Determinants of deposit rates

Which factors influence the deposit rates in the Dutch retail deposit market?

Master thesis Financial Management

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Abstract

This paper explores the retail deposit rate in the Dutch savings market. The deposit rate for savings accounts is dynamic and this study is conducted in order to test which factors influence the deposit rate. The factors of influence which are studied in this research are: *market concentration, market power, market rate, bank capital, liquidity, bank size* and *operational inefficiency.* The data to measure these variables is gathered at three Dutch banks, ABN AMRO, ING and Rabobank for the period 1995-2009.

The data set of this research is defined as panel data because it combines both cross-sectional data and time series data. In panel data several econometric issues might occur but after controlling for these issues the most appropriate model to analyse the data is found. Ultimately the FE with AR(1) model is used because this model fits the panel data best.

The results of this study show that the independent variables *bank size* and *operational inefficiency* both have a significant and negative effect on *deposit rate*. Hence an increase in the size of the bank leads to a decrease in the deposit rate. A decrease in the *operational inefficiency* – the bank becomes more efficient – leads to an increase in the deposit rate. The variables *bank size* and *operational inefficiency* are also economic significant.

Preface

This master thesis is the last step taken in order to finish my master Financial Management at Tilburg University. I have the past six months dedicated to this research and my internship at ABN AMRO, where I conducted this research. When I began my internship, I had little knowledge about the dynamics of the deposit rate and I was not familiar with a fulltime working week. During those months, I learned not only about the deposit rates but also about working at a bank and working in a team. I developed my knowledge about the topics in my research, but also my knowledge about broader financial topics and I developed my interpersonal and social skills.

My research not always progressed as much as I would like. Due to the nature of my data several econometric issues arose and it took me quiet some effort to overcome these issues. Therefore I needed to understand advanced statistical procedures and different techniques for analysing data. In the end, I am proud of the knowledge that I developed in this field.

This thesis symbolizes the end of my student days. I would like to use this preface to thank some people. At first, I want to thank my supervisor, Drs. Steven Ongena, for his guidance and critical feedback. I also would like to thank Drs. Lieven Baele. Furthermore I would like to thank Rene Keijers and all my colleagues at the 'Sparen' department. Rene took his 'job' of being my supervisor very serious and made a lot of time available to discuss the progress of my master thesis and my personal development. The 'Sparen' team allowed me to become a part of their team and I really enjoyed working with them. A great initiative of ABN AMRO is CASt (Club Stagiaires ABN AMRO). Next to my master thesis and internship, I got the possibility to develop my organisation skills by joining the board of this club. The lunches and drinks always were a welcome break from the daily business.

Finally, I would like to thank my parents, brother, sister and family, for all their support and confidence. Next I would like to thank my friends. And last but not least I want to thank Freek, not only for being with me, but also for reading my thesis and providing me with valuable feedback

Thanks!

Hilde Vink, October 2010

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1. Introduction

The news the last weeks is filled with items about interest rates and the financial situation. In September the European Central Bank (ECB) announced to keep their most important interest rate unchanged at 1%, a historical low level (www.spaarbaak.nl). Although the financial situation is still not stable, there are no indications for a 'double dip' in Europe. However, the expectation is that the ECB will keep the interest rate unchanged in the time coming. This has an effect on the Dutch rates, as well money market rates, interest loan rates as deposit rates (Economisch Bureau, ABN AMRO, September 2010).

This introduction is organised as follows: first the Dutch retail deposit market will be discussed, followed by the different types of retail deposits and the deposit rate. Next, the research question will be stated, followed by the relevance of this research. The last section of this introduction contains the structure of this thesis.

Dutch retail deposit market

The scope of this research is the Dutch retail deposit market. The three biggest players in this market are ABN AMRO, ING and Rabobank. These three banks are included in this research. However the Dutch retail deposit market is dynamic, with the recent entry of Bank of Scotland and the announcement of LeasePlan Bank to stop accepting new clients with regard to savings.

The total amount of retail savings in the Netherlands for households is €289,724 million at the end of July 2010. Of this total amount, €34,674 million is in fixed term deposits and €255,050 million is in deposits redeemable at short notice. In the Netherlands, the amount of savings per household is €39,225.34 and the amount of savings per capita is €17,479.59. Since 2008 the trend is that the amount of money saved in fixed deposits is decreasing and the amount of money saved in deposits redeemable at short notice is increasing (website De Nederlandsche Bank). The NMa (Nederlandse Mededingings Autoriteit) describes the Dutch retail deposit market as relatively transparent. Furthermore, the deposit market is pre-eminently a market in which customers switch between banks. Probably most of the Dutch retail deposit customers own several deposit accounts at different banks. In doing so, the customers can easily transfer savings between their deposit accounts, for example when the deposit rate offered by another bank is increased (Boonstra and Groeneveld, 2006).

