# POST CRISIS COMPETITIVENESS OF THE EUROPEAN BANKING SECTOR AND THE EFFECTS OF MONETARY POLICY

Erasmus University Rotterdam

Erasmus School of Economics

Department of Economics

Supervisor:

Dr. S. Bijkerk

Author: Robert Hofman

Student Number: 379780

Email: robert10321@gmail.com

Abstract:

As the banking sector recovered from the 2008 financial crisis, the European Central Bank tried to improve the financial conditions in Europe by pursuing an expansionary monetary policy. This thesis tries to find whether banking competition was affected by this policy and to give an overview of the state of competition in Europe after the crisis. European banking competition is characterized by imperfect competition. The results suggest that the decreasing interest rates did not affect competition. This result is based on the north and south of Europe, and applies to small and big banks as well. Nevertheless, there are noticeable differences in competition between countries and banks.

### *1.1 Introduction*

After the financial crisis in 2008, the European central bank used an expansionary monetary policy to aid the economy and to address the failures in the financial sector. Their main policy instrument was the interest rate, which decreased significantly in the aftermath of the crisis (Figure 1).

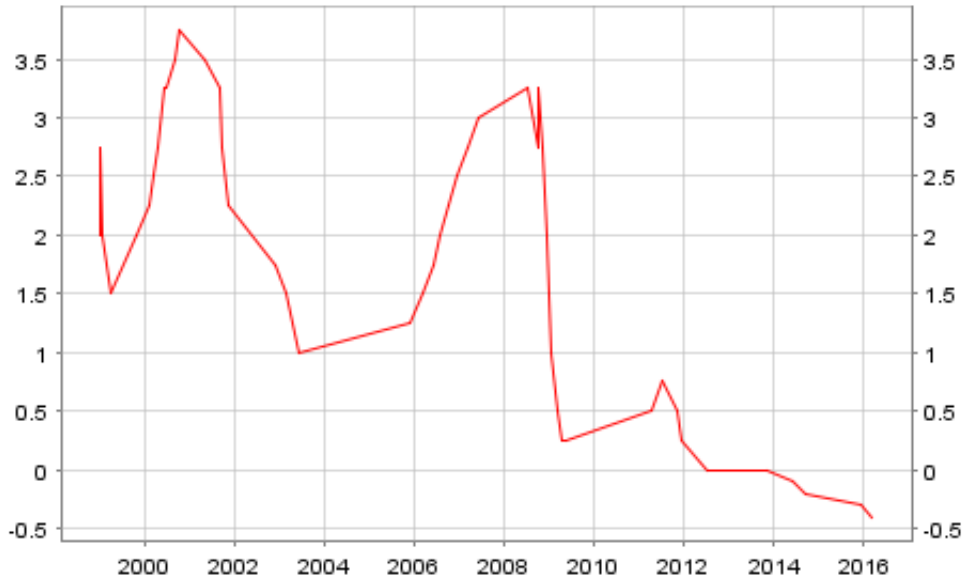


*Figure 1 EU Key interest rate - ECB Deposit facility - Euro, provided by ECB*

However, to further stimulate lending, the ECB also started purchasing assets directly to increase liquidity in the banking sector which massively increased the amount of assets of the ECB. In 2015, the ECB adopted the unconventional policy of quantitative easing, especially targeted at stimulating inflation. To assess the effects of such policies, existing literature tries to find direct links on indicators such as bank risk, amount of loans granted and inflation. However, another aspect of the effects of monetary policy is the behaviour of the banking sector as a whole. In particular, with respect to competition. This is an important issue for a number of reasons. Competition is an indicator for efficiency in a sector. Especially in a situation with low interest rates, banks struggle to offer competitive deals to customers. It is therefore important to have sufficient competition in order to maintain a customer focussed sector, specifically in a sector that was accused of greed towards its customers in the preface of the financial crisis. The crisis showed that the systemic problems in the market can be detrimental for society, so analysing sector wide characteristics is significant in the process towards a healthier financial climate. Previous literature also showed other aspects such as

the positive effects of competition on access to credit, which might benefit economic growth. The empirical literature on this subject is still developing and since monetary policy is such a relevant subject in the current post-crisis period, it is important that the impact of it is sufficiently analysed. Competitiveness is a relatively difficult measure to compute, as it includes several determinants such as market structure, entry possibilities and behaviour of market participants. On top of that, national characteristics influence the banking sector, such as taxation, a country's macroeconomic performance and regulation. To overcome those irregularities between countries and individual banks, a marginal approach to individual bank behaviour will be analysed in this thesis.

Following the methodology of the empirical work of Claessens and Laeven, 2004 the data used in this thesis will assess the competitiveness of banks in Europe and relate this indicator to the policy of the European Central Bank. In their paper, Claessens and Laeven follow a model by Panzar and Rosse, 1987 that uses bank-level data. It relates the indicator of competition to bank revenue with respect to the changes in the input prices. There are two extremes in this method. One is perfect competition, where the increase in input prices increase total revenues. The effect depends on the elasticity of demand. If marginal costs rise, inefficient suppliers drop out, until marginal costs equal marginal benefits again. The other extreme is a monopoly, where input prices increase marginal costs and therefore reduce equilibrium output and hence decrease total revenues. The indicator is the H-statistic, a number below 1, with smaller than 0 being an indicator for a (joint) monopoly and 1 being perfect competition.

Then, Claessens and Laeven use a worldwide study to assess the effects of certain country specifics and relate these to the competitiveness indicator. Following this methodology, this thesis uses the data for monetary policy of the European Central Bank (interest rates of the deposit facility of the ECB) which regresses this indicator in an effort to compute the H-statistic. Then, following the changes in the input prices, the effects on competition are evaluated from the coefficient estimates. Hence, the research question will be:

*How is banking competition in the Euro Area affected by expansionary monetary policy in the form of decreasing interest rates of the lending and borrowing facility by the ECB in the post crisis period of 2008 until 2015?*

Different from Claessens and Laeven, this thesis focusses on European banks to look at the effect of European monetary policy. Also, data from later periods are used to look at the impact of the policy response after the crisis of 2008. Following the regression model of Claessens and Laeven, the dependent variable is the ratio of gross interest revenue to total assets as a proxy for the output price of loans. The input price of deposits, labour, equipment and fixed capital are used as the total input proxies. There will also be certain control variables, which will be explained in the data section of this thesis. First the general remarks and trends of European banking competition will be shown. Whether the ECB policy has a significant effect must be noticeable from the change in the H-statistic after regressing the policy effect, which will be the second part of the results section.

