Euro Area Interest Rate Pass-through: Normalization or Disruption?

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### Sammandrag:

I study the adjustment of retail bank interest rates on loans to non-financial corporations in response to changes in the policy rate. I estimate a model of the transmission process for the corporate loans market in 7 Euro area countries. I study whether a significant shift has occurred after the financial crisis of 2008 in both the equilibrium mark-up on bank lending rates and the degree to which bank lending rates adjust to movements in money market rates. In line with previous literature, I find the shift to be significant. The results however indicate that the period up until the crisis, in the countries that later experienced greater economic distress, appears to be unusual and should not be considered as a baseline period.

### Nyckelord:
Interest Rate Pass-through, Bank Lending, Monetary Transmission, Monetary Policy
# TABLE OF CONTENTS

1 INTRODUCTION ........................................................................................................................... 1

2 TRANSMISSION OF MONETARY POLICY INTEREST RATES ......... 4
   2.1 Transmission channels of monetary policy ................................................................. 4
   2.2 Transmission of policy rates to bank lending rates .................................................. 6
   2.3 The structure of interest rates .................................................................................... 8
      2.3.1 The rational expectations hypothesis of the term structure of interest rates 8
      2.3.2 The risk structure of interest rates ...................................................................... 9
      2.3.3 The market structure of interest rates ................................................................. 9
   2.4 Modeling the bank lending rate ................................................................................. 10
      2.4.1 Model assumptions ............................................................................................... 11
      2.4.2 Bank profit maximization and equilibrium loan rate ........................................ 12
      2.4.3 Implications of the model .................................................................................... 14
   2.5 Further considerations ................................................................................................. 14
      2.5.1 Business cycle effects on bank behavior ........................................................... 16
   2.6 Implications of incomplete interest rate pass-through .................................... 17

3 LITERATURE REVIEW ................................................................................................................. 18
   3.1 Differences in past empirical approaches ................................................................. 18
   3.2 Short run interest rate pass-through ......................................................................... 20
   3.3 Long run interest rate pass-through ......................................................................... 22

4 EMPIRICAL SPECIFICATION .................................................................................................... 26
   4.1 Tests for non-stationarity of the time series ............................................................. 26
   4.2 The Engle-Granger cointegration methodology .................................................... 27

5 DATA ........................................................................................................................................ 30
   5.1 Time series descriptions ......................................................................................... 30
      5.1.1 Bank loan interest rates .................................................................................... 31
      5.1.2 Money market rates ......................................................................................... 31

6 RESULTS AND DISCUSSION .................................................................................................. 32

7 CONCLUSIONS .......................................................................................................................... 37

8 SAMMANFATTNING PÅ SVENSKA ........................................................................................... 38
REFERENCES ........................................................................................................ 45

APPENDIX

Bilaga 1  Time series........................................................................................................ 49
Bilaga 2  Appendix Tables ............................................................................................. 51
Bilaga 3  Appendix Figure 1 .......................................................................................... 57

TABLES

Tabell 1  Intercepts and slope coefficients of the long run relationship ................... 33

FIGURES

Figur 1  Transmission of policy rate changes to the bank lending rates. ................... 7
Figur 2  Medium term interest rates on bank loans in Germany and Spain ............. 34
1 INTRODUCTION

Understanding the transmission of central bank policy rate changes to the retail bank lending rates is vital for implementing monetary policy. Recent findings have indicated that the changes that occurred in connection with the global financial crisis had a significant impact on both the level and the dynamics of the interest rate pass-through (Blot and Labondance 2013). In this paper I argue that what initially looks like an impairment of the pass-through process in the southern countries of the Euro area more accurately can be characterized as a normalization. I discover the result by estimating a standard error correction model for a sample of 7 Euro area countries. The major conclusion that I propose is that it is unreasonable to expect the interest rate pass-through in all countries studied to return to their pre-crisis state.

The transmission of monetary policy impulses to the rest of the economy has been studied extensively. Of particular interest has been the pass-through of policy interest rates to retail bank lending rates since the early work of (Cottarelli and Kourelis 1994). Recent research on lending rates has found that the long run pass-through of policy interest rate adjustments has decreased in the southern Euro area (Holton and Rodriguez d’Acri 2015; Blot and Labondance 2013). The spread between money market rates and corporate bank lending rates remain high in these countries despite the efforts of the ECB to improve access to funding for SME’s. Extended econometric specifications are employed in later studies to account for the hike in credit risk premiums, fragility of the national banking sectors and macroeconomic risks. Controlling for CDS indices on national banking sectors and non-performing loans seems to bring pass-through estimates to a level resembling the pre-crisis period (Gambacorta, Illes, and Lombardi 2014). Alternatively, controlling for the term spread between long term government bonds and overnight rates and the rate of unemployment is also found to normalize pass-through dynamics (Darracq Paries et al. 2014).

The pass-through of policy interest rates became a major field of research in Europe in the year 1999, when the European Central Bank together with the National Central Banks launched a joint initiative to gain as much insight as possible on how the monetary policy of the newly created central bank would affect the Euro area economies (Angeloni, Kashyap, and Mojon 2003). A process of harmonizing the retail bank lending rates statistics of the Euro area was initiated and directly comparable time series are available starting from January 2003. The empirical research on European economies can roughly
be categorized into: pre-Euro area research, which uses unharmonized data; early Euro area research, which typically uses a combination of both harmonized and unharmonized data; post financial crisis research, which is primarily based on the harmonized time series. The main finding that persist across all time periods is that the interest rate pass-through process tends to be slow. No simple generalization can however be with regards to the degree of pass-through completeness in the long run. The results are heterogeneous across countries during all time periods that have been studied thus far (Andries and Billon 2015).

In this paper I study the interest rate pass-through process in the countries Austria, Finland, France, Germany, Italy, Netherlands and Spain. I use harmonized data on the average lending rates to non-financial corporations between January 2003 to February 2016. Bank lending rate statistics are split into three categories based on the interest rate fixation period of the underlying loans. I find that there has been a great increase in the spread between the lending rate and the policy rate in both Italy and Spain. On the other hand, in the banking markets of the other countries spreads rose only marginally after the crisis. I further find that the long run pass-through in Finland, France, Germany and The Netherlands is roughly complete in both the pre and post financial crisis time periods. A slight increase in the pass-through coefficient is observable in the post crisis period for both long and medium term loans in the aforementioned countries. The immediate impact is found to be low but heterogeneous across countries.

I estimate an error correction model which allows for a separation of short run dynamics around a long term equilibrium in the lending market. The equilibrium lending rate of retail banks is modeled as being dependent only on the policy interest rate and a markup. In order to accommodate the effect that the financial crisis has on the lending market equilibrium I allow for a shift in both slope and intercept terms. In line with the findings of previous literature the separation of the lending market equilibrium into two separate regimes is found highly significant. In particular, I find that the spread between bank interest rates and the policy rate has widened considerably in Italy and Spain as compared to other countries included in the study. The spread increased between 2,0 - 2,5 % on both medium and long term loans in the two previously mentioned countries. The long term pass-through coefficient of policy rate changes dropped from being close to unity to approximately 0,6 for all loan categories in Italy and Spain. The changes in long term pass-through in the rest of the countries did not adjust to any greater extent. At first sight it appears that the transmission of policy rate changes to Spain and Italy is
severely impaired. I will however argue that it can more accurately be described as a normalization rather than an impairment, as adjustments in risk premiums of various sort obscure the analysis of transmission properties.

The results of the study highlight challenges of the ECB to effectively control the interest rates that non-financial corporations in the Euro area face. Especially the small to medium sized enterprises are forced to accept exceptionally high interest rates in comparison to large enterprises, the problem is largest in Spain and Italy. The pass-through of interest rates is found to be weakened in Spain and Italy. I do however argue that the results appear more extreme than they actually are due to the inappropriateness of assuming the period of January 2003 to August 2008 to constitute a representative baseline period.

The structure of the paper is the following: In chapter 2 there is a theoretical overview of how central bank monetary policy is transmitted to the real economy and how banks operate and price the loans they grant. Chapter 3 then follows with a summary of previous empirical research and covers some of the major results. Section 4 explains the econometric modeling approach of this paper, section 5 contains technical details on the time series that are used for the estimation and section 6 contains the presentation of the results and the discussion. The last section contains some final concluding remarks.
2 TRANSMISSION OF MONETARY POLICY INTEREST RATES

In this chapter I cover the relationships between the central bank, the money market and the retail bank market. Part one consists of a general overview of the theory behind different transmission channels of monetary policy, which are mechanisms by which monetary policy has an effect on the real economy. Particular focus lies on the interest rate channel as it describes how central bank manipulation of interest rates affect the real economy. I also briefly discuss some of the implications of incomplete interest rate pass-through on the efficiency and conduct of monetary policy.

2.1 Transmission channels of monetary policy

Monetary policy transmission channels are ways through which central bank policy actions have an effect on the real economy. The speed and strength of policy transmission determines the potential effectiveness of monetary policy. Effective monetary policy enables the central bank, at least in theory, to steer the economy in a desired direction. Two central concepts required for the analysis of central bank decision making are goals and instruments. “Goals, such as inflation or deviations of unemployment from the natural rate, are the ultimate variables of interest to policy makers; instruments are the actual variables under their direct control.” (Walsh 2010). Furthermore, the data on instrument variables are typically obtained at a much higher frequency than the goal variables which has implications for practical economic modeling and the operations of the central bank. Central bank tools are methods by which the instruments are manipulated in practice.

The tools that are at the central banks disposal are open market operations, setting of the interest rates on the central banks own lending and deposit facility, setting the level of minimum reserves and controlling what interest it pays on bank reserve deposits (Ball 2012). The central bank may additionally try to affect the expectations formation of the agents in the economy by its communication strategies but these are beyond the scope of this paper.

The phenomenon called interest rate pass-through is the process by which a change in the central bank’s policy rate is transmitted to retail bank lending rates. The properties of the pass-through process depend to a great extent on the interest rate transmission channel. It is however affected by several of the other transmission channels of monetary
policy. In practice, the transmission channels are ways in which monetary policy instruments have an effect on the economy through price effects on assets, yields, collateral values, exchange rates, credit availability, net worth of economic agents etc. (Walsh 2014)

Monetary transmission channels can be categorized into two basic categories depending on whether a perfect financial market is assumed or not. The transmission channels that exist in the absence of financial market imperfections are referred to as neoclassical channels and are channels that relate to investment decisions, consumption decisions and international trade. The non-neoclassical channels that represent the so called “credit view” are those of the bank lending channel, bank capital channel, balance sheet channel and the effects on credit supply that government interventions in credit markets have. (Boivin, Kiley, and Mishkin 2010)

The direct interest rate channel of monetary policy operates through the effect interest rates controlled by the central bank have on the cost of capital in the economy. For the central bank to be able to influence the real interest rate through its setting of nominal interest rates sticky prices are needed (F. Mishkin 1996). In standard neo classical models the cost of capital is the key determinant for the demand for capital, which in turn is needed for the financing of investments (Boivin, Kiley, and Mishkin 2010). This applies to both business investment decisions as well as consumers’ investment decisions relating to housing and durable goods (F. Mishkin 1996).

The other channels of monetary policy that will come to influence the observed dynamics of the interest rate pass-through are the so called lending channel, the balance sheet channel and bank capital channel. These channels have an impact on the economy through their effect on credit supply (Bernanke and Gertler 1995). The bank lending channel becomes relevant in economies where certain borrowers are bank dependent for their access to finance. The monetary policy implication of this channel is that monetary shocks will have much greater effects on such agents that are dependent on bank funding as their only source of capital. The balance sheet channel works by the effect monetary policy shocks have on balance sheets (e.g. a monetary tightening results in lower asset prices resulting in lower net worth of firms). The effect of the change in balance sheet valuations is then translated into modified bank lending behavior as there is less collateral for the firms to pledge. The balance sheet effect of monetary policy shocks does thus amplify the shocks on the economy by worsening the informational frictions, the models that incorporate these effects are referred to as financial accelerator macro
models, see (Bernanke, Gilchrist, and Gertler 1999). The value of banks own assets is also a transmission channel in itself as the loan supply decisions of the banks are heavily dependent on the quality of the assets they possess. A sudden deterioration of bank assets can then lead to a comparatively larger cut-back in lending which in this case isn’t the result of increased informational problems but banks trying to repair their balance sheet to comply with minimum asset quality regulations (Boivin, Kiley, and Mishkin 2010).

2.2 Transmission of policy rates to bank lending rates

As the process of transmission of policy rates to bank lending rates is complex, I will rely on a stylized picture to give the reader an overview before going into further details. Figure 1 shows the process starting from an initial adjustment in the policy rate up until the ultimate effect on real economic variables such as inflation and the level of economic activity.

The first step in the process relates to how the adjustment of the policy rate is reflected in the whole term structure of interest rates. In other words, the process by which an adjustment of the policy rate immediately is mirrored in the overnight rate and how the adjustment consequently affects money market interest rates of longer maturity. This term structure relationship between interest rates of similar credit risk but differing in terms of maturity is commonly referred in the finance literature as the yield curve (Cuthbertson and Nitzsche 2010).