Retail deposits

The Dutch central bank ('De Nederlandsche Bank') makes a disposition of three types of retail deposits. The first is an overnight deposit; this is a current account, which almost all households possess. The rate offered on this type of deposit is often relatively low. The second type is a fixed term deposit which is an account with non-transferable money, at which an early withdrawal gives a penalty to the depositor. The third type is a deposit redeemable at short notice; this account offers mostly a lower rate than the second account but the advantage of this account is that the money can be quickly withdrawn. In this paper no distinction is made between the types of deposits and the general term deposit will be used.

Deposits are the core of banks' financial intermediation function hence of importance for financial institutions. By issuing deposits, banks reconcile wishes of small savers for high liquidity and low risk with the needs of investors (Meas & Timmermans, 2005). Deposits are subject to several conditions of which the most important and visible one is the rate the bank pays over the amount of savings. The interest rate on retail deposits offered by banks is named deposit rate in this thesis.

There is a difference between retail and wholesale deposits. Wholesale deposits are deposits held by firms instead of individual customers. The last ten years, banks are relying more on wholesale deposits to raise large amounts of funding at relatively low cost. Hence more stable retail deposits are replaced by short-term wholesale deposits, which expose banks more to interest rate and liquidity risks because wholesale deposits are more interest-sensitive and volatile. With the financial market turmoil, the shortcomings of this increasing dependence on wholesale deposits become apparent, for example at Northern Rock (ECB, 2008; Chick, 2008).

Deposit rate

The challenge for banks is to set the deposit rate in a way that supports profitable growth. An important choice in the pricing strategy for the deposit rate is whether the focus should be on volume or margin. When the rate is too high, it damages the margin of the bank. However, when the rate is too low, customers will take their saving money somewhere else and volume will decline. Hence there must be a balance between margin and volume (Baird, 2008).
In general, the Dutch deposit rates are above average in the Euro area (Statistisch Bulletin December, 2004).

Research question

This paper studies the deposit rates offered by banks. Several factors might have an impact on the deposit rate, such as the amount of competition between banks, the Euribor, the financing needs of the bank and other bank related factors (Statistisch Bulletin December, 2007). Therefore the research question is as follows: which factors influence interest rates offered by banks regarding their retail deposits within the Dutch market? The research is conducted over the time period 1995-2009 in order to explore what the impact was of the several factors on the deposit rate, in this past period.

Relevance

As stated before, deposits are very important for the stability of financial institutions (Meas & Timmermans, 2005) which emphasizes the relevance of this research. The rate offered on deposits influences the volume of savings attracted by banks. Therefore it is of great importance to gain more insights in factors that influence the deposit rate. Especially in these times of unstable financial markets (Economisch Bureau, ABN AMRO, June 2010) and increased competition between banks (Sullivan 2009). It is for banks of great importance to attract enough deposits and offer a rate that supports growth.

Research design and results

In this research there are several factors determined to have an influence on the deposit rate. The data to measure these factors are gathered at ABN AMRO, ING and Rabobank. In short, the results indicate that the size of the bank and the operational inefficiency of the bank have an influence on the deposit rate. The relationship between bank size and deposit rate is negative, this means that when the size of the bank is increasing, the deposit rate is decreasing. The relationship between operational inefficiency and deposit rate is also negative; when the operational inefficiency is decreasing, hence the bank is more efficient, the deposit rate is also increasing.

Structure of this research

This paper is organised as follows: chapter 2 gives an overview of the factors of influence derived from existing literature. Furthermore the hypotheses and conceptual model are presented in this chapter. Chapter 3 discusses the measurement and data gathering of the factors of influence. Chapter 4 gives a description of the statistical models and tests used in this study in order to find the most appropriate model for the data. Chapter 5 contains the

results of the analyses described in chapter 4 by answering the hypotheses, followed by a critical reflection on this research. Finally in chapter 6 there will be a short conclusion provided, followed by management recommendations, the limitations of this research and recommendations for future research.

2. Theoretical foundation

2.1 Introduction

Since the early 1980s banks rather than regulators set the interest rates on bank deposit products in the United States (Rosen, 2002). In the Netherlands the interest rate regulation took place in 1981, what was relatively early compared to other European countries like Belgium (1990), France (1990) and Spain (1992). Only the interest rate deregulation in the United Kingdom was earlier (1979). Germany regulated its interest rates also in 1981 (Gual, 1999). Since then a lot of research is conducted about interest rate changes in deposits. There are several theoretical explanations to explain these changes in deposits. One set of theories is related to issues of market concentration (Hannan and Berger, 1991; Neumark and Sharpe, 1992), but there are also other determinants. All the factors of influence on the pricing behaviour of banks will be discussed below.