This thesis will contribute to the current research in two ways. First of all, an overview of the current state of European banking competition will be analysed. This can be used to see if the results presented by Claessens and Laeven still hold, even in a post crisis period. Secondly, a possible strategy to evaluate the effects of monetary policy will be analysed. Considering that the most central banks in the world currently employ expansionary monetary policy, it is useful to have developed certain statistical methods to analyse these specific policies.

Overall, the European banking system is characterised by imperfect competition, with the exception of a few countries that have very high H-statistics, such as the Netherlands and Slovakia. The effect of the interest rate however, does not appear to be influencing the competitiveness in Europe as much. Five regions and types of banks are compared: Europe, Northern Europe, Southern Europe, big banks and small banks. The biggest difference in competitiveness exists between big and small banks. Big banks appear to be more competitive than small banks in Europe. However, the regional differences and the effect of monetary policy are not large.

The structure of this thesis is as follows: first the related literature (2) will be discussed, then, there will be an overview of the data (3) used and the methodology (4) and finally, the results (5) will be examined and followed by some robustness checks (6). Finally, a discussion and conclusion (7) is done.

## *2 Literature overview*

Since competitiveness is quite a broad measure and is both important for systemic and individual banking characteristics, the literature on the effects of competition itself is quite diverse. Unlike some industries, the plain view that increased competition is beneficial for the financial sector is not so clear. Several aspects potentially increase or decrease welfare and thus need to be taken into account. In recent years, the role of the central bank grew as its monetary policy directly targeted the banking sector in an attempt to stimulate growth. Although the central bank did not directly affect competition, its policies might have influenced the market structure and conditions.

### *2.1 Risk taking*

Competition in theoretical models of the banking sector usually lead to lower profits, and therefore lower incentives to provide good loans. Due to these less efficient loans, the moral hazard problem on the side of the borrower increases, thus he becomes riskier (Hellman, Murdoch & Stiglitz, 2000). They show that there is a negative relationship between interest rate liberalization and welfare improving banking behaviour. So, with sufficient competition, banks find it attractive to gamble more, because of the decrease in expected future profits. This increases incentives to take on more risk and possibly increases the overall systemic instability of the whole sector.

This view mainly stems from the role of deposit insurance, which results in moral hazard and distorts bank risk taking incentives. Banks take on too much risk because of the regulatory system which provides its customers with their savings in case of a bank failure. As a result, banks take this into account, which increases the risk of a failure.

More recent literature questions the assumption that banks focus on solving an optimal portfolio problem, but instead solve an optimal contracting problem. The former takes asset prices and return distributions as given, the latter assumes the actions of borrowers unobservable, or at least observable with a cost (Boyd & De Nicolo, 2005). In the contracting model, banks compete on both sides of the balance sheet; deposit and loan markets. Less competition implies more rents earned in both markets, thus higher loan rates are charged to customers if the number of banks decreases. Higher loan interest rates imply a higher bankruptcy rate for borrowers and this effect is further stimulated by the moral hazard part on the consumer side. They now optimally favour investments with increased risk.

On the other hand, less competition also implies lower deposit rates. Their model unambiguously shows that increasing competition lowers bank risk.

While these effects seem to contradict each other, Boyd and De Nicolo also show that empirical work leads to mixed conclusions. However, their most important point is that policy makers should not solely focus on a stable banking industry with reduced competition. This was often seen as essential for a solid financial system. Especially during times of crises, bank mergers are a recurring theme, which consequently has an ambiguous effect on the risk that banks take and could therefore worsen the systemic risk in the market. Hence, competitiveness of the banking sector is a controversial topic with respect to risk taking behaviour and a central bank policy targeted at stimulating growth through the banking sector should take into account the effects on competition and thus risk.

### *2.2 Other general effects of banking competition*

Petersen and Rajan, 1995 show that theoretically, access to finance for new, credit-constrained firms is easier if the banking sector is more concentrated. This occurs because if competition is lower, banks have more market power and thus can extract more future profits from the firm that it provides with loans. This enables the bank to set a lower interest rate on early short term loans because it has a stake in the equity of the firm in later periods. This allows for two beneficial effects. First, lower interest rates allow for more firms to be financed, also of lower quality. Second, the moral hazard effect on the side of the firm decreases, which decreases the risk the firm takes. Eventually the bank extracts the expected profits by charging higher interest rate on future loans. Hence, decreased competition positively affects the access to finance in this model.

Looking at the empirical evidence supporting banking competition and its effects, Beck, Demirgüç-Kunt and Levine, 2006 find that crises are less likely to occur in a concentrated banking sector, which supports the older theoretical view. However, lower barriers to entry reduce the systemic fragility of the banking sector, which lets them to conclude two things. First, something else drives the negative relationship of concentration and system fragility than just concentration on bank profits. Second, concentration might not be the best measure for competition to assess the competitiveness of the whole banking sector.

Furthermore, Boot and Thakor, 2000 examine the effects of relationship banking in a setting with increasing competition. In a model where banks offer a relationship or a

transaction loan, where a relationship loan offers more value to the customer but is also more expensive to the bank, banks choose the amount of relationship loans with respect to the capital market and other banks. Without any competition, the monopolist bank would only supply relationship loans to the lesser quality borrowers, because it can capture the added value of the loan with market power. For high quality borrowers, this added value is too small to cover the costs for the bank. Relationship lending helps to lock in certain customers and if competition increases, banks will shift to relationship lending to minimise the decrease in profits from competitive behaviour. However, due to the capital market competition, rents decrease and due to the prospect of lower profits, entry decreases. All in all, the overall system is more competitive, but with fewer banks. This decreases overall relationship lending, but increases the differentiation between banks due to the shift towards relationship lending, making only the higher quality borrowers unambiguously better off.

Therefore, in a more competitive setting, banks find it profitable to differentiate more, in order to capture a customer base that is being kept by the bank because of the added value due to the relationship.

### *2.3 Policy effects on the banking sector*

Regulatory effects on the banking sector are not as broadly investigated yet. Barth, Caprio and Levine, 2004 show that tighter entry requirements imposed by regulators are detrimental for bank efficiency. It leads to both higher interest rate margins and overhead expenditures. Also, restricting foreign bank participation tends to increase bank fragility. While this does not imply that monetary policy directly influences the competitiveness of the banking sector, efficiency of a sector definitely is an important proxy for competition. Their results might indicate that the regulatory decrease of competition through monetary policy can hurt welfare through a loss in efficiency.