The next step in the process is relates how movements in the term structure of the money market and government bond market affect the interest rate setting behavior of retail banks on their loan products. The spreads observable between the bank lending rates and the money market rates are furthermore influenced by both changes in structural factors and movements in credit risks and bank funding conditions. By structural factors I refer to issues such as the intensity of competition in the retail bank market, the operational efficiency of the bank system and the burdens of complying with national bank regulations and so forth. (ECB 2009)

We can thus state the objective as determining the ability of the central bank to transmit impulses on very short term money market rates to the bank lending specific market structure of interest rates (Acuña 2005). Where market structure of interest rates can be thought of as a yield curve over both the maturity and credit risk dimension.
The scope of this paper is limited to analyzing the process up until the realized changes in bank lending and deposit rates. The effects on spending and investment, and ultimately, inflation and output are thus left out of my analysis. The estimated coefficients of the pass-through that I present can however be used as input values in large scale macro model simulations that are used to predict the final effects on the real economy.

I motivate the empirical approach I take by introducing some theoretical models for decomposing the market structure of interest rates. Decomposition of the observed interest rate can also be viewed in the context of figure 1, the final bank lending rates that corporations face can viewed as a result of an additive process of the kind sketched out in the figure. First the rational expectations of the term structure will provide a foundation for how interest rates for debt obligations of different maturities are related. Then two different types of premiums are introduced to explain how the relationship between two given interest rates can fluctuate over time. Finally, I introduce explicit
banking market characteristics that furthermore play a role in determining the market outcomes that we actually observe.

2.3 The structure of interest rates

The three parts that together determine the level of interest rates are a term premium, a risk premium and a market specific premium. The last factor relates to the unique characteristics of a specific interest bearing asset, such as that of a bank loan in our case. To illustrate how factors beyond the risk and term premium play a role in determining the market outcomes in retail bank lending markets I apply an industrial organization modeling approach to the market in question.

2.3.1 The rational expectations hypothesis of the term structure of interest rates

The term structure of interest rates describes the relationship between long term interest rates and short term interest rates. It applies directly to similar financial instruments that have identical credit risk characteristics but differ in their maturity. As an illustration, a risk free bond of one period with return \( r_t \) and a bond with maturity of \( n \) periods and return \( r_t^n \) shall be considered. According to the hypothesis the following relationship holds between the two interest rates:

\[
    r_t^n = \frac{1}{n} \left[ r_t + \sum_{i=1}^{n-1} E_t(r_{t+i} | \Omega_t) \right] + \gamma(n)_t
\]

Where \( E_t(\ast | \Omega_t) \) is the rational expectations operator conditional on the information available at time \( t, (\Omega_t) \). The term \( \gamma(n)_t \) represents the so called term premium. Under the pure expectations hypothesis, the term premium is equal to a constant zero and independent of \( n \). In practice, we expect the term premium time series process to be positive over time as there has to be some sort of “reward” for holding an asset with longer maturity, for a further discussion on the topic see (Advanced Asset Pricing Theory, Chenghu Ma, 2011, p. 484-485). Depending on whether the auto covariance and first moment properties of \( \gamma(n)_t \) are time independent or not can be useful for modeling interest rate time series that are integrated of order one, which they typically are found to be (Brooks 2002). It is then argued that if the expectations hypothesis of the term
structure of interest rates holds any pair of interest rates from the term structure would be related by a cointegrating vector \((1,-1)\) and the left over term premium be a stationary process. E.g. 
\[
\begin{align*}
\frac{1}{n} \left[ r_t + \sum_{i=1}^{n-1} E_t(r_{t+i}|\Omega_t) \right] + \gamma(n)_t & \to r^n_t - \frac{1}{n} \left[ r_t + \sum_{i=1}^{n-1} E_t(r_{t+i}|\Omega_t) \right] = \\
\gamma(n)_t, \quad &y_t \sim WN(\mu, \sigma^2),
\end{align*}
\]
where \(r^n_t\) is the long term interest rate and \(r_t\) a short one period interest rate of an identical debt contract credit risk wise. Indeed, by studying whether this cointegrating relationship holds is how most researchers assess the expectations hypothesis in empirical work. (Cuthbertson and Nitzsche 2010)

### 2.3.2 The risk structure of interest rates

The second dimension of interest rates that we will explicitly single out relates to the particular risk associated with the underlying asset. The concept risk structure refers to the relationship between interest rates on debt contracts with identical time to maturity but with heterogeneous risk characteristics. As an illustration we can consider the difference in yields on risk free government bonds and risky corporate bonds in a competitive bond market. The risk structure of interest rates can be plotted as curve, like the term structure, but as a mapping between yields and default risk probabilities (Powers, Castelino, and Powers-Castelino 1991). The relationship between the yield of two different debt contracts of same maturity can be formally expressed as:

\[
i_t = g_t + \phi_t
\]

Where \(i_t\) is the yield on the comparatively riskier debt, \(g_t\) the yield on the less risky debt and \(\phi_t\) the risk premium as determined in the credit market for the two separate risk categories. For empirical modelling the stationarity properties of \(\phi_t\) is of similar interest as the stationarity properties of the term premium \(\gamma(n)_t\) was. Given that there exists a cointegration vector \((1, -1)\) for the pair of interest rates \(\{i_t, g_t\}\) error correction models can be used for modeling the interest rates if found to be integrated of order one (Acuña 2005). (F. S. Mishkin 2013)

### 2.3.3 The market structure of interest rates

Now both of the concepts of term premiums and risk premiums of interest rates can be combined in a single framework. This would allow us to describe the spread between any two interest rates observed by participants in the financial market. The relationship would thus be:
\[ r_t^n = g_t + \gamma(n)_t + \phi_t \]

Where \( r_t^n \) is a riskier long term interest rate, \( g_t \) a less risky short term interest rate, \( \gamma(n)_t \) is the term premium and \( \phi_t \) the risk premium. Establishing the stationarity of the term \( \eta_t = \gamma(n)_t + \phi_t \), would again allow us to employ error correction models for studying the long term relationships between the interest rate pair in question.

Explicit term premium modeling has become a topic of very active research in the last decade. The findings typically indicate that the term premium fluctuates quite a lot over time, this might pose serious challenges to the empirical analysis we are about to perform. The same applies to the aggregated credit risk premium market participants require as well. The deviation from the equilibrium relationship between any given pair of interest rates can thus be quite large in times when these premiums experience large rapid fluctuations. This makes the analysis of interest rate pass-through more challenging. See (Adrian, Crump, and Moench 2013) for further details on the challenges of estimation of the term premium in practice.

As pointed out in (Acuña 2005) the risk and term premium should not be taken as perfectly describing why a spread occurs between any given pair of interest rates. The market specific features can be quite important and in the case of bank lending rates it is useful to adopt a modeling approach that explicitly accounts for the banks’ profit maximizing behavior. The microeconomic models of bank behavior of the industrial organization (IO) literature allow for this. These richer IO models reveal that equilibrium credit market outcomes are not only dependent on money market rates along with term and risk premiums but the result of the banks optimal behavior in response to changing market conditions. Factors such as time varying marginal costs of providing loans, market power of providers of credit, demand elasticity of loans and issues like adverse selection of borrowers will among others come to influence the specific market outcomes.

2.4 Modeling the bank lending rate

The core theoretical framework that I will use to explain the determinants of credit market equilibrium is based on the Monti-Klein model of a monopolistic bank (Klein 1971)(Monti 1972). The model serves as a theoretical illustration of how factors beyond the term and risk structure of interest rates determine the equilibrium bank lending rates. The Monti-Klein model is the foundation on which more recent theoretical models in the industrial organization literature have extended upon. This framework plays an
important role in motivating the particular econometric approach opted for in this paper as well as most of the other empirical literature, for summaries of papers that follow this approach more or less directly see (G. De Bondt 2002)(G. J. De Bondt 2005) and (ECB 2009).

Following the traditional approach of the industrial organization literature, the role of the bank in the Monti-Klein framework is a profit maximizing firm like any other. The original Monti-Klein framework considers a monopolistic market structure; however, the European banking markets are better described as oligopolistic (Angeloni, Kashyap, and Mojon 2003). After all, there are several competing banks in all countries but the barriers to entry are quite high, so the market structure does not approximate perfect competition. The version of the Monti-Klein framework that I will present is based on that of (Freixas and Rochet 1997) and is modified to accommodate Cournot competition between a finite number of competing banks. Finally both credit risk and minimum reserve capital requirements are included in the model as a further extension following (Wong 1997) and (Corvoisier and Gropp 2002). The optimal lending rate of a representative bank is then derived by imposing equilibrium in the lending market. The presented derivations are directly the work of (Putkuri 2010).

2.4.1 Model assumptions

First I introduce the assumptions on top of which the model is built and then the resulting optimization behavior is characterized.

There is a market where banks and borrowers meet. The banking industry is assumed to be oligopolistic and there are a number of banks $N$, where $N$ is finite and banks are indexed as $n \in [1, N]$. The banks offer both loans and deposits to their customers. Banks are furthermore forced to hold a certain amount of equity capital as reserve capital. Furthermore, there is an interbank market where banks amongst themselves can lend and borrow surplus reserve capital.

The balance sheet of a bank is described by the following identity:

$$L_n + M_n = D_n + K_n \ [1]$$

Where $L_n$ is the quantity of loans, $D_n$ the quantity of deposits, $K_n$ the amount of equity capital held by the bank and $M_n$ the amount lent or borrowed from the interbank market.
The interest rate in the interbank market, \( r_M \), is controlled exogenously by the central bank. The minimum amount of equity capital \( K_n \) that the bank chooses to hold is determined by the reserve requirement set by the central bank:

\[
K_n \geq \kappa L_n \quad [2]
\]

The cost of holding equity capital, \( r_K \), is assumed to be greater than the interbank market rate, \( r_M \) and the rate paid on deposits, \( r_D \), at all times. This criterion ensures that the reserve requirement is strictly binding and that \((1 - \kappa)L_n\) will be financed by either deposits or interbank borrowing.

Individual banks are assumed to have an identical cost function which is strictly increasing and of the form:

\[
C(L, D) = \gamma_L L_n + \gamma_D D_n \quad [3]
\]

Where parameters \( \gamma_L \) and \( \gamma_D \) are assumed to be constant. The parameters are equal to the marginal costs of providing loans and respectively deposits as can be seen from the separable form of the cost function.

\[
\gamma_L \equiv \frac{\partial C(L, D)}{\partial L} \quad \text{and} \quad \gamma_D \equiv \frac{\partial C(L, D)}{\partial D} \quad \text{with} \quad \frac{\partial^2 C(L, D)}{\partial L \partial D} = \frac{\partial^2 C(L, D)}{\partial D \partial L} = 0 \quad [4]
\]

Demand for bank loans \( L(r_L) \) are decreasing in the loan rate \( r_L \) and vice-versa the demand for bank deposits \( D(r_D) \) are increasing the deposit rate \( r_D \).

The credit risk banks face on their loans is represented by the parameter \( \mu \in [0,1] \) and in the original model is the probability that a given loan will defaulted upon. The parameter is identical for all banks as all banks are assumed to have similar degrees of risk aversion and can be thought of as the share of non-performing loans at the end of the period (Wong 1997) or alternatively the default probability of loans (Corvoisier and Gropp 2002).

### 2.4.2 Bank profit maximization and equilibrium loan rate

Banks compete in a static Cournot game by setting quantities of supplied loans \( L \) and supplied deposits \( D \). Given the total quantities \( L \) and \( D \) chosen by the banks both lending and deposit interest rates adjust to their market clearing levels \( r_L(L) \) and \( r_D(D) \).