The factors will be divided in factors related to the market; **'market related factors'** and factors related to the bank; **'bank related factors'**. Below, for each factor of influence hypotheses are formulated based on empirical research and literature. After each section a summary of the factors of influence and the effect on the deposit rate is given. At the end of this chapter the conceptual model will be presented. In the next chapter, the measurement of each variable will be described.

2.2 Market related factors

In this section the market related factors that may influence the deposit rate are described. Market related factors are factors present in the Dutch banking sector, hence present for all banks in this sector. The factors described in this section are market concentration and market rates.

(I) Market concentration

The pricing behaviour of banks is assumed to be affected by the degree of competition among banks and the degree of concentration within the banking sector. The degree of market concentration is measured by market concentration ratios, which are used for explaining competitive performance in the banking structure as the result of market structure. However a measure of concentration does not warrant conclusions about the competitive performance in a particular market. Even in highly concentrated markets, competitive behaviour between the leading banks is still possible (Bikker and Haaf, 2002).

High concentration within a market means a market structure in which only a few banks supply most of the deposit services demanded by the market (Shaffer, 1994).

The degree of concentration in the market is discussed by two opposing streams of hypotheses. On the one side, the structure-conduct-performance hypothesis and the relative-market-power hypothesis and on the other side the efficient-structure hypothesis (Berger, 1995).

The structure-conduct-performance hypothesis

The structure-conduct-performance hypothesis implies that fewer firms in a market – a concentrated *structure* – will lead to less competitive *conduct* – in terms of higher prices – and less competitive *performance*; higher profits at the expense of lower consumer welfare (Shaffer, 1994). Hence, the structure-conduct-performance hypothesis states that higher market concentration leads to less favourable pricing to consumers because banks my find it easier to collude or show other forms of non-competitive behaviour (Gropp, Sorensen and Lichtenberger, 2007) and higher market concentration will lead to competitive imperfections, in these markets (Berger, 1995). The structure-conduct-performance hypothesis would predict higher profit rates, higher loan interest rates and lower deposit rates in more concentrated markets (Tokle and Tokle, 2000).

Hutchinson (1995) states that deposit rates, on average, are lower in more concentrated markets (measured by the Herfindahl index) and that the response of deposit rates on increases in short term market interest rates is sluggish, tending to occur with a lag, and less than one for one. Neumark and Sharpe (1992) found that banks in concentrated markets are slower to raise interest rates on deposits in response to rising market interest rates but are faster to reduce them in response to declining market interest rates. They conclude that 'when market interest rates fluctuate in either direction, the adjustment behaviour of banks in concentrated markets seems to allow them to extract more surplus from depositors than banks in less concentrated markets' (p. 944). These findings are confirmed by Gropp, Sorensen and Lichtenberger (2007).

However, it is controversial whether concentration is an indicator of market power in the banking industry. Shaffer (1994) states that, depending on various factors, competitive outcomes might be observed in both concentrated as unconcentrated markets while, under different conditions, monopoly power might be sustained in unconcentrated markets as well as concentrated markets.

The relative-market-power hypothesis

The relative-market-power hypothesis is related to the structure-conduct-performance hypothesis and states that only firms with large market shares and well-differentiated products are able to exert market power in pricing deposits (Berger, 1995). De Graeve, De Jonghe and Vennet (2007) confirm this relative-market-power hypothesis in the Belgian market where they find that having a large market share allows banks to pay low deposit rates.

The efficient-structure-hypothesis

The efficient-structure-hypothesis states that concentration would increase the overall efficiency of the sector; therefore banks might price their deposits more competitively in a highly concentrated market, hence offer higher rates on deposits (Gropp, Sorensen and Lichtenberger, 2007). Increased efficiency is caused by superior management or production technologies, this leads to lower costs and therefore higher profits. Furthermore, the efficient-structure hypothesis also states that some firms simply produce at more efficient scales than others and therefore have lower unit costs and higher unit profits (Berger, 1995).

Martin-Oliver, Salas-Fumas and Saurina (2008) investigated bank deposit products in the Spanish market. They found that, if the number of banks increases in a market, both deposit interest rates and dispersion in the interest rates also tend to increase.

In sum, the three hypotheses regarding market concentration are:

Hypothesis	Theory	Effect on deposit rate
Structure-conduct-performance hypothesis	A concentrated *structure,* will lead to less competitive *conduct* and less competitive *performance.*	Lower deposit rates in more concentrated markets.
Relative-market-power hypothesis	Firms with large market shares are able to exert *market power* in pricing deposits.	Lower deposit rates when a bank has a large market share.
Efficient-structure hypothesis	A concentrated *structure* increases the overall *efficiency* of the sector, banks price their deposits more competitively.	Higher deposit rates in more concentrated markets.