Other related research does find that bigger banks, in the form of higher asset size and bank capital affect the ability of banks to raise funds and maintain loan growth during contractionary periods (Kishan & Opiela, 2000). Small bank's loan supply is more responsive to monetary policy, and their substitution towards the lending channel of the central bank increases in contractionary periods. This would imply that there is a difference between small and big banks with respect to the responses to monetary policy, with a greater effect for small banks.

Claessens and Laeven, 2004 link their competitiveness measure to several policy measures such as inflation and concentration. As inflation is also a target of the central bank, it is indirectly affected by monetary policy. The authors find a positive significant relation between concentration and competition, indicating that a higher concentration, fewer banks, increase the competitiveness of the sector. They do not find a significant relationship between inflation and competition. This might show that monetary policy does not affect competition, however, inflation is indirectly affected by a broad scale of variables. So it is more interesting to look at the direct impact of monetary policy in the form of interest rates.

### *3.1 Data*

The data to assess the competitiveness of the financial sector will be retrieved from BANKSCOPE, a database containing financial information including balance sheets, income statements and informative ratios of banks worldwide. As mentioned before, this thesis looks at the effects of European policy, so the sample is reduced to only contain European banks. The kind of banks that are included are commercial banks, savings banks, cooperative banks and holding companies. Banks without any data in the relevant period, or with errors in the data are deleted from the sample. Furthermore, the dataset ranges from 2008-2015.

The final sample consists of an unbalanced panel data set of 3701 banks, with the most of the banks being in Germany, Italy, Austria, Spain and France. The amount of banks per region is available in the form of the status of a bank. BANKSCOPE has data that shows whether a bank is active or not and the relevant date of inactivity, if a bank has been dissolved. Combined with its country of origin, this can be used to compute the amount of banks in certain regions.

The main variables of interest are: the ratio of gross interest revenue to total assets ($P_{it}$) as the output price of loans, the ratio of interest expenses to total deposits ($W_{1,it}$) as the input price of deposits, the ratio of personnel expenses to total assets ($W_{2,it}$) as the input price of labour and the ratio of other operating and administrative expenses to total assets ($W_{3,it}$) as the input price of equipment and fixed capital. The interest revenue over total assets ratio is calculated by taking the gross interest income on loans and the other interest income over total assets. For the ratio of interest expenses to total deposits, two options are available. The first is taking the interest expense on consumer deposits over total deposits. Another option is to take the total interest expenses and take the ratio over total deposits and money

market funding. The latter will be used in the overall regressions, because it has a lot more data available and hence is more reliable. Especially when comparing northern and southern Europe, the lack of observations for the Northern part is detrimental for the statistical interpretation. The other variables are directly available from the income statement.

The regression also includes the following data for the control variables: the ratio of equity to total assets, the ratio of net loans to total assets, the logarithm of total assets and a time dummy. Both these ratios and asset data are variables that are accessible from the BANKSCOPE database itself, directly from the financial data provided by the banks. The descriptive statistics for all variables are displayed in the tables 1 and 2.

The data on monetary policy is gathered from the ECB statistics database, under monetary operations. Since interest rate changes occur during the year, the average interest rate is calculated using the average of the beginning and the end of each respective year. This is also the average rate computed by the ECB statistics website.

*Table 1 Descriptive statistics of the dependent and independent variables*

| | *Revenues over Total assets* | *Personnel expenses over total assets* | *Operating expenses over total assets* | *Interest expenses over total deposits and money market funding* |
|---|---|---|---|---|
| *Mean* | 0,037326 | 0,013863 | 0,011959 | 0,023170 |
| *Median* | 0,036513 | 0,012513 | 0,008475 | 0,018043 |
| *Maximum* | 0,556715 | 0,532802 | 0,950787 | 1,593053 |
| *Minimum* | -0,001853 | 0,000000 | -0,012349 | -0,000658 |
| *Std. Dev.* | 0,016075 | 0,018276 | 0,028156 | 0,034858 |
| *Observations* | 22393 | 22077 | 22415 | 22121 |

*Table 2 Descriptive statistics of the control variables*

| | *Total assets (thousands)* | *Total loans over total assets* | *Equity over total assets* |
|---|---|---|---|
| *Mean* | 14.890.575 | 57,8153 | 9,987603 |
| *Median* | 615.500 | 60,3365 | 7,923000 |
| *Maximum* | 2.590.000.000 | 100 | 100 |
| *Minimum* | 311 | 0 | -51,29 |
| *Std. Dev.* | 108.000.000 | 18,78838 | 10,71002 |
| *Observations* | 22573 | 22286 | 22564 |

Overall, there are no huge outliers in the explanatory variables. For the control variables, total assets consist of some banks which have considerably higher values than the mean value. So to use this control variable it is important to take the logarithm to reduce these outliers. But the point of including this variable is to control for size of banks, hence the fact that it is a diverse variable is not problematic for the outcome of the regression. The equity over total assets ratio seems to have certain outliers on the negative side. Given that this variable is also regressed with the natural logarithm, only the positive values will be taken into account. Hence the negative outliers will have no effect on the outcome of the regression. This is applicable for all variables, so negative outliers will have no consequence for the regression outcome.

### *4.1 Methodology*

This thesis follows the same methodology as the one used in Claessens and Laeven. They use an approach to assess the competitive nature of the banking market using the sum of elasticities of the total bank revenue with respect to the bank's input prices. How much of a change in input prices is reflected in the revenues earned by bank *i* is used as an indicator of market power. It assumes that profits are maximised at the firm and industry level and the specific formula is the following:

$$H = \frac{\partial}{\partial t} \frac{R_{it}}{\sum_{k=1}^{3} W_{k_i t}}$$

Where $R_{it}$ is total revenue per bank, per year and $W_{k_i t}$ the total of all three input prices, per bank, over time. The statistic is called the H statistic and can be interpret in the following way; if H < 0, then this is an indication of a monopoly, if H = 1, there is perfect competition. Any number between 0 and 1 indicate imperfect competition. The intuition behind this is as follows. Under perfect competition, an increase in costs will be reflected one to one in marginal cost and marginal revenue earned by a specific bank. When there is only one firm, an increase in input prices will increase marginal costs, and hence decrease the optimal output for a firm. Hence, the monopoly revenue will go down and the H statistic will be lower than zero. So, the H statistic is a measure of the degree of monopoly power, or analogous, the degree of competition.