The profit function that a given bank \( n \) is maximizing, taking into account its budget constraint [1], takes the following form:

\[
\max_{L_n, D_n} E[\pi_n(L_n, D_n)] = (1 - \mu)r_L L_n + r_D D_n - r_K K_n - C(L_n, D_n) \quad [5]
\]
The total expected profit is a simple function of expected interest income less total capital expenditure. The expected profit function [5] can be expressed utilizing the relationships [1], [2] and [3].

\[ E[\pi_n] = ((1 - \mu)r_L(L) - r_M)L_n - (r_D(D) - r_M)D_n - (r_K - r_M)\kappa L_n - \gamma_L L_n - \gamma_D D_n \]  

The optimum quantities of loans and deposits for the individual bank firm to supply are found by taking first order conditions while taking the quantities that the other \( N-1 \) banks are supplying as given. However only the first order condition for the optimal number of loans is relevant for the research question in this paper and thus the first order condition for the quantity of deposits is omitted here. The Cournot Nash equilibrium is the following given that the profit function is strictly concave in both \( L_n \) and \( D_n \) and twice differentiable. The sum of optimal lending quantities of all banks is denoted \( L^* \) and \( L^*_n \) indicates the optimal lending quantity of the individual bank \( n \). Loan quantities are increased until the expected marginal profit is equal to zero.

\[
\frac{\partial E[\pi_n]}{\partial L_n} = (1 - \mu)r_L(L^*) - (r_M + (r_K - r_M)\kappa + \gamma_L) + (1 - \mu)r_L'(L^*)L_n^* = 0 \quad [7]
\]

The optimal quantity of loans supplied by the individual firm can thus be solved as:

\[
L^*_n = \frac{(r_M + (r_K - r_M)\kappa + \gamma_L) - (1 - \mu)r_L'(L^*)}{(1 - \mu)r_L'(L^*)} \quad [8]
\]

The independence of \( n \) implies a symmetric equilibrium where all banks choose the same quantity, i.e. \( L^*_n = \frac{L^*}{N} \forall n \in [1, N] \). To then solve for the equilibrium lending rate \( r_L^* \), the previous expression for \( L^* \) is inserted into [8] and rearranging yields:

\[(1 - \mu) \left( r_L'(L^*) \frac{L^*}{N} + r_L(L^*) \right) = r_M + (r_K - r_M)\kappa + \gamma_L \quad [9]\]

Dividing both sides by \( (1 - \mu)r_L(L^*) \)

\[
\frac{(1 - \mu)r_L(L^*)}{(1 - \mu)r_L(L^*)} + \frac{(1 - \mu)r_L'(L^*)}{(1 - \mu)r_L(L^*)} \frac{L^*}{N} = \frac{r_M + (r_K - r_M)\kappa + \gamma_L}{(1 - \mu)r_L(L^*)} \quad [10]
\]

Replacing \( \frac{r_L(L)}{r_L(L^* \text{L})} \) with \( -\varepsilon_L(r_L) \)

\[
1 - \frac{1}{\frac{N\varepsilon_L(r_L)}{1}} = \frac{r_M + (r_K - r_M)\kappa + \gamma_L}{(1 - \mu)r_L(L^*)} \quad [11]
\]

Solving for the equilibrium interest rate \( r_L^* (L) \) yields the expression:

\[
r_L^*(L) = \frac{1}{1 - \mu} \left( 1 - \frac{1}{\frac{N\varepsilon_L(r_L)}{1}} \right) (r_M + (r_K - r_M)\kappa + \gamma_L) \quad [12]
\]
Which can be written as a simple linear relationship between the bank lending rate and the interbank interest rate:

\[ r_L^* (L) = \beta_0 + \beta_1 r_M \quad [13] \]

where \( \beta_0 = \frac{1}{1-\mu} \frac{1}{1-N_{\epsilon_L(r_L)}} (kr_K + \gamma_L) \) and \( \beta_1 = \frac{1}{1-\mu} \frac{1}{1-N_{\epsilon_L(r_L)}} (1 - \kappa) \)

This kind of simplification does imply certain restrictive assumptions on our empirical model. For \( \beta_0 \) to be constant over time, the variables related to the degree of competition need to be unchanged over time. In a simple linear model, the constant \( \beta_0 \) can be augmented with a trend but it still rather restricted. This simple expression shall serve as a starting point for the empirical investigation of the transmission of the policy rate to bank lending rates that is conducted in this paper.

### 2.4.3 Implications of the model

From equation [13] one can easily see what restrictions on variables \( \mu, N, \epsilon_L(r_L), \kappa, r_K \) and \( \gamma_L \) a linear regression with time invariant \( \beta_0 \) and \( \beta_1 \) imply. The comparative statics of the theoretical model are found by differentiating with respect to \( \{ r_D, r_M, r_K, r_L, \mu, N, \epsilon_L, \kappa \} \). The lending rate is curiously found completely separable from the interest rate on deposits. The markup term \( \beta_0 \) is found positively dependent on increasing operating costs \( \gamma_L \), cost of capital \( r_K \), the required capital to loans ratio \( \kappa \) and credit risk \( \mu \). An increase in the number of competitors \( N \) and elasticity of substitution \( \epsilon_L \) both have a negative effect on the equilibrium markup. The same parameters except for the cost of capital and the operating costs have an effect on the sensitivity towards the money market rate \( \beta_1 \), i.e. the pass-through. An increase in credit risk \( \mu \) and the capital-to-loans ratio \( \kappa \) both increase the degree of pass-through. Increasing market power of individual banks, i.e. lower number of competitors \( N \) and lower elasticity of substitution \( \epsilon_L \), both decrease the interest rate pass-through.

### 2.5 Further considerations

As empirical research has found the interest rate pass-through process to be rather sluggish and often less than complete, further theoretical analysis beyond the comparative statics of the Monti-Klein model is warranted. In this section I cover theoretical arguments that can help explain the observed features better.
First we will consider the effect of competition on the dynamics of interest rate pass-through. The steady state result of the Monti-Klein type model implied that the degree of long run pass-through would be increasing with the number of competitors as well as with the availability of substitutes to bank financing. In model of bank pricing behavior authors (Hannan and Berger 1991) allow for asymmetric responses with regards to changes in marginal costs of funds for the banks. It is argued that banks that have a sufficient degree of market power, would choose to pass on increases in interest rates to their customers quicker than what they would pass on decreases. These type effects could be magnified by what is typically referred to as menu costs, that is costs associated with implementing price adjustments. If there furthermore is uncertainty with regards to the permanence of the change in marginal funding costs of banks, the pass-through sluggishness could become even greater (Hannan and Berger 1991). The adjustment costs could themselves be affected by asymmetry as customers who value “dependable” prices are likely to react more unfavorably to price hikes (Rotemberg 1982). The relative importance of corporate bank relationships has the ability to smooth the interest rates of corporate loans as banks shield their clients from the volatility of the money markets (Berger and Udell 1992). It is furthermore argued that in banking systems where the banks rely on deposits to a greater extent for their funding, the contractionary effects on bank lending would be even larger in the event of a monetary shock (Lensink and Sterken 2002).

The degree of concentration in retail banking markets and how it affects the markup that is charged has been studied rather extensively using various techniques. For a summary on the results from studies that use the Herfindahl-Hirschman index of market concentration see (Ongena, Kim, and Degryse 2009). In general, the overall consensus appears to be that a higher degree of market concentration is associated with only slightly higher markups on bank loan rates. The magnitudes vary considerably depending on the country and how narrowly the market is defined. More advanced measures to measure the concentration in bank lending markets than the Herfindahl-Hirschman index have been devised and consequently employed to further shed light on the complex relationship between market structure and pricing strategies in lending markets (Ongena, Kim, and Degryse 2009). Utilizing an alternative competition measure of (Panzar and Rosse 1987) authors (Claessens and Laeven 2004) find most banking markets to actually be characterized by monopolistic competition. More importantly they find evidence that it is entry barriers that determine the degree of competition in banking markets rather than market structure.
The special nature of the banking sector arising from their function as “delegated monitors” on behalf of the depositors has potential effects on the interest rate pass-through. Informational asymmetries exist not only between the banks and the depositors but also between the banks and the borrowers. A resulting phenomenon of information asymmetry between lenders and borrowers is credit rationing. Credit rationing refers to lenders restricting credit supply rather than letting the interest rate adjust upwards until supply and demand quantities match. The authors (Stiglitz and Weiss 1981) show that credit rationing is a better strategy for banks rather than letting the interest rate adjust to a market clearing level if there is adverse selection of borrowers applying for a loan. Adverse selection would in this case imply that borrowers with legitimate investment projects would be crowded out by borrowers whose projects would be of an increasingly speculative nature where repayment is increasingly unlikely. Equivalent effects result from adverse incentives where raising interest rates may tempt entrepreneurs to pursue projects that are stochastically dominated of a second order. Based on the insights of (Stiglitz and Weiss 1981) and a marginal cost pricing framework (Winker 1999) constructs a model where banks thus adjust their interest rates asymmetrically to monetary policy contractions and expansions. Whether credit rationing really is a large enough problem in the Euro area lending markets for there to be reason for it to be accounted for explicitly is a debated subject (G. J. De Bondt 2000).

2.5.1 Business cycle effects on bank behavior

Given that the central bank actually conducts countercyclical monetary policy and that the retail banking market is characterized by oligopolistic competition (Bagliano, Dalmazzo, and Marini 2000) show that the banks incentives to collude are affected by how countercyclical the monetary policy is. As the central bank can affect the costs of obtaining funds and an increase in the funding costs decreases the potential gains of more aggressive pricing strategies, they succeed in showing that even though non-cooperative Nash strategies are followed by the market participants the optimal price strategy can be to price above the competitive level. As the level of competition in bank lending markets have been shown to depend on the reaction function of the central bank it is worth pointing out that there was a shift in the central bank reaction functions as countries transitioned either from an exchange rate peg against the European Currency Unit or a free floating national currency to adopting the Euro.
2.6 Implications of incomplete interest rate pass-through

A limited pass through from money market rates to retail bank lending rates has several implications for the stability of an economy. A limited short run pass through has a stabilizing role in the sense that bank based economies have some insulation against liquidity shocks (Scharler 2008). Lower pass-through in the long run has positive implications for long run volatility of output. The downside on the other hand from a lower long run pass through is that macroeconomic stabilization monetary policy is less powerful which is reflected in greater inflation volatility. Even though monetary policy would be tightened sufficiently as in accordance with the Taylor principle, it is possible that retail rates would not respond to a degree great enough to be stabilizing if the pass-through is low. Less than unity pass-through in the Euro area compared to the estimated reaction function of the ECB was however not found to be a source of instability before the financial crisis. However, if the pass-through degree were to decrease substantially it could potentially become a real problem. (Kwapil and Scharler 2007)
3 LITERATURE REVIEW

Before presenting any of the actual results of the previous literature I first discuss some of the differences in approach of the previous research. The main differences between the papers arise from variations in the selection of the money market interest rate, time period that is studied, geographical focus, econometric methods applied and type of data used. Of particular importance is also the treatment of structural shifts, the two most prominent being the inception of the European Monetary Union and the onset of the financial crisis of 2008.

3.1 Differences in past empirical approaches

The empirical literature can roughly be categorized into two strands, one which adopts a monetary policy approach to the problem and the other that takes a cost of funds approach. The difference between the two approaches is with respect to the interest rate that the bank lending rate is modeled to depend upon. The monetary policy approach takes a short term money market rate, such as EONIA, which the central bank can more or less directly control. The cost of funds approach on the other hand takes a money market interest rate that is typically higher up in the yield curve. The exact term to maturity of the money market rate is typically selected on the basis of correlation with the bank lending rate that is being studied (G. De Bondt 2002). Selecting a matching money market rate based on correlation analysis has been criticized for biasing the pass-through estimation results towards being too fast (Sørensen and Werner 2006).

This literature review will focus exclusively on research conducted on European data. Studying the interest rate pass-through in European countries is particularly interesting because their financial systems are typically so heavily bank dominated. That is, corporations in Europe traditionally make use of bank financing rather than corporate bond markets as well as households preferring bank deposits over money market mutual funds for short term deposits (“Report on Financial Structures” 2002). The effect of monetary policy on the European economies is thus strongly dependent on the way banks transmit monetary policy impulses through their interest rate setting behavior, which ultimately determines corporate investment and by extension future economic growth.

The largest obstacle to making comparisons of the results of previous research across time and between countries is due to the lack of harmonized statistics before January 2003. With the inception of the EMU a harmonization process of the member countries
bank statistics began. It is however only recently that these harmonized time series have reached a length where statistical analysis can be applied directly, without having to append either synthetic back-dated series or combine harmonized and unharmonized series. Underlying reasons for data collection heterogeneity in bank lending rate statistics are extreme value filtering policies, national loan type classification definitions, potential inclusion of overdraft type credit, various interest rate fixation (IRF) periods, loan collateral considerations and opaque separation of rates on pre-existing loan stocks and new loan rates (Marotta 2009). As the comparability of the underlying time series is limited so should the conclusions with regards to any cross country comparisons be.

The econometric modeling approaches that have been used in the previous literature for uncovering the dynamic properties of the interest rate pass-through can be roughly categorized as linear single equation models, autoregressive distributed lag (ARDL) models and error correction models (ECM); linear multiple equation systems, vector auto regression (VAR) models and vector error correction models (VECM) and more advanced non-linear modeling approaches such as Markov switching VAR and VECM models. Furthermore, some authors have chosen to extend their models by allowing for asymmetric pass-through dynamics. As I have chosen a standard error correction model the focus of this literature review will be primarily be on the previous results of those.