Although mixed results arise in the current state of literature, the majority of the research seems to confirm the structure-conduct-performance literature.

Therefore, based on the studies discussed above, the following hypothesis is derived:

H1a: an increase in the degree of market concentration in the Dutch market for bank deposits leads to a decrease in the deposit rate.

With regard to the relative-market-power hypothesis, also market power can be included in a hypothesis. However, the measurement of market concentration is often based on the market power of several or all companies within a certain sector (Bikker and Haaf, 2002). Therefore market concentration and market power will probably show a large correlation and this will give statistical problems. To conclude whether market power is of influence on deposit rate there will be an additional test conducted which includes the following hypothesis instead of hypothesis 1a:

H1b: an increase in the market power of the bank leads to a decrease in the deposit rate.

(II) Market rates

There are several definitions for market rates; the interbank interest rate, the money market rate and in Europe the Euribor and Libor which will be used interchangeable in this paragraph. In this section the dynamics of the market rate will be first explained. Secondly, studies which include market rates are discussed. Finally, the hypothesis regarding the market rate will be given.

Financial institutions in the Euro-area are obliged to maintain a certain amount of money, the so called minimum reserves, at their national central bank. Because of this regulation, the European Central Bank (ECB) creates a shortage in liquidities in the Euro-area. Commercial banks are for their financing dependent on the ECB to obtain these liquidities. The shortages are filled up by placing short-term loans at the Dutch national bank ('de Nederlandsche Bank'). The ECB determines official rates for these loans, which they consider appropriate in their aim for price stability. When this rate is raised, the lending of money by banks at the central banks will become more expensive. This raise in interest rate will be reflected in the European money market, the market where banks lend to each other. The European money market rates, the so called Euribor, are in turn reflected in the rates banks offer to their consumers (Statistisch Bulletin, 2007).

Martin-Oliver, Salas-Fumas and Saurina (2008) investigated yearly averages of daily interbank interest rates and this showed that deposit interest rates followed the trend of interbank interest rates. Hence there is a relationship assumed between the money market rate and deposit rate. A lot of research with regard to interbank interest rates or market rates is whether prices are asymmetrically sticky, hence whether the speed at which a price rises is

different from the speed at which it falls (Heffernan, 1997). Fuertes, Heffernan and Kalotychou (2010) show that the adjustment of deposit rates is faster when the official market rate is cut than when it is raised. Hannan and Berger (1991) confirm this by stating that deposit rates are more rigid when the stimulus for change is upward rather than downward. Maes and Timmermans (2005) show that, in the Belgian market, deposit rates have been and still are rather sticky compared to market rates. When banks change deposit rates, they seem to do so in a partial and sluggish way, in the same direction as market rates and typically in multiples of $1/8^{th}$ percentage points.

Jarrow and van Deventer (1998) state that the deposit rate is a function of the market rate, the change in the market rate from the preceding period and the previous deposit rate. Kalkbrener and Willing (2004) confirm that deposit rates are influenced by market rates but the sensitivity by which deposit rates react on changes in market rates varies among different types of deposits.

Not only the changes in market rate will be of influence on the deposit rates but high volatility of the interbank interest rate should increase the deposit rate (Gambacorta, 2008; Gropp, Sorensen and Lichtenberger, 2007; Maudos and de Guevara, 2004).

Based on the described literature, the following hypothesis is deduced:

H2: an increase in the market rate leads to an increase in the deposit rate.

Market rate is in further sections of this research defined by the interbank interest rate in Europe, the Euribor rate. In the **data** section this definition will be discussed in more detail.

Hence, the factors degree of market concentration in the Dutch market for bank deposits, the market power of the bank and the market rate (Euribor) may have an effect on the deposit rate. In the table below the factors of influence and the direction of the effects on deposit rate are given.

Factor of influence	**Effect on deposit rate**
- Market concentration	- Negative effect
- Market power	- Negative effect
- Market rate	- Positive effect

Summary of market related factors

2.3 Bank related factors

In this section the bank related factors that might influence the deposit rate are described. The bank related factors included in this research are bank capital, liquidity, bank size and operational inefficiency. These factors are, in contrast with the market related factors, specific for each bank included in this research.