To estimate the value of the H-statistic, the following regression equitation will be the base model for the sample of individual banks depending on i and time t:

$$\ln(P_{it}) = a + \beta_1 \ln(W_{1,it}) + \beta_2 \ln(W_{2,it}) + \beta_3 \ln(W_{3,it}) + \gamma_1 \ln(Y_{1,it}) + \gamma_2 \ln(Y_{2,it}) + \gamma_3 \ln(Y_{3,it}) + Dt + \varepsilon_{it} \quad (1)$$

Where $P_{it}$ is the ratio of gross interest revenue to total assets, $W_{1,it}$ is the input price of deposits, which is likely to be the most correlated input price with respect to monetary policy. $W_{2,it}$ is the input price of labour and $W_{3,it}$ is the input price of equipment and fixed capital. These three input proxies should in theory approximate the total costs of a bank. To control for variables at the individual bank level, three control variables are added in the regression. $Y_{1,it}$ is the ratio of equity to total assets, $Y_{2,it}$ is the ratio of net loans to total assets and $Y_{3,it}$ is the logarithm of total assets. These control variables mainly target the potential size-effects of individual banks, such that bigger banks do not influence the outcome for smaller banks. Also, the way in which a bank is primarily financed is controlled for by the first variable. Finally, Dt is a time dummy, which controls for time varying effects. The t is an indicator for time, with the years ranging from 2008 until 2015. The natural logarithm is used for all input variables, since the H-statistic requires the elasticity of input prices with respect to the output price. Hence, the growth of interest revenue is obtained from a combination of the growth of all three input prices. The panel data sample offers the option to use fixed effects to mitigate the time-varying effects and the different characteristics between individual banks. So, by using ordinary least squares, the H-statistic equals $\beta_1 + \beta_2 + \beta_3$, which can be calculated for any region in Europe. As stated in the data section, to take the logarithm, values must be higher than zero, hence all other values are not taken into account in the regression.

Generally, one can expect the competitiveness to fall in between the range of 0 and 1, because imperfect competition seems the most plausible description of the European banking system. Usually an increase in costs will be somewhat noticeable in the output price, so hypothetically, the three betas are likely to be positive and sum up to a number in the range between 0 and 1.

A decrease in interest rates of the lending facility of the ECB decreases the banking cost of borrowing, given they have sufficient collateral. This increases the amount of loans that banks supply to the market, which would imply an increase in competition and hence a

higher H-statistic. However, during times of crises, more firms collapse and hence, the value of bank collateral decreases. On top of that, bank risk expectations increase and banks start financing itself from other sources. Since the ECB usually cuts interest rates during crisis periods, the ECB funding is used instead of the money market, bond market, etc. This would imply that there is a mere substitution between money suppliers, which would not imply a significant change in the competitiveness. Which effect dominates is unclear, but the ECB would definitely prefer the first effect to occur, for increasing competitiveness is necessary to let consumers benefit from decreasing interest rates.

Since the H-statistic can be calculated for individual banks, regions, countries, etc., the follow up approach to relate to the effects of monetary policy will be to regress this H-statistic with the interest rate with the following regression model:

$$\ln(P_{it}) = a + \beta_1 \ln(W_{1,it}) + \beta_2 \ln(W_{2,it}) + \beta_3 \ln(W_{3,it}) + \gamma_1 \ln(Y_{1,it}) + \gamma_2 \ln(Y_{2,it}) + \gamma_3 \ln(Y_{3,it}) + \theta C_t + \varepsilon_{it}$$

It is the same regression used to calculate the H-statistic, but it includes the proxy for the effect of the interest rate: $C_t$. The interest rate is a fixed number set for each year and is the same across all banks in Europe, because it is set at a specific rate by the ECB. Because the interest rate is changed each year, the regression will only take into account bank-level fixed effects, since the interest rate is time-varying and hence cannot be included in a period fixed effects regression. The value of $\theta$ is expected to be positive, because when interest rates increase, the overall interest rate revenues are likely to increase. Similarly, with expansionary monetary policy, the interest rates are expected to decrease. Nevertheless, the most interesting concept after adding the interest rate variable is the difference in the explanatory variables, compared to the situation with only fixed effects. In the case with fixed effects, all time varying effects, including the interest rate are not affecting the H-statistic. If the interest rate is influencing the competitiveness of the banking sector, the H-statistic must be different when this interest rate is added into the regression, without fixed time effects. A distinction will be made between different sized banks and different regions in Europe, in particular the northern part and the south.

### *5.1 General results*

First of all, a series of tests is performed to see whether the regression can be executed as specified in the methodology. To test for multicollinearity, a Pearson correlation test is done for all the cost input variables and control variables. Afterwards, an autocorrelation test for the interest revenues is done, which is the dependent variable. The outcome of the correlation test is the following (table 3):

*Table 3 Correlation between explanatory and control variables*

| **Correlation values** | $W_1$ | $W_2$ | $W_3$ | $Y_1$ | $Y_2$ | $Y_3$ |
|---|---|---|---|---|---|---|
| $W_1$ | 1 | 0,090 | 0,099 | 0,047 | 0,061 | 0,081 |
| $W_2$ | 0,090 | 1 | 0,629 | 0,288 | -0,101 | -0,065 |
| $W_3$ | 0,099 | 0,629 | 1 | 0,222 | -0,111 | -0,034 |
| $Y_1$ | 0,047 | 0,288 | 0,222 | 1 | -0,085 | -0,075 |
| $Y_2$ | 0,061 | -0,101 | -0,111 | -0,085 | 1 | -0,077 |
| $Y_3$ | 0,081 | -0,065 | -0,034 | -0,075 | -0,077 | 1 |

If correlations of multiple explanatory variables are high, the effect of both variables may not be estimated correctly (spurious regression), because both move in the same or opposite direction in any case. For this particular data set, the ratios of operating expenses over assets and the personnel expenses over assets are highly correlated (0,63). Hence the value of the coefficients will not be correctly displaying the actual effect. Considering that this can affect the value of the H-statistic, not all three variables can be input variables in the same model. So in the regression, one variable will have to be dropped to overcome the problem of multicollinearity. In general, the ratio of operating expenses over total assets is less significant when comparing regression outcomes, while the amount of observations is comparable, this variable will be dropped from the regression model. So, the H-statistic will now be calculated as the sum of two input prices proxies. In section 6, robustness checks will be evaluated and the ratio of operating expenses over total assets will also be looked at when computing the H-statistic.