The model selection procedure in the field of interest rate pass-through research is first and foremost dependent on whether the set of chosen interest rates are found to be non-stationary. It is crucial to determine this empirically and not take it for granted based on economic theory. Indeed, interest rate series would actually be expected to be stationary over longer time periods, as a the illustrative quote of John Cochrane reported in (Maddala and Kim 1998) puts it: “Interest rates now are the same as in the Babylonian days. How can there be a unit root in interest rates?”. The nonstationary driving force of interest rate is likely the underlying inflationary process (Gambacorta and Iannotti 2007). In this paper I will not dwell further on the issue of whether interest rates truly are stationary or not. If the persistence in the interest rates is great enough to make them appear non-stationary appropriate econometric methods will be used. Non-stationarity typically means making use of cointegration methods to enable further analysis of level effects, this does however require a stationary relationship between some of the included time series to exist throughout time. In particular, the stationarity properties of the term structure premium in the form of the long run equilibrium that the Monti-Klein model implies is what interest rate pass-through research is based around.
3.2 Short run interest rate-pass through

The effect of a policy rate change on the next period bank lending rate is typically what is meant by short run interest rate pass-through. Alternatively, the effect on the contemporary bank lending rate is also sometimes referred to by the same term. I will stick to the former definition henceforth. The literature unanimously points towards an incomplete short run pass-through (see summary articles: (G. J. De Bondt 2005), (VanHoose 2010) and (Andries and Billon 2015)). Where incomplete implies that a unit change in the policy rate is reflected to a degree less than unity in the bank lending rate.

The early results of (Cottarelli and Kourelis 1994) already points towards a great deal of heterogeneity in the short term interest pass-through. Their estimated coefficients for example for Italy and Finland are 0,11 and 0,13 which in contrast to 0,82 in the UK implies a vastly slower adjustment process. The results for Spain and Netherlands are between the two extremes at 0,35 and 0,52. This great deal of heterogeneity in the degree of short run pass-through amongst the European countries is repeatedly found in the research that follows (VanHoose 2010). Whilst being universally incomplete it appears to be slightly higher in Spain and the Netherlands (Donnay and Degryse 2001), (Toolsema et al. 2002) and (Marotta 2009).

Identification of the structural determinants behind the observed variation in short term pass-through has not received as great an interest of researchers. This is largely explained by the difficulty in compiling consistent cross country time series for potential explanatory variables. The dominating structural interpretation of the low short run pass-through is that it is an outcome of the comparatively low degree of bank competition in Europe (Gigineishvili 2011), (VanHoose 2010) and (van Leuvensteijn et al. 2013). Disentangling the effects of simple lack of competition and other explanations that theory suggests such as collusive practices, importance of relationship banking and informational problems inherent in financial markets (Lowe and Rohling 1992) is non-trivial so any conclusions need to be made with care.

Several authors have investigated whether the formation of the European Monetary Union changed the structural factors determining the limited degree of interest rate pass-through. Rather than explicit modeling of the factors themselves most authors test for a break in the estimated long run pass-through equation using Chow tests (Chow
1960) or similar procedures. The underlying hypothesis for performing such studies is that the degree of integration of the participating economies financial markets would increase through greater transparency and interbank competition in the EMU (Coffinet 2005). A faster short run pass-through is indeed also found in several of the EMU banking markets (Angeloni and Ehrmann 2003). For aggregated EMU data (G. J. De Bondt 2005), (G. De Bondt, Mojon, and Valla 2005) and (Coffinet 2005) all find significantly faster pass-through in both lending and borrowing markets. By applying a Welch test to estimates of two subsamples (Bernhofer and van Treeck 2013) find no significance in the improvements in the short run pass-through.

The onset of the financial crisis and the widening credit spreads observed in the financial markets had researchers focus their attention on whether the interest rate pass-through mechanism had become impaired in some of the countries in the Euro area. The early evidence consisted of comparisons between out of sample forecasts and actual outcomes (ECB 2009). The transmission appeared normal albeit slower than predicted for the long term lending rates. The results of (Blot and Labondance 2013) indicate that the short run interest rate pass-through decreased in Austria, Spain, Finland, Italy and the Netherlands. To capture the change dynamics (Aristei and Gallo 2014) estimate a regime switching vector error correction model where several periods after September 2008 are identified as “high-volatility” periods with altered pass-through dynamics. Their results support those of (Blot and Labondance 2013), they find slower short term pass-through in the “high-volatility” alternate regime. Further evidence for a slower short term pass-through is presented in (Hristov, Hülsewig, and Wollmershäuser 2014) who argue that banks in the post crisis period had become structurally less inclined to lower their interest rates. However, virtually no change is found in the short term dynamics for Germany, France, Italy and Spain by (Al-Eyd and Berkmen 2013).

Pass-through heterogeneity among different bank products is also an almost universal finding. Typically consumer loans and deposits react slower compared to the interest rates on corporate loans (Mojon 2000), (Heinemann and Schüller 2002), (G. J. De Bondt 2005) and (Sander and Kleimeier 2004a). Lack of competition and limited substitutability in the market for consumer loans and deposits, as compared to the corporate lending markets, is favored as an explanation for the observed heterogeneity in pass-through dynamics (G. J. De Bondt 2005).

To conclude this section on the short run pass-through of interest rate, it is worth pointing out that some of the early research may be skewed due to a priori assuming...
pass-through to be complete in the long run. Of the papers I have referenced, (Mojon 2000) and (Heinemann and Schüller 2002) make this assumption. In the next section a discussion will follow on papers that explicitly allow the long run pass-through to deviate from unity.

3.3 Long run interest rate pass-through

Typically, the long run pass-through is classified as less than complete, complete or above complete. Complete pass-through in the long run implies that a unit change in the policy rate at a given time will be reflected by a unit adjustment in the lending rate within a finite time period. Less than complete pass-through and more than complete pass-through refer to a situation where the long run adjustment is either below or above unity.

To determine the long run pass-through in autoregressive models that use stationary econometric modeling techniques one sums the coefficients of the impulse response function. In error correction type models the long run pass-through is even more straightforward to obtain, it is simply equal to the coefficient of the money market rate in the equation describing the long run equilibrium.

In this section it is my intention to cover some of the similarities and differences that authors have found both over time and across countries by estimating pass-through in autoregressive models in levels or from error correction type models. It bears mentioning a second time, that the findings presented are a product of both differences in country specific financial structures and their evolution over time as well as less than perfectly comparable time series. Any conclusions should thus be made with care.

Early findings based on national interest rate statistics data provide evidence for large variations across countries with respect of the degree of the long run pass-through. Impulse response functions from an SVAR model highlight that the transmission process was dysfunctional during the 1990’s in Ireland, Belgium and Portugal compared to better functioning pass-through in Germany, Netherlands, Spain and France (Donnay and Degryse 2001). Using the same type of model but on aggregated data of EMU-member countries (Angeloni and Ehrmann 2003) find long term pass-through to be about 0.81. Significant heterogeneity in pass-through to both long term and short term corporate loans is found in the same set of EMU countries by (Sørensen and Werner 2006). The long run pass-through is found to vary between 0.41 and 0.99 for short term loans and between 0.33 and 0.96 for long term loans, with no systematic patterns distinguishable.
Similar heterogeneity of long run pass-through is found by (Sander and Kleimeier 2004a), who conclude that structural differences in the studied countries financial sectors are the root cause. The findings of (G. J. De Bondt 2005) appear similar for the long term loans on EMU member country aggregated data, the estimated pass-through coefficient is 0,88. However, pass-through to short term corporate loans have a pass-through coefficient of 1,37.

A more than complete pass-through to short term loan rates is found subsequently by (Marotta 2009) and (Rocha 2012). The proposed explanation is that the presence of riskier borrowers in this market segment would force banks to increase rates more than proportionally to compensate for an expected higher frequency of defaults. That is, higher asymmetric information costs but banks not resorting to credit rationing (Lowe and Rohling 1992). The common denominator of these three findings of more than complete pass-through is that all of them are studies where national interest rate statistics from the 1990’s are used. This effect does not seem to appear in studies where more recent data is used for the estimations.

The previously discussed findings of more than complete interest rate pass-through relate to the inception of the EMU. It has become a thoroughly explored topic of whether the inception of the single currency union caused a major structural shift to take place in the bank lending markets. An overall conclusion that can be made with respect to what the patterns of change have been is that long run pass-through has become less heterogeneous and less complete (Andries and Billon 2015). This conclusion is based on findings of (Coffinet 2005), (Marotta 2009), (G. J. De Bondt 2005) (Chionis and Leon 2006), and (Sander and Kleimeier 2004b). The more formal Welch tests for changes in long run pass-through conducted by (Bernhofer and van Treeck 2013) indicate that there would have been an increase in pass-through for long term loans and decrease for short term loans. The decrease in cross country heterogeneity for long run pass-through may be explained by structural improvements such as decreasing volatility of money market rates and a more coherent policy for control of inflation (Sander and Kleimeier 2004b). The prevailing less than complete long run pass-through were initially interpreted as evidence against strongly integrated financial markets in the Euro area (Sander and Kleimeier 2004b) and (Heinemann and Schüller 2002). Later studies conducted after the financial crisis do however argue that financial integration in the interim period was quite strong as evidenced by comparable government debt yields during that period and
that the country specific premium on corporate bonds was small (de Sola Perea and Van Nieuwenhuyze 2014; ECB 2008).

The literature which examines whether the long run pass-through relationship has changed since the onset of the financial crisis is steadily expanding. The early evidence which is made up of differences between forecasted reaction of bank lending rates and actual outcomes point towards generally unchanged pass-through properties although the response of long term rates is somewhat weaker (ECB 2009). A greater degree of homogeneity of long run pass-through across countries is found by (Blot and Labondance 2013). Their results of their error correction model do overall point towards a sharp reduction in long run pass-through in the post crisis period. Their conclusion is that the sharp reductions in money market interest rates following the ECB policy easing has not been reflected to a similarly great extent in the actual funding costs of the retail banks. This conclusion is partly supported by (Van Rixtel and Gasperini 2013) who show an increase in segmentation of banks access to funding. The banking systems of Greece, Ireland and Portugal became dependent on ECB funding shortly after the crisis whereas Spain and Italy became affected by that problem only after the sovereign debt crisis of 2012.

Evidence of fragmentation of the financial markets in Europe and a broken monetary transmission mechanism in Spain, Italy and Portugal are findings of (Al-Eyd and Berkmen 2013). They furthermore argue that the impact on lending to small-and-medium enterprises in the previously mentioned countries has been tightened disproportionally to that of more stable economies like Germany. The long run interest rate pass-through to short term corporate loans has decreased from being close to complete to between 0,4 and 0,55 in Italy and Spain. Further evidence of fragmentation of Euro area lending markets is presented in (de Sola Perea and Van Nieuwenhuyze 2014) who observe increasing divergences in lending rates between the heavily distressed countries Spain, Italy, Greece and Portugal and the lesser distressed Euro area economies. Based on the heterogeneous reductions in lending rates among the Euro area economies that followed the monetary easing of the ECB, they hypothesize that either the transmission mechanism is impaired in the more distressed economies or it’s a product of changes in other structural factors. As explanatory structural factors they choose to focus on the degree of capitalization in the respective countries banking systems as well as the share of non-performing loans. As high frequency proxies for the previously mentioned structural parameters they chose to include unemployment and a
5-year CDS index on the national banking sectors. They estimate their VEC model for Germany, Italy, Spain and Belgium. They find that the unemployment rate influenced bank lending rates in Germany, Italy and Spain and the CDS index to be relevant in Italy, Germany and Belgium. Their conclusion is thus that the defective monetary transmission in the distressed economies might not be due to a problem with the transmission mechanism itself but a result of bank lending rates being influenced by the deterioration in the financial systems soundness and macroeconomic situation.

A similar approach to studying the pass-through in times of financial fragmentation is adopted by (Darracq Paries et al. 2014) who augment a standard error correction model with unemployment and yields on 10-year government bonds. They argue that reduction in pass-through in the countries Italy and Spain are largely a product of increased macroeconomic risk and increased borrower risk. Finally the study which has the most closely comparable results to those I will present later is that of (Gambacorta, Illes, and Lombardi 2014). They find that long run pass-through in Italy and Spain has been greatly reduced in a standard error correction model and note that the cointegration relationship no longer holds after the crisis. The model is then extended by including a CDS index of the national bank sector to account for the fragility of the bank sector and the share of non-performing corporate loans which reflect the riskiness of the borrowers. The cointegration relationship holds afterwards and it appears that long run pass-through has only decreased marginally in the two troubled economies. They thus attribute the decrease in pass-through that baseline error correction model estimates point towards as being caused by sharp increases in credit risk premiums and tighter lending conditions following the repair of banks’ balance sheets.
4 EMPIRICAL SPECIFICATION

This section explains the methodology I have employed to study the pass-through mechanism. First I provide a short explanation of unit roots and cointegration. Then I explain how these time series modeling concepts can be used to facilitate the study.

4.1 Tests for non-stationarity of the time series

All empirical work on interest rate pass-through necessarily begins by determining whether the time series to be used in the modeling are driven by a stochastic trend(s). In practice, this means that I test the autoregressive time series processes under consideration for a unit root. If the persistence in the time series process is found to be large enough, the presence of a unit root cannot be rejected.