(III) Bank capital

Bank capital can be described as the monetary reserves of the bank. The capital requirement is a bank regulation on how banks must handle their capital. Capital requirements constitute a minimum for banks but banks often choose to hold more capital against unexpected credit losses or market discipline may induce them to hold more capital (Flannery and Rangan, 2006). However, holding capital is a more expensive source of funding than debt due to tax and dilution of control reasons. Banks that have a relatively high capital ratio can be expected to seek to cover some of the increase in the average cost of capital by operating with higher interest rate spreads. The interest rate spread is the difference between the rate on deposits and on lending, so this recovery can be done by offering lower deposit rates, higher lending rates or both. Furthermore, capital is considered to be the most expensive form of liabilities, holding capital above the regulatory minimum is a credible signal of the creditworthiness of the bank; this may enable the bank to lower its deposit rates (Claeys and Vander Vennet, 2008).

According to De Graeve, De Jonghe and Vennet (2007), bank capital exerts a positive effect on deposit margin; hence the bank offers a lower deposit rate. Highly capitalized banks have a lower pass-through for deposits, which means that the pricing behaviour of these banks is least tied to market developments. So when the market rate increases, the deposit rate of highly capitalized banks may not have to adjust to this increase in market rate but the deposit rate can be maintained at the current level.

Kiser (2004) argues that well capitalized firms with less risky asset portfolios may pay a lower risk premium for wholesale funds than their riskier competitors. If wholesale funds are used as substitutes for retail deposits in funding loans, its ability to buy wholesale funds at low cost should reduce its demand for retail deposits. Therefore well capitalized banks may price their deposits lower. Gambacorta (2008) endorses this finding by stating that low-capitalized banks have less capacity to issue bonds and therefore try to contain the amount of deposits by raising their rates more. Hence all these arguments indicate a negative relationship between bank capital and deposit rate.

However, some studies conclude that the relationship between bank capital and deposit rate is ambiguous. Fuertes, Heffernan and Kalotychou (2010) argue that well capitalised banks are less likely to fail. Therefore they may experience lower funding costs and could attract more customers. However, setting aside more capital reduces their profit opportunities; hence managers may try to make up for it through nonlinear, asymmetric pricing whereby the deposit rates do not follow a policy rate change linearly. Bassett and Brady (2002) state that higher capital ratios would add to a bank's ability to lend and so would be expected to lead to an increase in its deposit rates. In order to provide in the demand for loans, the bank needs money to lend out. On the other hand, rising capital ratios should also boost the demand for liabilities of the bank, hence the deposits, which would tend to reduce rates on these deposits.

The review of studies above shows that there are various results and arguments with regard to the relationship between bank capital and deposit rate. Despite these mixed results, the arguments for a negative relationship between bank capital and deposit rate seem most plausible. This will lead to the following hypothesis:

H3a: an increase in the capital ratio of the bank leads to a decrease in the deposit rate.

(IV) Liquidity

Liquidity is an important concept for banks and it means the following: the ability of banks to meet their liabilities, unwind or settle their positions as they come due, without incurring unacceptable losses (BIS, 2008). There are several studies that included liquidity in their study with regard to deposit rates.

De Graeve, De Jonghe and Vennet (2007) find liquidity to act as a buffer against market fluctuations, implying a negative effect on the pass-through of market interest rates to deposit rates. Liquid banks have a lower pass-through for deposits, hence the pricing behaviour of these banks is least tied to market developments. Furthermore, less liquid banks have less capacity to issue bonds and therefore they want to maintain the drain of deposits by raising their interest rates more (Gambacorta, 2008).

<u>Required reserve ratio</u>

Related to liquidity is the concept of required reserve ratio, a state bank regulation that sets the minimum reserves each bank must hold in reserve with regard to customer deposits and notes. The required reserve ratio ensures that banks do not run out of cash to meet the demand

for withdrawals. Agénor and Aynaoui (2010) state that an increase in the required reserve ratio lowers the deposit rate. Furthermore these authors find that deposit rates are stickier upward in the presence of excess liquidity. They may be less responsive to reductions in the required reserve ratio, because it internalizes the fact that raising the deposit rate will induce households to shift more of their assets into bank deposits, thereby increasing the initial problem of excess liquidity. The studies described above, all imply a negative relationship between liquidity and deposit rate.

However, there might be the issue of reversed causality between liquidity and deposit rate. This means that deposit rate can influence liquidity instead of liquidity influencing the deposit rate. According to Diamond and Dybvig (2000) deposits are liquid claims that provide the bank with liquidity. With a high deposit rate, there would probably flow more deposit savings into the bank and this increases the liquidity of the bank.

Funding

A concept closely related to liquidity is funding, which simply means providing resources. Also funding and the deposit rate have shown to influence each other. Core deposits provide a stable source of funding to banks by insulating them from fluctuations in market rates. As a smaller proportion of bank assets is funded by core deposits, banks face increasing pressure on their profits (Genay, 2000). Sullivan (2009) states that losing deposits can undermine the funding positions of financial institutions, some of which are becoming more reliant on deposits to fund their lending. Furthermore, the importance of deposits has also increased with the tightening of offshore wholesale credit markets.