Secondly, to assess whether the dependent variable is auto correlated with itself, a unit root test with an intercept is executed. Since there is no clear pattern of a trend in the

dependent variable, the unit root test with only an intercept is used. The test has the following results (table 4):

*Table 4 Panel Unit Root test summary*

| **Unit root test** | *Statistic* | *Probability* | *Cross-sections* | *Observations* |
|---|---|---|---|---|
| Levin, Lin & Chu t* | -120,5 | 0,000 | 3235 | 18107 |
| Im, Pesaran and Shin W-stat | -55,2 | 0,000 | 2956 | 17270 |
| ADF – Fisher Chi-square | 13386,1 | 0,000 | 3235 | 18107 |
| PP – Fisher Chi-square | 19244,3 | 0,000 | 3235 | 18168 |

Because all tests clearly reject the hypotheses of a unit root, autocorrelation for the ratio of interest revenue over total assets does not seem likely. Hence, there is no need to control for any previous period effect of this ratio.

To give an overview of the data, the following table (5) shows the average H-statistic over the period 2008 until 2015 for each country and the amount of banks in the sample. The H-statistic is calculated using fixed effects in both the bank-level and the periods, to factor out any time varying effects and individual bank characteristics.

Overall, the H-statistic ranges from 0,36 until 0,98 for respectively Slovenia and Slovakia. Due to the small amount of observations in certain countries, these results might not be comparable in all cases. All observed countries with at least twenty banks have an H-statistic which ranges between 0,46 and 0,96 with Germany being the lowest and the Netherlands the highest. The values all range between zero and one, so the European banking system can be seen as imperfectly competitive. Some countries do however, seem to have an almost perfectly competitive sector, like the Netherlands and Slovenia.

There does not appear to be a clear pattern between the H-statistic for specific types of countries. The unweighted average in Europe is 0,65 and the average of countries with at least twenty banks is 0,62. This makes Europe fairly competitive in general, which is in line with what was found in previous research by Claessens and Laeven, 2003.

*Table 5 Average H-statistic for each country, standard errors and number of banks*

| *Country* | *H-statistic* | *Standard Error* | *Number of banks* | *Number of observations* |
|---|---|---|---|---|
| Germany | 0,46 | (0,016) | 1742 | 10929 |
| Italy | 0,55 | (0,023) | 655 | 3929 |
| Austria | 0,61 | (0,033) | 283 | 1486 |
| France | 0,67 | (0,046) | 217 | 1293 |
| Spain | 0,50 | (0,048) | 200 | 931 |
| Portugal | 0,65 | (0,055) | 116 | 496 |
| Luxembourg | 0,72 | (0,060) | 87 | 454 |
| Finland | 0,53 | (0,113) | 48 | 163 |
| Belgium | 0,75 | (0,076) | 42 | 233 |
| Netherlands | 0,96 | (0,140) | 40 | 242 |
| Cyprus | 0,48 | (0,158) | 22 | 100 |
| Greece | 0,85 | (0,141) | 18 | 91 |
| Latvia | 0,74 | (0,145) | 20 | 119 |
| Slovenia | 0,37 | (0,115) | 18 | 119 |
| Slovakia | 0,98 | (0,188) | 17 | 91 |
| Ireland | 0,63 | (0,161) | 13 | 60 |
| Lithuania | 0,36 | (0,130) | 11 | 63 |
| Malta | 0,77 | (0,134) | 10 | 58 |
| Estonia | 0,85 | (0,221) | 8 | 50 |

The notably low value of Germany is interesting, as it is the country with the biggest amount of banks in the sample. These irregularities of countries with few banks combined with high values of the H-statistic and countries with large amounts of banks with a low value of the H-statistic might indicate that banking competition is unlike other sectors. The increase of the amount of banks does not necessarily increase competition. This supports the evidence that, as Claessens and Laeven, 2003 already point out, concentration is not a good indicator for banking competition. They also find that big countries like Germany and the US report relatively low values of the H-statistic. As small banks may operate in a local market that is less competitive, including many of these small banks may influence the measure in such a way that the H-statistic it is very low.

### *5.2 Interest rate policy results*

To evaluate the effect of the interest rate on competition, another correlation test is done in table 6, which also includes the interest rate variable.

*Table 6 Correlation between explanatory and control variables and the interest rate*

| **Correlation values** | Interest rate |
|---|---|
| $W_1$ | 0,342 |
| $W_2$ | 0,015 |
| $W_3$ | 0,004 |
| $Y_1$ | -0,061 |
| $Y_2$ | 0,025 |
| $Y_3$ | -0,013 |
| Interest Rate | 1 |

It makes sense that the interest rate is correlated the highest with the interest rate expense ratio, because the effect of decreasing interest rates will in most cases decrease a bank's interest expenses. However, the interest rate is not extremely correlated with one of the explanatory variables, so it can be used in the regression without a problem. Just like previous regressions, the operating expense ratio will be dropped as it is highly correlated with the personnel expense ratio. As mentioned in the methodology, the effect of the interest rate policy is evaluated using the outcome of a fixed period effects regression and a regression which includes the interest rate variable. It compares the situation of competition in a case which nothing happened, and in the case the interest rates changed. Table 7 gives an overview of the relevant regressions and comparison between the H-statistic with and without the effect of the interest rate.

Before the analysis of the regression, it is worth pointing out the general results of the estimated coefficients. First of all, and as expected, both input price beta's are positive and significant for all regressions. The control variables show some contrasting numbers. The ratio of equity over total assets is positive in the Northern Europe under fixed effects, and for small banks. However, it is negative for the Southern European banks and for big banks. One explanation could be that for big banks, an increase in equity compared to total assets, which is costly for banks, increases their costs. Since bigger banks face greater competition (table 7), this increase in costs can be transferred to higher prices which decreases demand due to the competitive pressure. All in all, this could then decrease total revenues. The coefficient for total assets is also negative for big banks, which again differs from the other regressions. If big banks increase their assets, the revenue goes down according to this regression. But this

also implies that the equity over assets ratio decreases, which in turn increases revenues. The correlation for big banks between these two variables is only -0,13, so there is no evidence for spurious regression. Looking at the data for biggest banks, a rise in equity over assets which is accompanied by a decrease in revenues also shows a decrease in assets. This might suggest that the rise in equity over assets is indeed caused by a decrease in assets, which would then, following the previous reasoning, decrease revenues.