The unit root property of an autoregressive time series process implies that the variance approaches infinity over time. As standard econometric techniques like ordinary least squares (OLS) estimation relies on variance and covariance properties being finite, the conventional asymptotic theory no longer applies in case of unit root behavior (Maddala and Kim 1998). To resolve the issue one can either resort to differencing of the time series to obtain difference stationary processes or try to determine whether a cointegration relationship between the processes exist.

To determine whether the time series that I study are non-stationary I use the Augmented Dickey Fuller methodology. In practice this means estimating the following equation for an autoregressive time series $y$ of order $p$:

$$
\Delta y_t = \tau' DR_t + \pi y_{t-1} + \sum_{j=1}^{p-1} \gamma_j \Delta y_{t-j} + u_t
$$

Where $DR_t$ is a vector of deterministic components and $u_t$ is a white noise term. To determine the lag order of the autoregressive time series I use the modified Akaike information criterion (MAIC) of (Ng and Perron 2001). I choose to use the MAIC for lag selection in this context due to its endorsement in recent literature (Martin, Hurn, and Harris 2013). I then test the null hypothesis of a unit root, $\pi = 0$, by computing a statistic similar to that of the common t-statistic. As the distributional properties of the statistic not even asymptotically follow the standard t-distribution, I compare the test statistic against critical values especially computed for this purpose computed by (MacKinnon...
1996). As the null hypothesis of the ADF test is that the series is non-stationary the p-values reported in the tables in the appendix refer to the rejection of the unit root hypothesis. The ADF methodology of unit root testing was selected so as to make the results as directly comparable to the other literature on interest rate pass through as possible.

### 4.2 The Engle-Granger cointegration methodology

As discussed in Chapter 2, the rational expectations theory of the term structure of interest rates coupled with the theoretical Monti-Klein model predict the existence of a long term equilibrium in the bank lending market. This equilibrium state was expressed as a linear relationship between the bank lending rate RLOA and the interbank market rate MMR. If variables RLOA and MMR share a common stochastic trend in their data generating processes, then a stationary linear combination of these two variables can be found. Such a linear combination is referred to as a cointegration relationship between the two variables. Given that the stochastic trend is shared, the cointegration relationship must exist, this is the result of the Granger representation theorem. I thus embed the long run equilibrium [13] in an error correction model.

As I furthermore am especially interested in whether a change in the equilibrium relationship between the lending rate and the money market rate has occurred after the onset of the financial crisis I construct a dummy variable for this purpose. The dummy variable, I(2008:09), takes the value 0 up until September 2008 after which it assumes the value 1 for the rest of the remaining time.

The empirical model to describe the long run relationship between the bank lending rate (RLOA) and the money market rate (MMR) is the following that results from the reasoning above is the following:

\[
RLOA_t = \beta_1 + \beta_2 I(2008:09)_t + \beta_3 MMR_t + \beta_4 I(2008:09)_t * MMR_t + \epsilon_t, \\
\epsilon_t \sim NID(0, \sigma^2_e)
\]

The intercept term \( \beta_1 \) is interpreted as the markup that the banks charge customers on top of the marginal costs to cover their operating expenses etc. The \( \beta_2 \) term is the control for a change in the markup after the financial crisis. Thus the markup before the crisis is simply \( \beta_1 \) and the after crisis markup is equal to \( \beta_1 + \beta_2 \). The slope coefficient \( \beta_3 \) indicates to what extent the money market rate is passed through to the lending market in the pre-
crisis period. The term $\beta_4$ coefficient is the control for the change in slope in the post crisis period. Thus the interpretation is the same as for the slope, $\beta_3$ before the crisis and $\beta_3 + \beta_4$ in the after crisis period. The error term $\epsilon_t$ is a stationary white noise process. After the parameters of this model have been estimated the residuals $\hat{\epsilon}_t$ can be computed, these residuals indicate the deviations from the equilibrium relationship described above. The residuals form the error correction term which is needed in the second step of the Engle-Granger procedure.

The next step of the Engle-Granger modeling procedure accounts for the short term dynamics and fluctuation around the cointegration relationship. The model in our case is specified as:

$$
\Delta RLOA_t = \alpha_1 + \alpha_2 \epsilon_{t-1} + \alpha_3 \epsilon_{t-1} I(2008:09)_t + \sum_{i=1}^{k} \alpha_{3+i} \Delta MMR_{t-i} + \sum_{j=1}^{l} \alpha_{k+j} \Delta RLOA_{t-j} + u_t,
$$

$$
u_t \sim NID(0, \sigma_u^2)
$$

Where the sign of $\alpha_2$ is required to be negative for there to be convergence towards an equilibrium. The magnitude of $\alpha_2$ indicates how fast the series is “pulled” back towards its long term equilibrium. The term $\alpha_2$ will further need to be tested for statistical significance for the correction to be relevant. The number of lags $k$ of $\Delta MMR$ and lags $l$ of $\Delta RLOA$ are selected using a general to specific type of procedure. The procedure starts with estimating an over fitted model of a lag order that is likely to be too high for this specific case (e.g. $k$ and $l = 6$). A Durbin-Watson test is then performed to confirm that no autocorrelation is present in the error terms. If the last lags of $\Delta MMR$ or $\Delta RLOA$ are insignificant, the lag order of the model is decreased. Lag orders $l$ and $k$ are then iteratively decreased to obtain the most parsimonious model possible for which the Durbin-Watson statistic gives no reason to suspect autocorrelation in the residuals. In borderline cases a larger model is chosen.

However, before proceeding to the estimation of the short run dynamics, the long run relationship needs to be validated as a true cointegration relationship. Specifically, I apply a so called residual based approach to determining the presence of cointegration as I test the series of residuals $\hat{\epsilon}_t$ for stationarity. If the series $\hat{\epsilon}_t$ on the other hand is found to be integrated it simply means that the stochastic trends of the time series were
distinct and thus will not cancel each other out. No trend is expected to be present in this relationship so the ADF tests for stationarity are performed using only a constant (Hamilton 1994). The advantage for using a single equation relationship between two time series in the first step of the Engle-Granger method is that the cointegration relationship, as described by $\beta$, is uniquely identifiable.

As we now have seen, the core advantage of the Engle-Granger two step procedure is that it facilitates the estimation of both short and long term dynamics of a time series process. The error correction term that the model includes refers to the mechanism that pulls the process towards a stationary equilibrium when the process is in disequilibrium due to shocks to the system. The “pull” towards equilibrium is assumed to be linearly increasing with the size of the disequilibrium error as well as symmetric. This is a limitation that needs to be acknowledged and taken into account when interpreting the results.

The actual implementation of the Engle-Granger algorithm for estimation of this type of time series model is performed in R and follows closely that of (Pfaff 2008).
5 DATA

In this section both data processing methods as well as further details on the series used in the econometric modeling are covered. The selection of the group of countries and the sample period was made based on the availability of harmonized directly comparable lending rate statistics. The included countries can roughly be divided into two sub categories, countries that experienced greater distress during the financial crisis and those that experienced comparatively lesser distress. The former category includes the countries Italy and Spain and the latter one the countries Austria, Finland, France, Netherlands and Germany. The categorization is done for reasons of convenience and based on how affected the countries financial markets and real economies were by the global financial crisis. The categorization is the same as in (Holton and Rodriguez d’Acri 2015).

All lending rate statistics are obtained from the Monetary Financial Institution Interest Rates (MRI) database of the ECB. The econometric results are thus not directly comparable to most of the older studies that rely heavily on the National Retail Interest Rates (NRIR) statistics database, as the interest rate series of these two databases are found to differ significantly in both levels as well as dynamics (Marotta 2008). The great advantage of relying on the shorter time series of the MRI database is that it not only provides comparable harmonized data but also allows for analysis of three types of loan categories rather than two, where the categorization is made based on the interest rate fixation period of the loans.

5.1 Time series descriptions

I next provide some detailed descriptions of the origin of the time series that are used in the econometric modeling. All of the series are at the monthly frequency and the observations range from January 2003 to February 2016. The unique identifiers for all series can be found in the appendix and are provided to ensure easy replication of the econometric study. Of particular interest in this study are the interest rates on bank loans over the Eonia interest rate. Plots of the spreads between all bank loan interest rates and Eonia can be viewed in Appendix Figure 1.
5.1.1 Bank loan interest rates

The precise bank loan interest rate series that I analyze are obtained from the ECB MIR database and have all been calculated based on harmonized standards of the ECB. There are three series for each country where the classification is based on the interest rate fixation period. The bank interest rates in question are those on all new loans. An existing loan for which the interest rate is renegotiated before reaching its maturity is counted as a new loan. The three interest rate fixation categories are: 0-1 years, 1-5 years and over 5 years. I will refer to them as short, medium and long term loans subsequently in this text. The exact maturity of the loans in each category are not known but the interest rate fixation periods give a good indication. The loans covered are those granted by monetary and financial institutions (except money market mutual funds and central banks) to non-financial corporations. All loans except revolving loans, overdrafts, convenience and extended credit card debts are included.

5.1.2 Money market rates

As the money market rate I use monthly average of the Euro OverNight Index Average (EONIA) interest rate. The interest rate represents the interest rate at which banks lend funds between themselves at a maturity of one day. The choice was made based on the fact that central banks signal their monetary policy stance by steering overnight interbank interest rates. The overnight interest rate is the closest market based proxy for the actual policy rates which makes it an especially suitable choice. The spread between the policy rate and the overnight interbank rate is non-zero but typically very small, the mean spread between the ECB target rate and EONIA was 7.2 bsp between June 2000 to August 2006 (Linzert and Schmidt 2008).

The overnight interest rate is freely fluctuating within a certain interval which is determined by the marginal lending facility and deposit facility of the central bank. The marginal lending facility provides a ceiling for the overnight interest rate in the form of an interest rate at which the banks are allowed to borrow directly from the central bank against eligible collateral. The deposit facility of the central bank provides the floor of the overnight interbank interest rate in the form of an interest rate banks receive on depositing excess reserves at the central bank.
6 RESULTS AND DISCUSSION

A summary of the estimated loan markups and long run pass-through coefficients for both the period before and after the crisis is presented in Table 1. More detailed results covering individual coefficients statistical significance etc. are presented in the Appendix Tables section. The results clearly show that the introduced shift dummy indicating the additional markup in the post crisis period is highly significant. Only for the long term loans in the countries Finland, Netherlands, France and Austria has there been no significant change in the markup on bank loans. How the markup has changed follows a similar pattern in Italy and Spain, markups have greatly increased in the post crisis period on loans in all three term categories. For short term lending the increase in markups are generally higher the lower the pre-crisis markup was set. That is, the increases in markups on the short term loans in Italy and Spain are by far the largest. The non-southern European countries have equilibrium markups that are slightly below 2%. For the medium term lending there has been a jump in markups in all countries except for Finland. The equilibrium lending markups for medium term loans are around 3% for Finland, Germany, France and Austria. Italy, Spain and the Netherlands have lending markups that are about 0.50% above the rest. For long term loans the only other significant change except for the already mentioned large increases in Italy and Spain have happened in the German lending market where the markup has dropped by 0.74%.

The shift dummy for the slope coefficient is in general also very significant, it appears that the pass through dynamics have changed in the post crisis period in all countries in some way. The change in pass through degree for the countries Italy and Spain follow again a similar pattern. The long run transmission of the policy rate to all three loan categories in these two countries has clearly decreased. The change in pass through is not only significant but also very large as the pass through has dropped from being close to complete in the long run to around one half. For the countries Finland and Netherlands, the pass through to short term loans has dropped from unity to a level of around 0.9. The pass-through in France has dropped from being 1.1 to close to 1.0. Both Germany and Austria have seen no significant shift in the pass through dynamics to short term loans. For the both the medium and long term loans the pass-through has become more complete in the countries that have fared better during the crisis. The pass through rises to between 0.9 and 1 in Finland, France and Germany in the long term loan category, for Austria and the Netherlands the pass through increases to about 0.7.
The most striking results are those pertaining to the changes in loan markups in the distressed countries Spain and Italy. Comparing the level of bank loan markups across the categories of interest rate fixation before the financial crisis with the rest of the countries it appears that the lending rates in both Italy and especially in Spain were much lower than they had any right to be, especially the medium and long term categories. To illustrate this point I refer to Figure 2. During the time period before the crisis when interest rates were lower for Spanish borrowers than German lenders credit grew by roughly 20% p.a. in Spain compared to roughly 2% p.a. in Germany (Deutsche Bundesbank 2013). Loans with medium and long term interest rate fixations were apparently significantly underpriced in Spain and Italy during the pre-crisis period. The post crisis markups appear to reflect more appropriate risk pricing rather than an overreaction despite the great magnitude of change. The post crisis lending rates in the distressed countries are only around 50 bsp higher compared to the non-distressed countries. The real estate bubble that fueled the Spanish lending excess in the pre-crisis period was powered by high GDP growth and low benchmark interest rates since Spain joined the EMU (Fernández de Lis and Garcia-Herrero 2013). The strong GDP growth was paired with increasing public sector spending which has made the post-crisis
adjustment process more painful. The cheap credit available to non-financial firms fueled an enormous increase in the total debt to GDP ratio of Spanish non-financial corporations, which increased from 108% in 1999 to 196% in 2007 when it peaked. In comparison the same ratio increased from only 100% to 122% in Italy during the same time period (OECD 2014).