Berlin and Mester (1999) argue that a stable pool of core deposits provides the bank with cheap funding and allows them to operate with higher margins, hence lower deposit rates. Also Hannan and Prager (2006) state that banks with a funding advantage offer lower deposit rates.

However the concepts liquidity and funding are interdependent of each other because banks create liquidity by funding illiquid loans with liquid deposits. The measurement of liquidity often includes the concept of funding (Berger and Bouwman, 2009). Therefore only liquidity and not funding is regarded as a factor of influence in this study.

According to Berger and Bouwman (2009), also the concepts bank capital and liquidity seem to be related. However it is not evident which direction the relationship has, some theories

predict that bank capital reduces the bank liquidity creation while others predict that capital makes banks capable of absorbing more risk and thereby allows them to create more liquidity (Berger and Bouwman, 2009).
Because of statistical problems incurred when two variables in the analyses correlate too strongly with each other, and the possibility of reversed causality between liquidity and deposit rate, there is chosen to include only the variable bank capital in the primary conceptual model and conduct additional tests including liquidity.

Based on the review of existing literature above the following hypothesis is derived:

H3b: an increase in the liquidity ratio of the bank leads to a decrease in the deposit rate.

(V) Bank size
There is quite some research conducted regarding the relationship between bank size and deposit rate. Firstly, there is evidence that there is a negative relationship between bank size and deposit rate. Bassett and Brady (2002) state that small banks use retail deposits as a marginal source of funding. Small banks need to increase the interest rates offered on deposit accounts in order to progressively attract more deposit funding. Hannan and Prager (2006) also find that large banks offer lower deposit interest rates than their smaller counterparts because large banks have greater access to wholesale funds that are cheaper than retail sources of funds. Ruthenberger and Elias (1996) state that smaller banks increase their deposit rates in order to increase their competitiveness with larger banks.

However, there are also studies which find a positive relationship between bank size and deposit rate. Rosen (2003) states that growing banks tend to offer higher interest rates on deposits and having more large banks in a market generally increases rates at all banks. Bank size can also be used as a proxy for economies of scale. If economies of scale are present, a larger bank size will mean lower average costs, which may be passed on in higher deposit rates (Tokle and Tokle, 2000).

Although the empirical results found in the literature are mixed, the majority of the researchers seem to find a negative effect between bank size and the deposit rate. Therefore the following hypothesis is stated:

H4: an increase in the size of the bank leads to a decrease in the deposit rate.

(VI) Operational inefficiency

The last factor that might have an influence on deposit rate in this research is operational inefficiency. De Graeve, De Jonghe and Vennet (2007) state that efficient banks have lower costs and therefore have the incentive to offer above-average deposit rates. Operational inefficiency is measured by the cost-income ratio in their study. Their results show that the deposit spread is negatively affected by the inefficiency factor, hence the higher the inefficiency factor, the lower the deposit rate. A study by Focarelli and Panetta (2003) results in similar findings, banks that are more efficient pass on the saving due to that efficiency onto consumers by offering a higher deposit rate. Also Gambacorta (2008) shows that bank inefficiency decreases the interest rate on deposits. Hence all the studies described above show a negative relationship between operational inefficiency and deposit rate.

Based on the, although limited amount of, empirical research discussed above the following hypothesis is derived:

H5: a decrease in the inefficiency ratio of the bank leads to an increase in the deposit rate.

In short, the section above states that the following bank related factors may have an effect on deposit rate: bank capital ratio, liquidity ratio, bank size and the operational inefficiency ratio. In the next chapter, the measurement of these variables will be determined.
The table below summarizes the bank related factors of influence and the direction of their effect on deposit rate.

Factor of influence	**Effect on deposit rate**
- Bank capital ratio	- Negative effect
- Liquidity ratio	- Negative effect
- Bank size	- Negative effect
- Operational inefficiency ratio	- Negative effect

Table 2: Summary of bank related factors

2.4 Conceptual model

Based on the hypotheses described in this chapter, the conceptual model tested in this research is the following:

Deposit Rate = β_0 - β_1 market concentration $_{i,t-1}$+ β_2 market rate $_{i,t-1}$ - β_3 bank capital $_{i,t-1}$ - β_4 bank size $_{i,t-1}$ - β_5 operational inefficiency $_{i,t-1}$ + α_i + $\upsilon_{i,t}$

Due to the fact of possible correlation between market concentration and market rate and bank capital and liquidity, market rate and liquidity are not included in the equation, however:

β_1 market concentration $_{i,t-1}$ can be replaced by β_1 market power $_{i,t-1.}$

β_3 bank capital $_{i,t-1}$ can be replaced by β_3 liquidity $_{i,t-1.}$

α_i and $\upsilon_{i,t}$ are the error terms. The variable α_i captures all unobserved, time-constant factors that affect the dependent variable. The error $\upsilon_{i,t}$ is the idiosyncratic error which represents unobserved factors that change over time and affect the dependent variable (Wooldrigde, 2000).