A few general results are noticeable and worth to be pointed out. The northern and southern part of the EU do not differ a lot in terms of competition. A bigger difference arises when comparing big and small banks. Bigger banks are far more competitive than small banks, regardless of the effect of interest rates. This difference suggests that bigger banks actually face a more competitive environment, possibly due to the fact that smaller banks operate in a more local market that is less competitive. Similar findings in Claessens and Laeven, 2003 show that the H-statistic is lower in countries with many banks, including many small ones. This could also be one of the reasons why the H-statistic is so low in Germany. Adding weights for larger banks into the regression might be more insightful in this particular case, but it lies beyond the scope of this thesis. The interest rate itself is only insignificant in the north of Europe, which indicates that the interest rate differences have less of an impact on banking revenues than in the south, where the effect is highest across all regressions. This indicates that banks in the south respond more heavily after a change in interest rates. This effect says nothing about competitiveness in terms of the H-statistic.

When it comes to competitiveness, it is the difference in H-statistic for each pair that shows the effect of the ECB policy on competition. In Europe, the H-statistic decreases with 0,009. Even though the interest rate is significant, it does not have a big effect on both the dependent variable and the H-statistic. The effect is bigger in the north of Europe, where the H-statistic increases with 0,023. The biggest influence of the interest rate effect is noticeable in big banks; a decrease with 0,024. However, these incremental changes do not significantly change the H-statistic, because the difference is fairly small compared to the standard errors of the H-statistic itself. So, in neither of the four presented situations the effect of the interest rate is observed in the competition statistic. Since the interest rate does affect revenues, but does not affect competition, banks seem unable or unwilling to effectively compete and hence experience a drop in their revenues.

*Table 7 Interest effect comparison*

| Variables | Europe[1] | Europe[2] | North EU[1] | North EU[2] | South EU[1] | South EU[2] | Big banks[1] | Big banks[2] | Small Banks[1] | Small Banks[2] |
|---|---|---|---|---|---|---|---|---|---|---|
| Constant | -2,237** (0,094) | -2,413** (0,087) | -2,322** (0,136) | -1,782** (0,120) | -2,834** (0,168) | -3,381** (0,175) | -0,357 (0,352) | -0,466 (0,355) | -2,565** (0,102) | -2,639** (0,092) |
| *Log of personnel expenses over assets* | 0,167** (0,007) | 0,164** (0,007) | 0,131** (0,010) | 0,135** (0,010) | 0,228** (0,012) | 0,204** (0,013) | 0,242** (0,019) | 0,242** (0,019) | 0,162** (0,008) | 0,159** (0,007) |
| *Log of Interest expenses over deposits* | 0,414** (0,004) | 0,406** (0,003) | 0,374** (0,006) | 0,394** (0,005) | 0,275** (0,007) | 0,307** (0,006) | 0,511** (0,012) | 0,487** (0,011) | 0,400** (0,004) | 0,397** (0,003) |
| H-statistic | 0,580 | 0,571 | 0,505 | 0,528 | 0,503 | 0,510 | 0,753 | 0,729 | 0,561 | 0,556 |
| Interest Rate | | 0,022** (0,002) | | 0,001 (0,002) | | 0,080** (0,004) | | 0,022** (0,006) | | 0,023** (0,002) |
| Control variables: | | | | | | | | | | |
| *Log of equity over assets* | 0,002 (0,005) | 0,008 (0,005) | 0,029** (0,009) | -0,015 (0,008) | -0,030** (0,008) | -0,023** (0,009) | -0,066** (0,013) | -0,052** (0,013) | 0,019** (0,006) | 0,021** (0,006) |
| *Log of loans over assets* | 0,089** (0,005) | 0,090** (0,005) | 0,086** (0,008) | 0,084** (0,008) | 0,152** (0,010) | 0,119** (0,011) | 0,208** (0,019) | 0,204** (0,019) | 0,080** (0,006) | 0,082** (0,006) |
| *log of total assets* | 0,070** (0,006) | 0,078** (0,006) | 0,054** (0,009) | 0,027** (0,009) | 0,079** (0,012) | 0,126** (0,012) | -0,039* (0,019) | -0,039* (0,019) | 0,092** (0,007) | 0,095** (0,007) |
| Adjusted R-squared | 0,89 | 0,89 | 0,88 | 0,88 | 0,91 | 0,89 | 0,92 | 0,92 | 0,89 | 0,89 |
| Total panel observations | 20907 | 20907 | 11567 | 11567 | 5605 | 5605 | 2144 | 2144 | 18763 | 18763 |

Notes: Dependent variable is the log of the ratio of total interest revenues over assets. The standard errors are displayed in the brackets. The H-statistic can differ from the above mentioned variables because of rounding errors. ** Significance at 1%; * Significance at 5%. 1: Period and bank-level fixed effects; 2: Only bank-level fixed effect. The northern part of Europe consists of Finland, the Netherlands, Germany and Belgium. The southern part includes the countries: Italy, Spain, Greece, Portugal, Malta and Cyprus. The final difference is between big and small banks. For this sample, big banks at least have a size of total assets of ten billion. All other banks are classified as small banks.

Finally, to assess country specific effects instead of bank-level fixed effects, table 8 shows an overview of European countries with at least forty banks. The dummy variable for the Netherlands is dropped to avoid the singularity of the dummy variables in the regression.