Figure 2  Interest rates on medium term loans in Germany and Spain

Fortunately, in the case of Spain, the recession of 1993 had pushed central bankers to think of a way to mitigate the problem of excessive credit expansion during economic booms (Saurina 2009). Thus a system for dynamic loan loss provisioning in Spain was put into place to deal with the lagged relationship between credit growth and credit risk (Saurina and Jimenez 2006). The dynamic loan provisioning system did as we can see not completely solve the problem but surely helped keep the banking system from greater disruption in Spain (Saurina 2009).

Typically, the interest rates are expected to be higher the longer the interest rate fixation period is. Corporations are normally willing to accept slightly higher interest rates for not having to worry about interest risk. This is typically something of greater concern for corporations undertaking longer term projects where the common heuristic is to attempt to match project financing with project length (Madura and Madura 2007). However, the results indicate that the interest rates are lower for loans with long term rate fixation compared to those of medium term fixation especially in the countries Finland, Germany and Netherlands. The underlying reason behind this phenomenon could be that large corporations who are in the position to obtain long term bank loans can obtain market
based funding at more favorable terms and thus put downward pressure on the rates that the banks are able to charge, supportive micro level evidence is found by (Holton and Rodriguez d’Acri 2015). In Germany an attempt at establishing a corporate bond market for SME’s has largely been a failure since its inception in 2010. The default rate of the issued bonds has been very high (17%), which has greatly reduced the appetite of prospective investors and reduced the number of issued bonds sharply (Scope Ratings 2015). As mentioned, the lower yield for long term loans in Germany in the post crisis period is likely a combination of a flight to quality phenomenon and of increased competitive pressure from corporate bond markets where yields have been very low. The prevailing industry sentiment is that German corporate bonds are a safe haven for investors whereas SME bonds don’t enjoy this privilege (Moody’s Deutschland 2015).

The result that non-financial corporations in the more distressed economies, Italy and Spain, face relatively higher lending rates than core Euro area countries mirrors previous findings (de Sola Perea and Van Nieuwenhuyze 2014; Al-Eyd and Berkmen 2013; Holton and Rodriguez d’Acri 2015). In Spain, a market for SME bonds was launched in late October 2013 as a direct consequence of the Memorandum of Understanding signed as a precondition for the ESM (European Supervisory Mechanism) assistance funds for restructuring the Spanish financial sector (European Commission 2012). The direct impact of this alternative source of funding made recently available to Spanish SME’s is hard to assess based on the current results but I expect them to start being reflected in the results of future studies.

The large decreases in the degree of long term pass through in Italy and Spain reflect a more challenging position for the ECB. It appears it cannot control the retail interest rates completely through the interest rate channel of monetary policy transmission in these countries. For the less distressed countries the patterns are different. At the short end of the maturity spectrum the pass-through has decreased just slightly in the Netherlands, Finland and France which possibly reflects that the banks are more cautious to lower their interest rates for the riskier borrowers who typically only receive short term credit. For medium and long term loans the pass-through has increased in all the less distressed economies. Countries that approach unity pass through are Germany, at all maturities; Finland, at long term maturity; France, at short and medium term and Austria and the Netherlands at short maturities. Typically the heterogeneity in long run retail bank rate pass-through is attributed to differing degrees of competition in the national bank sectors (Sørensen and Werner 2006). Despite several bank nationalizations and mergers in Spain and to a lesser degree Italy, the found decreases
in pass-through are most likely not attributable to that single phenomenon. The process of corporate credit risk repricing in these countries is likely playing a large role in these countries and further research that would try to untangle these effects is warranted. We can observe from Figure 2 that there is a great deal of fluctuation in the interest rates in Spain after the crisis, clearly there are other determinants at work than just the Eonia fluctuations which are minimal. During the same period a great deal of fluctuation can be observed in the yields of Spanish and Italian government bonds of a 10-year maturity. It appears that the bank loan rates may be adjusting to some degree to the comparatively more insecure future of these two economies.

The speed of convergence towards long term equilibrium varies somewhat between the countries, but as many of the coefficients in Appendix Table 3 are not statistically significant the results are simply indicative. It appears that France and Spain have the weakest convergence towards equilibrium. Whereas strong convergence is found in Finland, Austria and Germany for the medium and long term loans. There seems to be convergence in the Netherlands in the medium term loan market and in Italy in the market for long term loans. Furthermore, the ADF tests indicate that the long term spread between the lending rates and policy rate show very high degrees of persistence and do in fact in most cases still exhibit unit root like behavior as can be seen in Appendix Table 4.

The short term dynamics of the lending rates in all countries share a zero constant which is precisely as expected since there should be no deterministic time trend in the lending rates. The immediate impact of changes in the policy rate is significantly less than one for all the countries included in the study. It appears that the immediate impact of policy rate changes is the lowest on loans with a long term interest rate fixation period and the highest in for the short term loans. As a change in the policy rate will affect the cost of providing a loan with short term interest rate fixation to a relatively larger degree than one with a long term interest rate fixation the outcome is as expected. This result is also in line with previous literature (ECB 2009). The pass through of interest rates is clearly classified as sluggish, which is in line with what the previous research has found using various statistical methods and sample periods and countries.

The major caveats of the empirical results are the lack of stationarity of the error correction relationships and the lack of statistical significance that some of the error correction terms display.
7 CONCLUSIONS

The primary result of the study is that significant changes in retail bank interest rate pass-through dynamics have occurred in all 7 countries that I studied. There is a discernible pattern with regards to the change in both long run pass-through and prevailing loan markups being comparatively larger in Italy and Spain. Both countries have experienced relatively greater distress during the financial crisis than the other studied countries: Germany, Austria, Finland, France and the Netherlands. In the less distressed economies the pass-through to medium and long term loans has increased significantly whereas the loan markups have increased primarily on the short term loans. In general, the long run pass-through has become less diverse between the less distressed economies after the crisis for all loan categories. Significant decreases in the long term loan rates to German corporations are prevalent after the crisis, for which the most plausible explanation appears to be a flight to quality phenomenon where risk averse investors pour money into the credit market of the European economy which is commonly regarded as being the most stable. The speed of convergence towards long run equilibrium is heterogeneous both between countries and loan maturities.

The pass-through process in Italy and Spain, which previous research has characterized as impaired, seems in light of the results of this study to have normalized rather than become disrupted. The properties of the monetary transmission mechanism can thus not be expected to return to the pre-crisis state. I argue that the pre-crisis period cannot be considered as an appropriate baseline period for the functioning of the pass-through processes in these countries.

A natural improvement of the study would be to extend the study by re-estimating the empirical model with appropriate control variables reflecting macroeconomic conditions and account for fluctuations in term- as well as credit risk premiums.
SAMMANFATTNING PÅ SVENSKA

8.1 Introduktion

I detta arbete behandlar jag transmissionen av centralbankens penningpolitiska ränta till företagslåneräntorna. En djupare förståelse av fenomenet är en förutsättning för effektiv implementering av penningpolitik. Aktuell forskning har låtit påvisa att signifikanta förändringar i transmissionsdynamiken uppstått i samband med den finansiella krisen 2008 (Blot och Labondance 2013). I detta arbete estimerar jag transmissionsdynamiken under en period före krisen och efter krisen i sju euroländer. Jag finner i likhet med tidigare forskning att länder som drabbats värre av krisen, så som Spanien och Italien, har en trögare transmissionsdynamik i perioden efter krisen och att räntemarginalerna har ökat drastiskt. De länder som inte drabbats lika hårt av krisen uppvisar en mer eller mindre fullständig transmission av förändringar i styrränta till låneräntorna och räntemarginalerna har ökat primärt på lån med kortare räntebindningstid. Min tolkning av situationen är att det skett en normalisering av transmissionen och räntemarginalerna i de länder som är hårdast drabbade av krisen, snarare än att krisen skulle ha brutit samman den tidigare välfungerande transmissionen. Det vore alltså orimligt att förvänta sig att transmissionen i dessa länder skulle återgå till den situation som rådde före krisen.


Tidsserierna är de genomsnittliga företagslåneräntorna uppdelade i tre olika kategorier enligt räntebindningstid. Mina resultat visar att räntemarginalerna, dvs. skillnaden mellan låneräntorna och EONIA, har ökat kraftigt i Spanien och Italien efter finanskrisen medanökningen har varit modest i de övriga länderna. Transmissionen av förändringar i EONIA till låneräntorna över långsikt är ofullständig i Spanien och Italien medan den är nära fullständig i de övriga länderna.


8.2 Transmission av penningpolitik

Penningpolitiska transmissionskanaler är mekanismer genom vilka centralbankens penningpolitik har en effekt på realekonomin. Effektiv transmission av penningpolitik möjliggör, i all fall i teorin, för centralbanken att styra ekonomin i den riktning som behövs över konjunkturcykeln. Centralbanken utövar sin penningpolitik genom manipulering av olika instrument såsom styrräntan. Den transmissionskanal som primärt är relevant för detta arbete är räntetransmissionen som gör det möjligt för centralbanken att påverka hela räntematuritetsspektrumet över olika räntebärande tillgångar. Centralbankens räntepolitik har en effekt på realekonomin genom att kapitalkostnaden förändras vilket påverkar såväl företags som individuella hushålls investeringsbeslut.
Transmissionsprocessen av styrränteförändringar till företagslåneräntor kan delas upp i två skilda dimensioner. Den första dimensionen beskriver hur en förändring i den kortaste låneräntan påverkar räntorna på hela maturitetspektrumet genom rationella förväntningar. Den andra dimensionen är processen genom vilken förändringar i den riskfria räntestrukturen påverkar bankernas prissättning av låneprodukter. Förutom förändringar i den riskfria räntestrukturen påverkar bankernas beteende av marknadsstrukturella faktorer, förändringar i riskpremium etc.


Den version av Monti-Klein modellen som jag använder tar i beaktande vidare faktorer som efterfrågeelasticiteten på bankfinansiering, en oligopolistisk marknadsstruktur, bankreservkrav och kreditrisk (Putkuri 2010). Marknadsläneräntan härleds genom att likställa efterfrågan på bankfinansiering med utbud. Resultaten om hur de olika parametrarna i modellen påverkar det fasta räntepåslaget $\beta_0$, och koefficienten för låneräntans känslighet till penningmarknadsräntan $\beta_1$, följer från en analys av komparativ statik. Det fasta premiet $\beta_0$ påverkas positivt av operativa kostnader $\gamma_L$, kostnaden för eget kapital $r_K$, reservkravet $\kappa$ och kreditrisken $\mu$. Negativt påverkas det fasta räntepåslaget av antalet konkurrenter $N$ och efterfrågeelasticiteten $\varepsilon_L$. Somma parametrar påverkar även koefficienten för hur låneräntan beror penningmarknadsräntan i jämvikt med undantag av $\gamma_L$ och $r_K$.

oönskat urval och snedvridna incitament. Detta kan leda till att banken inte låter låneräntan justeras uppåt så att utbudet av lånekapital möts av efterfrågan. Istället kan det vara vinstmaximerande att begära en lägre låneränta och inte möta hela efterfrågan.

8.3 Tidigare forskning


Det strukturella skifte som är speciellt relevant för mitt arbete är finanskrisen 2008 och dess effekt på transmissionen. Transmissionen har funnits bli trögare, speciellt till låneräntorna med längre bindningstid (Blot och Labondance 2013; ECB 2009). De skarpa justeringarna i styrräntan verkar ha påverkat bankernas finansieringskostnad endast i en begränsad grad i de länder som drabbats värre av krisen (Van Rixtel och Gasperini 2013). Transmissionsprocessen konstateras ha försämrats i Spanien, Italien

8.4 Empiriskt tillvägagångssätt

Före val av metod testar jag ifall tidsserierna är stationära över det tidsintervall som jag har data över. Augmented Dickey-Fuller-test görs på var och en av tidsserierna och utifrån teststatistikorna kan inte nollhypotesen om att serierna är integrerade av första ordningen förkastas. För att kunna avgöra hur stor justering i låneräntenivån en förändring i penningmarknadsräntan ger upphov till använder jag en felkorrigeringsmodell som ger konsistenta estimat för integrerade tidsserier.


8.5 Resultat

Jag finner att uppdelningen av tidsserierna i en period före finanskrisen och en efter är motiverad då de dummyvariabler som representerar skiftet är signifikanta. Detta gäller både dummyvariablerna som representerar skiftet i räntepåslaget och de dummyvariabler som representerar skiftet i den lånsiktiga graden av transmission.
Räntemarginalerna har i samband med finanskrisen speciellt ökat för lånen med den kortaste räntebindningstiden. Det går att notera att en större ökning av räntemarginalerna skett i de länder där räntemarginalerna varit lägst före krisen. Räntemarginalerna har också ökat signifikant för lånen med 1–5 års räntebindningstid i alla länder förutom Finland. För lånen med en räntebindningstid på över 5 år har räntemarginalerna ökat signifikant bara i Spanien och Italien. De övriga länderna har inte påverkats medan Tyskland till och med har lägre räntemarginaler på de långa lånen efter krisen.


