerns the output aggregate and its growth, we will plug the real GDP in our model to account for it. As done for BLS variables, in order to deal with the quarterly time frame of GDP observations, we perform a Chow-Lin interpolation to transform data on a monthly basis. Moreover, concerning price variables, we have opted for Harmonised Index of Consumer Prices (HICP) that excludes energy and unprocessed food. In our VARs we will also use two variables to account for monetary policy effects. The first refers to Euro OverNight Index Average (EONIA, r) rate which is computed as a weighted average of all overnight unsecured lending transaction undertaken in the interbank market. Nevertheless, this rate is not suitable to be used as a sort of proxy for unconventional monetary policy. In fact, as explained by B. Rossi (2018), there are several different methods being used in the recent VAR literature to account for the unconventional tools of central banks among which we do not find EONIA rate. Among these different alternatives, we opted for the so called shadow rate (s) developed by J.C. Wu and F.D. Xia (2013). Once structured the models, we also need to perform residuals diagnostic checks in order to test if our VAR(p) models are stationary and correctly specified. First of all, we need to control if there is stationarity or not. A VAR(p) process is stationary if and only if all the np roots of the characteristic polynomial lie in absolute value the unit circle. Secondly, it is important to test whether the first lag length chosen initially is effectively optimal for our model. To do so, Eviews provides several different tests. Among these, in our work we resort more on Akaike's Information Criterion (AIC), Schwarz-Bayesian Information Criterion (SBIC), and Hannan-Quinn Criterion (HQ). In general, we opt for the smallest lag length arising from these three statistics. Moreover, to check for serial correlation we use the Lagrange multiplier (LM) test. Regardless of this, in our models we will expect to find serial correlation in some lags since we do not impose any kind of restrictions on parameters implied by theory. In other words, we use simple unrestricted VAR instead of a so called Structural VAR (SVAR). From a pure macroeconomics perspective, this means that our models do not consider all the explanatory variables making in this way the residuals correlate to the variables embedded in VAR models. This would be an issue in the case of structured analyses on the estimated parameters since serial correlation directly affects the residuals and in turn all the statistics tests' meaning. By the way, here we do not focus on statistics coefficients but rather on impulse responses and variance decomposition in order to capture the main trends and effects stemming from a possible linkage between monetary policies and the credit market. Finally, before to run impulse response functions and variance decomposition we need to imply orthogonalized residuals. To do so, we resort on the so called Cholesky decomposition as usually done in the literature. This process permits us to make errors uncorrelated across equations. Then we start our econometric investigation by developing impulse response functions (for Models 1 to 4) and variance decomposition (Model 5). These are two of the main types of analysis which are usually run with VARs. By looking at impulse responses, we can try to answer question like "what will happen to GDP after k periods if today central bank decides to launch a new tightening monetary policy?". Finally, even though we will simulate a tightening monetary policy, since impulse responses are symmetric we can read these outcomes also from an opposite point of view without making any conceptual mistake. Then, we perform the variance decomposition on Model 5 in order to disentangle the relative effects of credit demand and supply on the total loans aggregate. In fact, variance decomposition is widely used in economics studies since it permits to understand how much of a variation of a given dependent variable is explained by each of the independent variables. All the main results stemming from this analysis are summarized in the next section whereas all the figures of impulse responses and tables of variance decomposition are reported in the whole thesis.

Conclusion and results

Our results suggest how BLC is activated by both types of monetary policies. By simulating a tightening monetary policy through a policy rate innovation we also point out how inflation does not respond as expected in Italy and Spain since it strongly rises in the first periods. In our opinion this is a typical case of price puzzle affecting VAR models. As expected, GDP is negatively affected by the increase of the policy rate and it shows a typical hump shaped curve. In terms of loans aggregate, we register negative trends in response to a tightening policy innovation. Then we go deeper by considering not only loans as a whole but also a BLS variable accounting for credit supply. In particular our variable refers to credit standards which becomes rigid with positive values and vice versa. By looking at the derived impulse response functions, we find out different responses in the countries analyzed with Italy and Spain showing a loosening in the long run. In general, all countries seem to present the functioning of a BLC. However, some differences emerge amongst the countries analyzed. In particular, Austria presents outcomes with the expected signs (negative response in terms of loans and an increase in credit standards) which are both almost not statistically significant at all. The credit supply in Germany loosens in the first months after the policy innovations instead of tightening immediately as for the other countries. This suggests that at least for this initial period the loans offering depends more on other aspects rather than the policy rate. However, after six months credit requirements start to increase reaching peaks which are also statistically significant. In Italy credit supply is strongly affected by the policy shock despite a decrease in the total loans which is not statistically significant. Probably also other aspects influence the loan market in addition to the BLC. Only Spain shows a statistically significant reduction in the loans aggregate besides a significant increase in the credit requirements (in Model 3), suggesting that in this country BLC could be important for the conventional policy transmission. Nevertheless, in Model 4, the rise in credit standards completely loses its statistically significance. This suggests that BLC becomes less strong in the transmission of unconventional policies probably because of a poor banking market capitalization. Recalling U. Albertazzi et al. (2016), in contrast to what established by the conventional bank lending literature, since unconventional policies are brought forth in "hard times", the banks' capitalization level influence in terms of monetary policy stimulus may be overturned. In other words, banks presenting lower capitalization levels usually feel more regulatory constraints and, in turn, they could be less effective in the monetary transmission process due to the limited lending ability. Except for Spain, all other countries show quite similar impulse responses if we compare conventional and unconventional policy with some differences mostly in quantitative terms. Since one of the most important issue in this literature is the difficulty to disentangle demand and supply side in the credit market, we also provide a variance decomposition of loans aggregate. In this way we highlight how only Italy shows a greater sensitiveness on supply rather than demand side. According to us, this is a consequence of the impact of the Italian credit crunch phenomenon expe-

rienced during the economic downturns of the period here considered. On the other side, German credit market seems to depend on supply and demand side almost in the same way, whereas in Austria and Spain credit demand appears to be more relevant as determinant of the total credit outstanding amount. To check for these outcomes, we perform as a robustness check a change in the variable ordering which confirms again the results provided.
All in all, our results demonstrate how loosening monetary policies implemented by ECB during the crisis were supportive to the economic contexts of the countries analyzed. We also find out that overall BLC participates in the monetary policy transmission regardless of its kind. This finding is aligned with other empirical works such as U. Albertazzi et al. (2016). Despite this contribute to the monetary transmission process, BLC does not seem to have played a so crucial role during the financial and debt crises. Yet, such a result is shared with most of the literature described on Par. 3.4.5. However, based only on these outcomes is not possible to quantify the relative importance of each different unconventional policy and transmission channel as well.