3. Data

3.1 Introduction

This chapter describes the data used and the methodology applied in this research. First the research design and the sample description are given. Furthermore, the variables included in this research and their measurements are discussed. Finally, the descriptive statistics of these variables are presented.

3.2 Research design & sample description

In order to gain more insights into the influencing factors on the deposit rate, this research takes three Dutch banks into account. In addition to ABN AMRO, the bank where the graduate internship took place, ING and Rabobank are also part of this research. The inclusion of these banks may lead to more understanding of the total retail savings market.

For ABN AMRO, the data are mostly gathered by internal information and information in annual reports. For ING and Rabobank all of the data are gathered through the use of annual reports, the websites of these banks and external reports, like Standard & Poor's. Table I, at the end of the section **variables**, contains the data source per variable.

(I) ABN AMRO

The idea for this research was proposed by the department 'Sparen' of ABN AMRO, the department where this research is conducted. ABN AMRO is originated in 1991 by the merger of AMRO Bank and ABN. In 2007, ABN AMRO was taken over by a consortium of Banco Santander, Fortis and Royal Bank of Scotland (RBS). In 2008, the Dutch state fully acquired the Dutch part of the by Fortis acquired businesses to which the Dutch part of ABN AMRO Bank belonged. In July 2010, a merger between ABN AMRO and Fortis took place, resulting in ABN AMRO Bank N.V.

ABN AMRO focuses its business on different types of clients. First, there is Personal Banking in which ABN AMRO offers a range of products that meet the everyday financial needs of individuals. Second, ABN AMRO offers Preferred Banking, a 'relationship-banking approach' for wealthy customers, professionals and business owners. Third, there is Private Banking in which the aim is to help the Private Banking clientele to structure, manage and enhance their wealth by ABN AMRO's global expertise and resources. The above mentioned business units are all part of the consumer business of ABN AMRO.

Furthermore ABN AMRO offers Commercial and Merchant Banking which serves customised financial advice and solutions to Netherlands-based companies and their international operations. The client base includes business start-ups, established SMEs and larger corporate clients, as well as public institutions, multinationals and institutional investors.
In 2009, ABN AMRO served more than 6,800,000 retail clients and more than 400,000 business clients in 500 bank shops in the Netherlands (website ABN AMRO).

(II) ING

ING Bank is a part of the ING group and exists since 1927 under the name NMB Bank. In 1992 the name of NMB Bank changed into ING Bank. In 2009, ING Bank and Postbank integrated into ING. ING employs 107,173 employees worldwide and serves 9,200,000 account holders in 2009 in the Netherlands. ING is an international financial institution which serves its clients with regard to banking, investing, assurance, and pensions. ING wants to emphasize their position as an international retail-, direct-, and merchant bank (website ING).

(III) Rabobank

The Rabobank Group is originated in 1972 as the result of a merger between the *Coöperatieve Centrale Raiffeisen-Bank* and *Coöperatieve Centrale Boerenleenbank*. Rabobank is a cooperation, which means that Rabobank exists of independent joined banks which all have their own management and Board of Directors. In 2009 Rabobank consists of 147 local banks with 1,010 bank shops and more than 9,000,000 clients. The Rabobank Group is an international financial institution with a cooperative basis and is present in the following areas: retail and wholesale banking, portfolio management, leasing, real estate and insurance. The emphasis of Rabobank in the Netherlands is on 'Allfinanz service'. Internationally, Rabobank is focused on the food & agribusiness (website Rabobank).

3.3 Variables

This section includes more information about the measurement and operationalisation of the factors of influence that are used in this thesis. At the end of this section there will be an overview table given which contains all the variables discussed below. Each variable included in any of the analyses is considered in this section.