De mest drastiska förändringarna i transmissionen har skett i Spanien och Italien. Justeringen av räntemarginalerna har varit väldigt stor vilket också tidigare forskning har noterat. Det bör dock beaktas att den nivå av räntemarginaler som rådde i perioden före krisen var jämförelsevis låg. Det verkar som att låneprissättningen i perioden mellan 2003 och 2008 i dessa länder har varit onormalt optimistisk (Saurina 2009). De stora justeringarna i räntemarginalerna tyder enligt min tolkning därför inte på att transmissionen av de penningpolitiska räntorna till de spanska och italienska låne marknaderna nödvändigvis skulle ha försvagats. Snarare tyder de något högre lånomarginalerna i Spanien och Italien jämfört med de mera stabila ekonomierna att riskerna associerade med utlåning till företag i dessa länder nu prissatts mera i enlighet med de övriga länderna. Skattningarna av långsiktskoefficienterna är därför lägre jämfört med de övriga länderna på grund av den justering i riskprissättning som pågått i dessa länder efter krisen.

Den relativt förmånliga tillgången på banklånsfinansiering för de tyska företagen tolkar jag att beror på de relativt goda förhållandena för tyska större företag att få direktfinansiering via obligationsmarknaden. Detta gäller inte i lika hög grad för lånen med kort räntebindningstid vilket jag antar att utnyttjas primärt av småföretag. Detta skulle stämma väl överens med den gällande uppfattningen att tyska storbolagsobligationer är
relativt riskfria placeringsobjekt vilket inte är ett privilegium som små och mellanstora bolags obligationer åtnjuter (Moody’s Deutschland 2015).

8.6 Konklusion

De empiriska resultaten i min studie tyder på att transmissionen av penningmarknadsräntorna till låneräntorna förändrats i samband med finanskrisen 2008 i alla 7 länder. Det finns en tydlig systematik där lånemarginalerna har ökat mest i Spanien och Italien och transmissionen på lång sikt blivit betydligt svagare i dessa länder. I de övriga länderna som också klarat sig relativt sett bättre genom krisen har transmissionen till lån av med över 1 års räntebindningstid blivit mer fullständig. Lånemarginalerna har ökat primärt på lån med kort räntebindningstid och inte i lika stor grad som de har ökat i Spanien och Italien.

Trots att det skett en viss konsolidering inom de nationella banksektorerna är det mindre sannolikt att transmissionsdynamiken skulle ha påverkats i en större grad av den minskade konkurrensen. Snarare verkar det sannolikt att de signifikanta korrigeringsarna i riskprissättning driver de förändringar som går att observera i min enkla modell över transmissionsdynamiken. Vidare forskning som på ett explicit sätt kontrollerar för den cykliska prissättningen av risk vore definitivt intressant. Den välfungerande transmissionen av penningpolitik som gick att observera i Italien och Spanien före finanskrisen, reflekterade troligtvis inte de underliggande strukturella faktorerna och det förefaller därför orimligt att transmissionsdynamiken skulle återgå till denna form utan vidare åtgärder.
REFERENCES


BILAGA 1  TIME SERIES

The time series that have been used in the econometric study are all available from the Statistical Data Warehouse of the ECB with the following identifiers:

FM.M.U2.EUR.4F.MM.EONIA.HSTA
MIR.M.IT.B.A2A.F.R.A.2240.EUR.N
MIR.M.IT.B.A2A.I.R.0.2240.EUR.N
MIR.M.IT.B.A2A.I.R.A.2240.EUR.N
MIR.M.FI.B.A2A.F.R.A.2240.EUR.N
MIR.M.FI.B.A2A.I.R.A.2240.EUR.N
MIR.M.FI.B.A2A.I.R.0.2240.EUR.N
MIR.M.DE.B.A2A.F.R.A.2240.EUR.N
MIR.M.DE.B.A2A.I.R.A.2240.EUR.N
MIR.M.DE.B.A2A.I.R.0.2240.EUR.N
MIR.M.NL.B.A2A.F.R.A.2240.EUR.N
MIR.M.NL.B.A2A.I.R.A.2240.EUR.N
MIR.M.NL.B.A2A.I.R.0.2240.EUR.N
MIR.M.ES.B.A2A.F.R.A.2240.EUR.N
MIR.M.ES.B.A2A.I.R.A.2240.EUR.N
MIR.M.ES.B.A2A.I.R.0.2240.EUR.N
MIR.M.FR.B.A2A.F.R.A.2240.EUR.N
MIR.M.FR.B.A2A.I.R.A.2240.EUR.N
MIR.M.FR.B.A2A.I.R.0.2240.EUR.N
MIR.MAT.B.A2A.F.R.A.2240.EUR.N
MIR.MAT.B.A2A.I.R.A.2240.EUR.N
MIR.MAT.B.A2A.J.R.0.2240.EUR.N
### Appendix Tables

**Table 1: Intercepts and slope coefficients of the long run relationship**

<table>
<thead>
<tr>
<th>Loans with IRF period</th>
<th>Intercepts before ((\beta_1)) and after the shift ((\beta_1 + \beta_2))</th>
<th>0-1 Years</th>
<th>1-5 Years</th>
<th>5+ Years</th>
</tr>
</thead>
<tbody>
<tr>
<td>Country:</td>
<td>(\beta_1)</td>
<td>(\beta_2)</td>
<td>(\beta_1)</td>
<td>(\beta_2)</td>
</tr>
<tr>
<td>Finland</td>
<td>1.08***</td>
<td>0.80***</td>
<td>3.04***</td>
<td>0.14</td>
</tr>
<tr>
<td>Italy</td>
<td>1.61***</td>
<td>1.06***</td>
<td>1.43***</td>
<td>2.10***</td>
</tr>
<tr>
<td>Germany</td>
<td>1.40***</td>
<td>0.58***</td>
<td>2.48***</td>
<td>0.58***</td>
</tr>
<tr>
<td>Netherlands</td>
<td>0.78***</td>
<td>0.90***</td>
<td>3.01***</td>
<td>0.63***</td>
</tr>
<tr>
<td>Spain</td>
<td>1.11***</td>
<td>1.86***</td>
<td>0.81***</td>
<td>2.71***</td>
</tr>
<tr>
<td>France</td>
<td>0.55***</td>
<td>1.18***</td>
<td>3.56***</td>
<td>-0.56***</td>
</tr>
<tr>
<td>Austria</td>
<td>1.09***</td>
<td>0.58***</td>
<td>2.39***</td>
<td>0.46**</td>
</tr>
</tbody>
</table>

| Country:              | Slope coefficients before \((\beta_3)\) and after the shift \((\beta_3 + \beta_4)\) | \(\beta_3\) | \(\beta_4\) | \(\beta_3\) | \(\beta_4\) |
|-----------------------|-------------------------------------------------|-----------|-----------|---------|
| Finland               | 1.01***   | -0.13***  | 0.58***   | 0.16*   | 0.62***   | 0.31***  |
| Italy                 | 0.89***   | -0.18*    | 1.04***   | -0.58***| 0.92***   | -0.41*** |
| Germany               | 0.99***   | 0.04     | 0.77***   | 0.16*   | 0.43***   | 0.55***  |
| Netherlands           | 1.05***   | -0.12***  | 0.64***   | 0.00    | 0.46***   | 0.22***  |
| Spain                 | 1.06***   | -0.39***  | 1.17***   | -0.57***| 1.06***   | -0.62*** |
| France                | 1.12***   | -0.14***  | 0.45***   | 0.57*** | 0.37***   | 0.43***  |
| Austria               | 0.96***   | 0.01     | 0.60***   | 0.16*   | 0.28***   | 0.43***  |

**Table 2: Explanations of abbreviations and notation.**

Note: The results reported in Table 1 are obtained from the following specification: \(RLOA_t = \beta_1 + \beta_2I(2008 : 09)_t + \beta_3MMR_t + \beta_4I(2008 : 09)_t \ast MMR_t + \varepsilon_t\), where \(RLOA_t\) is the lending rate to the non-financial firms, \(MMR_t\) is the short term money market rate, \(I(2008 : 09)_t\) is a dummy variable which takes the value 1 from 2008-09 onwards and \(I(2008 : 09)_t \ast MMR_t\) is equal to the dummy variable \(I(2008 : 09)_t\) multiplied by \(MMR_t\). ***, **, * indicate significance at 1, 5, and 10 per cent, respectively.
Table 3: Error correction terms

<table>
<thead>
<tr>
<th>Country</th>
<th>0-1 Years</th>
<th>1-5 Years</th>
<th>5+ Years</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$\alpha_2$</td>
<td>$\alpha_3$</td>
<td>$\alpha_2$</td>
</tr>
<tr>
<td>Finland</td>
<td>-0.27*</td>
<td>-0.14</td>
<td>-0.51***</td>
</tr>
<tr>
<td>Italy</td>
<td>-0.13</td>
<td>0.10</td>
<td>-0.02</td>
</tr>
<tr>
<td>Germany</td>
<td>-0.11</td>
<td>0.09</td>
<td>-0.26**</td>
</tr>
<tr>
<td>Netherlands</td>
<td>-0.21</td>
<td>-0.06</td>
<td>-0.29**</td>
</tr>
<tr>
<td>Spain</td>
<td>0.02</td>
<td>-0.10</td>
<td>-0.25</td>
</tr>
<tr>
<td>France</td>
<td>-0.10</td>
<td>-0.07</td>
<td>-0.11</td>
</tr>
<tr>
<td>Austria</td>
<td>-0.08</td>
<td>-0.41***</td>
<td>-0.50***</td>
</tr>
</tbody>
</table>

Table 4: ADF test statistics and p-values for the null hypothesis of a unit root in the residuals of the estimated long run relationship.

<table>
<thead>
<tr>
<th>Country</th>
<th>0-1 Years</th>
<th>1-5 Years</th>
<th>5+ Years</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>statistic</td>
<td>p-value</td>
<td>statistic</td>
</tr>
<tr>
<td>Finland</td>
<td>-2.16</td>
<td>0.22</td>
<td>-2.77</td>
</tr>
<tr>
<td>Italy</td>
<td>-1.45</td>
<td>0.56</td>
<td>-1.29</td>
</tr>
<tr>
<td>Germany</td>
<td>-1.47</td>
<td>0.54</td>
<td>-1.19</td>
</tr>
<tr>
<td>Netherlands</td>
<td>-2.04</td>
<td>0.27</td>
<td>-3.41</td>
</tr>
<tr>
<td>Spain</td>
<td>-1.79</td>
<td>0.38</td>
<td>-1</td>
</tr>
<tr>
<td>France</td>
<td>-3.21</td>
<td>0.02</td>
<td>-2.07</td>
</tr>
<tr>
<td>Austria</td>
<td>-2.93</td>
<td>0.04</td>
<td>-1.37</td>
</tr>
</tbody>
</table>

Table 5: Summary of the error correction model for Finland

<table>
<thead>
<tr>
<th>Dependent variable:</th>
<th>Finland, All loans</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\Delta RLOA_t$</td>
<td>0-1 Years</td>
</tr>
<tr>
<td>Constant($\alpha_1$)</td>
<td>0.00</td>
</tr>
<tr>
<td>$\epsilon_{t-1}(\alpha_2)$</td>
<td>-0.27*</td>
</tr>
<tr>
<td>$\epsilon_{t-1} \ast I(2008 : 09)(\alpha_3)$</td>
<td>-0.14</td>
</tr>
<tr>
<td>$\Delta MMR_{t-1}(\alpha_4)$</td>
<td>0.41***</td>
</tr>
<tr>
<td>$\Delta MMR_{t-2}(\alpha_5)$</td>
<td>0.38***</td>
</tr>
<tr>
<td>$\Delta RLOA_{t-1}(\alpha_6)$</td>
<td>-</td>
</tr>
<tr>
<td>$\Delta RLOA_{t-2}(\alpha_7)$</td>
<td>-</td>
</tr>
<tr>
<td>Sample period</td>
<td>2003:04-2016:02</td>
</tr>
<tr>
<td>Adj. R-squared</td>
<td>0.37</td>
</tr>
<tr>
<td>DW Statistic</td>
<td>2.06</td>
</tr>
</tbody>
</table>
Table 6: Summary of the error correction model for Italy