*Table 8 Country specific competitiveness effects*

| Variables | Fixed effects | Interest policy effect |
|---|---|---|
| Constant | -1,688** (0,044) | -1,692** (0,043) |
| *Log of personnel expenses over assets* | 0,055** (0,004) | 0,055** (0,004) |
| *Log of Interest expenses over deposits* | 0,372** (0,004) | 0,374** (0,004) |
| *H-statistic* | 0,427 | 0,430 |
| Control variables: | | |
| *Log of equity over assets* | 0,017** (0,004) | 0,017** (0,004) |
| *Log of loans over assets* | 0,137** (0,003) | 0,137** (0,003) |
| *log of total assets* | -0,042** (0,001) | -0,042** (0,001) |
| Interest Rate | | 0,031** (0,003) |
| Country Dummy Variables: | | |
| *Germany* | 0,126** (0,182) | 0,128** (0,018) |
| *Italy* | 0,019 (0,018) | 0,021 (0,018) |
| *Austria* | -0,033 (0,019) | -0.031 (0,019) |
| *France* | 0,090** (0,019) | 0.092** (0,019) |
| *Spain* | 0,042* (0,020) | 0.044* (0,020) |
| *Portugal* | 0,144** (0,022) | 0.146** (0,022) |
| *Luxembourg* | -0,085** (0,022) | -0.083** (0,022) |
| *Finland* | -0,112** (0,028) | -0.110** (0,028) |
| *Belgium* | 0,143** (0,025 | 0.144** (0,025) |
| *Netherlands* | -dropped- | -dropped- |
| Adjusted R-squared | 0,53 | 0,53 |
| Total panel observations | 20156 | 20156 |

Notes: Dependent variable is the log of the ratio of total interest revenues over assets. The standard errors are displayed in the brackets. The H-statistic can differ from the above mentioned variables because of rounding errors. ** Significance at 1%; * Significance at 5%. In the fixed effects regression, time-fixed effects are added.

Compared to a bank-level fixed effects regression, the explanatory power of a country-level fixed effects regression is much lower. However, the average H-statistic lies somewhat lower than in the bank-level regression. Several aspects play a role in this fact. First, the countries with few banks are dropped from the sample, resulting in a different set of data which is used in the regression in table eight. Second, country-level fixed effects could have

different results on the impact of competitiveness. Country-level regressions only differentiate on the basis of nationwide characteristics, so it is showing the impact of countries on the revenues by banks. Compared to the Netherlands, only Luxembourg and Finland have significantly lower values for revenue over asset ratios. In all other countries, banks make more revenue compared to their assets than the Netherlands. Similar to bank-level fixed effects, the interest rate does have a significant positive effect on the revenue ratio, even more than in the bank-level fixed effects regression. Through the aggregate of banks within countries, the effect is stronger because most of the small, national banks compete within countries. This enforces the effect of the monetary policy between countries especially compared to a situation with bank-level fixed effects.

### *6.1 Robustness check*

To see whether the difference between incorporating the personnel expenses instead of the operating expenses in the model made a difference, a robustness check is done in the following table. The same methodology is applied as before, but operating expenses are used instead of personnel expenses. The result is displayed table 9. Overall, personnel expenses show a higher value of the change in revenues than operating expenses. The value of operating expenses is never above 0,1; while the value for personnel expenses was never below 0,131. Hence, when using the operating expenses as the input proxy, the H-statistic is lower. This could be because the mean personnel expenses are higher, which needs to be reflected in the output price. Banks might also allocate more personnel expenses as an input for price decisions than operating expenses.

On average, the H-statistic varies between 0,1 and 0,15 compared to the previously found measures. The decrease in the effect of operating expenses is not fully reflected in an increase of the interest expense proxy, which causes the H-statistic to be lower. The biggest difference between the two estimates is the gap between the north and the south. According to the previous estimate with personnel expenses, there is no significant difference between the two regions in Europe in terms of the H-statistic, which lies around 0,51. In the model with operating expenses, the north has a much higher H-statistic than the south, with a difference around 0,15 with and without the policy effect. So, according to this model, the northern banks are more competitive than the southern ones. The value for the interest expense is higher in the north for both regressions. The main difference between the two

methods is due to the effect of personnel expenses and operating expenses. In the north of Europe, the value for personnel expenses is lower than in the south, which compensates for the effect of the interest expenses. However, in the north, operating expenses are similar to the south, so the difference between the north and the south is larger.

The effect of the interest rate is very similar to the previous model, including the effect on the H-statistic between time-fixed effects and the interest rate model. There are little signs that the H-statistic was affected by the interest rate in this model as well. Similar to previous findings, bigger banks are more competitive than smaller banks, however, the difference between the two is smaller in the robustness model and the value for big banks is lower. This implies that especially big banks allocate less operating expenses in their interest revenue than personnel expenses.

The signs of the coefficients do not change between both the models and the adjusted R-squared is almost the same as well. The first model is slightly better in predicting, except for the regression with small banks. Overall, the R-squared for both models is very high, hence both do well in predicting the H-statistic. What the model in table nine shows, is that estimating different models can be good to increase the strength of this specific methodology to estimate the H-statistic. Since there might be more cost input variables and different estimates, it is useful to take an average effect when estimating the competitiveness of banks using this method.

*Table 9 Robustness check with operating expenses*

| Variables | Europe[1] | Europe[2] | North EU[1] | North EU[2] | South EU[1] | South EU[2] | Big banks[1] | Big banks[2] | Small Banks[1] | Small Banks[2] |
|---|---|---|---|---|---|---|---|---|---|---|
| Constant | -2,934** (0,095) | -2,982** (0,089) | -3,817** (0,136) | -3,126** (0,120) | -2,809** (0,171) | -3,340** (0,177) | -1,036** (0,037) | -1,124** (0,369) | -2,660** (0,102) | -2,613** (0,093) |
| *Log of operating expenses over assets* | 0,078** (0,005) | 0,076** (0,005) | 0,100** (0,007) | 0,098** (0,007) | 0,054** (0,007) | 0,053** (0,008) | 0,065** (0,015) | 0,070** (0,015) | 0,080** (0,005) | 0,078** (0,005) |
| *Log of Interest expenses over deposits* | 0,407** (0,004) | 0,407** (0,003) | 0,381** (0,006) | 0,408** (0,005) | 0,276** (0,007) | 0,304** (0,006) | 0,511** (0,013) | 0,491** (0,011) | 0,388** (0,004) | 0,392** (0,003) |
| H-statistic | 0,485 | 0,483 | 0,480 | 0,506 | 0,329 | 0,357 | 0,576 | 0,561 | 0,468 | 0,469 |
| Interest Rate | | 0,026** (0,002) | | 0,004 (0,002) | | 0,082** (0,004) | | 0,022** (0,006) | | 0,026** (0,002) |
| Control variables: | | | | | | | | | | |
| *Log of equity over assets* | 0,010 (0,006) | 0,011* (0,005) | 0,024* (0,010) | -0,032** (0,008) | -0,017 (0,009) | -0,013 (0,009) | -0,046** (0,013) | -0,035** (0,013) | 0,027** (0,006) | 0,025** (0,006) |
| *Log of loans over assets* | 0,113** (0,005) | 0,113** (0,005) | 0,126** (0,008) | 0,124** (0,008) | 0,155** (0,010) | 0,126** (0,010) | 0,251** (0,019) | 0,247** (0,019) | 0,088** (0,005) | 0,089** (0,005) |
| *log of total assets* | 0,083** (0,007) | 0,085** (0,006) | 0,148** (0,009) | 0,113** (0,009) | 0,017 (0,011) | 0,069** (0,004) | -0,062** (0,020) | -0,061** (0,020) | 0,067** (0,007) | 0,062** (0,007) |
| Adjusted R-squared | 0,89 | 0,89 | 0,88 | 0,87 | 0,90 | 0,89 | 0,90 | 0,91 | 0,90 | 0,90 |
| Total panel observations | 21072 | 21072 | 11592 | 11592 | 5604 | 5604 | 2158 | 2158 | 18914 | 18914 |