<table>
<thead>
<tr>
<th>Dependent variable: $\Delta RLOA_t$</th>
<th>Italy, All loans</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0-1 Years</td>
</tr>
<tr>
<td>Constant($\alpha_1$)</td>
<td>0,00</td>
</tr>
<tr>
<td>$\varepsilon_{t-1} (\alpha_2)$</td>
<td>-0,13</td>
</tr>
<tr>
<td>$\varepsilon_{t-1} * I(2008 : 09) (\alpha_3)$</td>
<td>0,10</td>
</tr>
<tr>
<td>$\Delta MMR_{t-1} (\alpha_4)$</td>
<td>0,40***</td>
</tr>
<tr>
<td>$\Delta MMR_{t-2} (\alpha_5)$</td>
<td>0,35***</td>
</tr>
<tr>
<td>$\Delta RLOA_{t-1} (\alpha_6)$</td>
<td>-</td>
</tr>
<tr>
<td>$\Delta RLOA_{t-2} (\alpha_7)$</td>
<td>-</td>
</tr>
<tr>
<td>$\Delta RLOA_{t-3} (\alpha_8)$</td>
<td>-</td>
</tr>
<tr>
<td>Sample period</td>
<td>2003:04-2016:02</td>
</tr>
<tr>
<td>Adj. R-squared</td>
<td>0,33</td>
</tr>
<tr>
<td>DW Statistic</td>
<td>2,02</td>
</tr>
</tbody>
</table>

Table 7: Summary of the error correction model for Germany

<table>
<thead>
<tr>
<th>Dependent variable: $\Delta RLOA_t$</th>
<th>Germany, All loans</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0-1 Years</td>
</tr>
<tr>
<td>Constant($\alpha_1$)</td>
<td>0,00</td>
</tr>
<tr>
<td>$\varepsilon_{t-1} (\alpha_2)$</td>
<td>-0,11</td>
</tr>
<tr>
<td>$\varepsilon_{t-1} * I(2008 : 09) (\alpha_3)$</td>
<td>0,09</td>
</tr>
<tr>
<td>$\Delta MMR_{t-1} (\alpha_4)$</td>
<td>0,66***</td>
</tr>
<tr>
<td>$\Delta MMR_{t-2} (\alpha_5)$</td>
<td>0,71***</td>
</tr>
<tr>
<td>$\Delta RLOA_{t-1} (\alpha_6)$</td>
<td>-0,39***</td>
</tr>
<tr>
<td>$\Delta RLOA_{t-2} (\alpha_7)$</td>
<td>-0,41***</td>
</tr>
<tr>
<td>$\Delta RLOA_{t-3} (\alpha_8)$</td>
<td>-</td>
</tr>
<tr>
<td>Sample period</td>
<td>2003:04-2016:02</td>
</tr>
<tr>
<td>Adj. R-squared</td>
<td>0,52</td>
</tr>
<tr>
<td>DW Statistic</td>
<td>2,12</td>
</tr>
</tbody>
</table>
Table 8: Summary of the error correction model for Netherlands

<table>
<thead>
<tr>
<th>Dependent variable: $\Delta RLOA_t$</th>
<th>Netherlands, All loans</th>
<th>0-1 Years</th>
<th>1-5 Years</th>
<th>5+ Years</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constant($\alpha_1$)</td>
<td>0,00</td>
<td>-0,01</td>
<td>-0,02</td>
<td></td>
</tr>
<tr>
<td>$\varepsilon_{t-1}^c$</td>
<td>-0,21</td>
<td>-0,29**</td>
<td>-0,13</td>
<td></td>
</tr>
<tr>
<td>$\varepsilon_{t-1} * I(2008 : 09) (\alpha_3)$</td>
<td>-0,06</td>
<td>0,16</td>
<td>0,01</td>
<td></td>
</tr>
<tr>
<td>$\Delta MMR_{t-1}(\alpha_4)$</td>
<td>0,75***</td>
<td>0,31***</td>
<td>0,16</td>
<td></td>
</tr>
<tr>
<td>$\Delta MMR_{t-2}(\alpha_5)$</td>
<td>0,51***</td>
<td>-</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>$\Delta MMR_{t-3}(\alpha_6)$</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>$\Delta RLOA_{t-1}(\alpha_7)$</td>
<td>-0,31***</td>
<td>-0,05</td>
<td>-0,40***</td>
<td></td>
</tr>
<tr>
<td>$\Delta RLOA_{t-2}(\alpha_8)$</td>
<td>-0,15*</td>
<td>-</td>
<td>-0,19**</td>
<td></td>
</tr>
<tr>
<td>$\Delta RLOA_{t-3}(\alpha_9)$</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>Sample period</td>
<td>2003:04-2016:02</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Adj. R-squared</td>
<td>0,39</td>
<td>0,09</td>
<td>0,19</td>
<td></td>
</tr>
<tr>
<td>DW Statistic</td>
<td>2,07</td>
<td>2,09</td>
<td>2,01</td>
<td></td>
</tr>
</tbody>
</table>

Table 9: Summary of the error correction model for Spain

<table>
<thead>
<tr>
<th>Dependent variable: $\Delta RLOA_t$</th>
<th>Spain, All loans</th>
<th>0-1 Years</th>
<th>1-5 Years</th>
<th>5+ Years</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constant($\alpha_1$)</td>
<td>0,00</td>
<td>0,01</td>
<td>-0,02</td>
<td></td>
</tr>
<tr>
<td>$\varepsilon_{t-1}^c$</td>
<td>0,02</td>
<td>-0,25</td>
<td>-0,13</td>
<td></td>
</tr>
<tr>
<td>$\varepsilon_{t-1} * I(2008 : 09) (\alpha_3)$</td>
<td>-0,10</td>
<td>0,14</td>
<td>0,01</td>
<td></td>
</tr>
<tr>
<td>$\Delta MMR_{t-1}(\alpha_4)$</td>
<td>0,54***</td>
<td>1,13***</td>
<td>0,16</td>
<td></td>
</tr>
<tr>
<td>$\Delta MMR_{t-2}(\alpha_5)$</td>
<td>0,49***</td>
<td>0,56*</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>$\Delta MMR_{t-3}(\alpha_6)$</td>
<td>-</td>
<td>-0,55</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>$\Delta RLOA_{t-1}(\alpha_7)$</td>
<td>-0,29***</td>
<td>-0,40***</td>
<td>-0,40***</td>
<td></td>
</tr>
<tr>
<td>$\Delta RLOA_{t-2}(\alpha_8)$</td>
<td>-0,24***</td>
<td>-0,14*</td>
<td>-0,19**</td>
<td></td>
</tr>
<tr>
<td>$\Delta RLOA_{t-3}(\alpha_9)$</td>
<td>0,21***</td>
<td>-</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>Sample period</td>
<td>2003:04-2016:02</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Adj. R-squared</td>
<td>0,38</td>
<td>0,24</td>
<td>0,19</td>
<td></td>
</tr>
<tr>
<td>DW Statistic</td>
<td>2,02</td>
<td>2,03</td>
<td>2,01</td>
<td></td>
</tr>
</tbody>
</table>
Table 10: Summary of the error correction model for France

<table>
<thead>
<tr>
<th>Dependent variable: $\Delta RLOA_t$</th>
<th>France, All loans</th>
<th>0-1 Years</th>
<th>1-5 Years</th>
<th>5+ Years</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constant($\alpha_1$)</td>
<td>0,01</td>
<td>-0,02</td>
<td>-0,01</td>
<td></td>
</tr>
<tr>
<td>$\varepsilon_{t-1}(\alpha_2)$</td>
<td>-0,10</td>
<td>-0,11</td>
<td>-0,06</td>
<td></td>
</tr>
<tr>
<td>$\varepsilon_{t-1} \ast I(2008 : 09)(\alpha_3)$</td>
<td>-0,07</td>
<td>0,04</td>
<td>0,04</td>
<td></td>
</tr>
<tr>
<td>$\Delta MMR_{t-1}(\alpha_4)$</td>
<td>0,66***</td>
<td>0,54***</td>
<td>0,26***</td>
<td></td>
</tr>
<tr>
<td>$\Delta MMR_{t-2}(\alpha_5)$</td>
<td>0,22*</td>
<td>-</td>
<td>0,07</td>
<td></td>
</tr>
<tr>
<td>$\Delta MMR_{t-3}(\alpha_6)$</td>
<td>0,24**</td>
<td>-</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>$\Delta RLOA_{t-1}(\alpha_7)$</td>
<td>-0,21**</td>
<td>-0,25***</td>
<td>-0,06</td>
<td></td>
</tr>
<tr>
<td>$\Delta RLOA_{t-2}(\alpha_8)$</td>
<td>-0,20**</td>
<td>0,12*</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>$\Delta RLOA_{t-3}(\alpha_9)$</td>
<td>-0,02</td>
<td>0,05</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>Sample period</td>
<td>2003:04-2016:02</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Adj. R-squared</td>
<td>0,42</td>
<td>0,20</td>
<td>0,20</td>
<td></td>
</tr>
<tr>
<td>DW Statistic</td>
<td>1,93</td>
<td>2,08</td>
<td>2,04</td>
<td></td>
</tr>
</tbody>
</table>

Table 11: Summary of the error correction model for Austria

<table>
<thead>
<tr>
<th>Dependent variable: $\Delta RLOA_t$</th>
<th>Austria, All loans</th>
<th>0-1 Years</th>
<th>1-5 Years</th>
<th>5+ Years</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constant($\alpha_1$)</td>
<td>0,00</td>
<td>-0,01</td>
<td>-0,02</td>
<td></td>
</tr>
<tr>
<td>$\varepsilon_{t-1}(\alpha_2)$</td>
<td>-0,08</td>
<td>-0,50***</td>
<td>-0,53***</td>
<td></td>
</tr>
<tr>
<td>$\varepsilon_{t-1} \ast I(2008 : 09)(\alpha_3)$</td>
<td>-0,41***</td>
<td>0,10</td>
<td>0,30**</td>
<td></td>
</tr>
<tr>
<td>$\Delta MMR_{t-1}(\alpha_4)$</td>
<td>0,56***</td>
<td>0,85***</td>
<td>0,09</td>
<td></td>
</tr>
<tr>
<td>$\Delta MMR_{t-2}(\alpha_5)$</td>
<td>0,37***</td>
<td>-0,52*</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>$\Delta MMR_{t-3}(\alpha_6)$</td>
<td>0,27***</td>
<td>-</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>$\Delta RLOA_{t-1}(\alpha_7)$</td>
<td>-0,32***</td>
<td>-0,13</td>
<td>-0,21**</td>
<td></td>
</tr>
<tr>
<td>$\Delta RLOA_{t-2}(\alpha_8)$</td>
<td>-0,14*</td>
<td>-</td>
<td>-0,07</td>
<td></td>
</tr>
<tr>
<td>$\Delta RLOA_{t-3}(\alpha_9)$</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>Sample period</td>
<td>2003:04-2016:02</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Adj. R-squared</td>
<td>0,59</td>
<td>0,27</td>
<td>0,27</td>
<td></td>
</tr>
<tr>
<td>DW Statistic</td>
<td>1,83</td>
<td>1,99</td>
<td>2,04</td>
<td></td>
</tr>
</tbody>
</table>

Table 12: Explanations of abbreviations and notation.

Note: The results reported in Table 5 to Table 11 are obtained from the error correction model $\Delta RLOA_t = \alpha_1 + \alpha_2 \varepsilon_{t-1} + \alpha_3 \varepsilon_{t-1} \ast I(2008 : 09) + \Sigma_i \Delta \alpha MMR_{t-i} + \Sigma_j \Delta \alpha RLOA_{t-j} + \epsilon_t$, where $\varepsilon_t$ are the residuals from the cointegration equation, $RLOA_t$ is the lending rate to the non-financial firms, $MMR_t$ is the short term money market rate and ***,**,* indicate significance at 1, 5, and 10 per cent, respectively.
Table 13: P-values of ADF unit root tests of individual time series

<table>
<thead>
<tr>
<th>Country</th>
<th>0-1 Years</th>
<th>1-5 Years</th>
<th>5+ Years</th>
</tr>
</thead>
<tbody>
<tr>
<td>Finland</td>
<td>0.6203995</td>
<td>0.5677683</td>
<td>0.7409877</td>
</tr>
<tr>
<td>Italy</td>
<td>0.6993838</td>
<td>0.3245372</td>
<td>0.5228666</td>
</tr>
<tr>
<td>Germany</td>
<td>0.7112206</td>
<td>0.8807864</td>
<td>0.9367822</td>
</tr>
<tr>
<td>Netherlands</td>
<td>0.8466455</td>
<td>0.6804099</td>
<td>0.9489634</td>
</tr>
<tr>
<td>France</td>
<td>0.3638957</td>
<td>0.9138308</td>
<td>0.7511768</td>
</tr>
<tr>
<td>Austria</td>
<td>0.6249234</td>
<td>0.7102894</td>
<td>0.9539804</td>
</tr>
<tr>
<td>EONIA</td>
<td></td>
<td>0.5400097</td>
<td></td>
</tr>
</tbody>
</table>
Appendix Figure 1

Loans to NFCs interest rate spread over Eonia

Loans categorized by interest rate fixation:

- Short: 0-1 years (Red)
- Medium: 1-5 years (Green)
- Long: 5+ years (Blue)