Notes: Dependent variable is the log of the ratio of total interest revenues over assets. The standard errors are displayed in the brackets. The H-statistic can differ from the above mentioned variables because of rounding errors. ** Significance at 1%; * Significance at 5%. 1: Period and bank-level fixed effects; 2: Only bank-level fixed effect. The northern part of Europe consists of Finland, the Netherlands, Germany and Belgium. The southern part includes the countries: Italy, Spain, Greece, Portugal, Malta and Cyprus. The final difference is between big and small banks. For this sample, big banks at least have a size of total assets of ten billion. All other banks are classified as small banks.

### *7.1 Conclusion & Discussion*

"Monetary policy has certainly contributed to reducing interest rates. Yet our policy should be understood as a response to this challenging context. Monetary policy cannot affect the secular forces weighing on the euro area economy, nor can it provide an answer to our institutional and structural questions. What it can and must do, however, is respond to the weakness in aggregate demand and the disinflationary pressures that creates." This is what Peter Praet, Member of the Executive Board of the ECB said at a Pension Funds Conference organised by De Nederlandsche Bank in Bussum, The Netherlands in 2015. Expansionary monetary policy has been affecting Europe now for quite a while and is not supposed to stop in the coming years, especially due to the introduction of quantitative easing in 2015. The relevance of solid research into the effects of monetary policy is therefore of great importance. The hypothesis of the effect of the ECB policy was unclear. On the one hand, the ECB would want to see competition improved by the lower interest rates. In this way, customers and businesses can enjoy the benefits of lower interest rates to its full potential. However, as banks can use these lower interest rate as a mere substitution of input prices, a direct effect towards competition is not clear cut. As the growth is still not caching up in Europe, collateral for banks has been an issue since the crisis and risks are still high. Hence, the substitution from money markets, bond markets, etc. towards cheap credit from the ECB might have had no influence on the competitiveness after all.

In a few European countries, the H-statistic in the post crisis period of 2008 until 2015 is very high. Because the competitiveness of these countries is so high already, any increase is less likely. As the average of Europe is roughly 0,6; competitiveness is in a decent spot, since it is still far away from 0. However, competitiveness does not change in a significant way, so the ECB should not expect its policy to generate an improvement in competition. These results are applicable in general in Europe, the north, south and for both small and big banks as well. All these different regions and characteristics have experience a very small change in competition when controlling for the Central bank policy. On a bank and national level, the effect of the central bank policy is significant. The effect on a national level is higher than on an individual bank level. The revenue ratio of banks moves in the same direction as the interest rates set by the central bank, without any shift in competition however. Even after a robustness check with another input for banking costs, the effect on competition remains very low.

### *7.2 Policy implications*

The direct target of the expansionary monetary policy by the ECB is to increase the inflation rate. However, the fact that competition is not affected might raise concerns for the central bank. Even though the inflation rate is the main focus of the ECB, it has not been increasing and there are raising concerns into the effectiveness the current policy. Supported by the fact that apparently, banks do not significantly improve in terms of competing with each other, the ECB policy might actually have some flaws. Since competition is not extremely low in Europe, the ECB might have other more important issues. For stability across Europe however, the competitiveness of the banking sector is of vital importance. Specific attention on countries with low H-statistics or many small banks could improve the European banking competition. The biggest attention obviously goes to the big banks, but according to the results presented in this thesis, big banks compete more effectively than small banks. Hence, the central bank should take into account the consequences of their policy across all levels of banks.

The low-interest rate period might also generate other negative externalities, such as financial bubbles. This increases the need for fierce competition, lower loan rates and better interest revenues for customers to increase the public's spending and trust in the economy. Looking into how banking competition evolves over the coming years, and how input price elasticities respond to interest rate changes by the central bank has to be an important aspect of evaluating monetary policy.

### *7.3 Limitations & Future research*

The method of this thesis, as it was used by Claessens and Laeven, suffers from a couple of drawbacks which could have affected the results. First of all, only eight years are taken into account, which is fine considering the huge amount of observations (over 20.000), but it only displays the period of the aftermath of the crisis. Obviously, banks have been involved in this crisis to a great extent, hence competition and competitive statistics could have been affected by this as well. Even with a fixed effects regression, results could be influenced given this post-crisis effect. However, to assess the effect of the ECB policy, it is only possible to look in such periods, in which expansionary monetary policy is carried out. To increase the robustness, other research could look into similar effects of expansionary policy carried out by other central banks across the world. Also, looking into the

competitiveness of the banking sector over a longer period of time could be an option, particularly to assess national or regional policies.

In the dataset that has been used in this thesis, the correlation of two of the input price beta's (the ratio of personnel expenses over total assets and the ratio of operating expenses over total assets) is very high and accordingly, the operating expenses variable was removed from the regressions and only used as a robustness check. Because of this, the total value of the H-statistic might not have been complete, due to this missing input factor. However, this thesis followed a specific methodology, so no other variable has been included. Since the robustness check with operating expenses showed some dissimilarities between the two models, further research into substitutes for the proxy of operating expenses could result in a better approximation for the H-statistic or could find ways to average multiple models to find a more robust H-statistic.

An interesting option for further (and later) research might be to apply the same methodology towards assessing the effects of quantitative easing. Given that this has been applied for only one year in Europe now, it might still be too early to evaluate its effects. Other banks however started this particular policy in an earlier period. So, with similar data, one could try to estimate those effects on competition. Since causal effects of monetary policy are hard to capture, research into side effects, and in particular systemic effects, could shed a light into the effects, but also the drawbacks of the current monetary policy.

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