3.3.1 The dependent variable: deposit rate

(I) ABN AMRO

The deposit rate on retail accounts is the dependent variable in this research. For ABN AMRO the deposit rate is measured on a monthly base for the period 1995-2009. The accounts used for this variable are the 'Internet Spaarrekening' for the period April 2001-2009 and the 'Riant Spaarrekening' for the period 1995-March 2001. There is chosen to use two savings accounts and not an average of all accounts because that would lead to a loss of variation in the deposit rates. The advantage of a plain account with no conditions is that it is better to compare with the savings accounts of the other banks. Although there was no savings account available that did not have any conditions or rate scales depending on volume of savings, the 'Internet Spaarrekening' and the 'Riant Spaarrekening' represent basic savings deposits. The 'Internet Spaarrekening' is one of the core products of ABN AMRO and contains a relatively high volume. Therefore the deposit rate of the 'Internet Spaarrekening' provides a proper reflection of the dynamics in the overall deposit rates. The rate used for the 'Internet Spaarrekening' is the rate for the amount of savings up to €1.2 million.

The 'Riant Spaarrekening' is not available for sale anymore but used to be one the of the core products of ABN AMRO. This account also contained a relatively high volume when it was part of the assortment available for sale and therefore reflected properly the amount of deposit rate in the period 1995-March 2001. The used rate for the 'Riant Spaarrekening' is the rate for the amount of savings above NLG 25,000.

Deposit rates can be changed during a month but in this analysis the following assumption is made: a change in the deposit rate during the month will take effect in the beginning of the next month. The moment whereupon the dependent variable measurement changes from the 'Riant Spaarrekening' into the 'Internet Spaarrekening' may leads to a bias in the analyses because of a difference in rates. To check whether this actually lead to a bias there is a dummy variable included in the analysis (1 = InternetSpaarrekening; 0 = other than InternetSpaarrekening). The result of the analysis is that the inclusion of the dummy variable does not lead to changes in the coefficients of the independent variables. Hence the use of two different savings accounts for ABN AMRO does not lead to a bias in the results.

At the end of this section there will be a summary given of the deposit accounts and characteristics used for each bank. For ING and Rabobank it was more difficult to gain access to the deposit rates because these are not reported on their websites for the period of interest.

(II) ING

ING provided, via a common contact form on their website, the deposit rates of the 'Plusrekening'. The 'Plusrekening' is a plain account without any conditions and exists since 1975. The interest-bearing amount of this savings product is €500,000. Unfortunately this account is no longer available for sale. However, it is preferred to use this account because the source of information is from ING directly and not from the internet. Furthermore, the other plain account showed a much higher rate in 2003 compared to the 'Plusrekening'. When this account is used for the period 2003-2009, there would be a large, sudden increase in the deposit rate in 2003. This may lead to a bias in the analyses.

(III) Rabobank

The Rabobank savings account used in this research is the 'Rabo SpaarRekening'. The deposit rates are received from the website www.spaarinformatie.nl. Unfortunately, this website reports deposit rates just only since 2002. The 'Rabo SpaarRekening' is, like the other savings accounts used, a plain account with no additional conditions. Hence the data with regard to the Rabobank are available for the period October 2002-December 2009 and only this time period is included in this research.

Bank	**ABN AMRO**		**ING**	**Rabobank**
Deposit account	Internet Spaarrekening	Riant Spaarrekening	Plusrekening	Rabo Spaarrekening
Interest-bearing amount	< €1.2 mln	> NLG 25,000	< €500,000	-
Time period	April 2001-2009	1995-March 2001	1995-2009	October 2002-2009
Characteristics	-	Not available for sale anymore	Not available for sale anymore	-

3.3.2 The independent variables

(I) Market concentration

The variable market concentration is measured by the CR5 ratio. The CR5 is the percentage share of the five largest credit institutions, ranked according to assets, over the sum of the assets of all the credit institutions in the Netherlands. Hence the CR5 ratio is the same for all three banks. Unfortunately there was no data source available in which the CR5 ratio for the

period 1995-2009 was given. Therefore several publications of the European Central Bank are used to derive these data (ECB, 2001; 2004; 2010).

(II) Market rate

The market rate is measured by the one-month Euribor for the period 1999-2009. For the period 1995-1998 the market rate is measured by the Aibor. The Euribor rate (*Euro Interbank Offered Rate*) is the average of the deposit rates (with exception of the highest and the lowest values) at which 57 first class banks out of the EFB panel (*European Federation of Banks*) are willing to lend out euro's interbancair. The Euribor was introduced at January 1, 1999. Before the Euribor was introduced the Netherlands made use of the Aibor (*Amsterdam Interbank Offered Rate*) (De Nederlandsche Bank).

(III) Market power

For ABN AMRO, the factor of influence market power is measured by the monthly market power percentage specific for the 'Sparen' department for the period 1995-2009. This percentage includes the amount of savings of subsidiary MoneYou and the part of ABN AMRO that is sold to Deutsche Bank in April 2010.

ING does not report their market power data in their annual reports or press releases so this variable is not included in the analyses conducted for ING.

For Rabobank market power is measured by the yearly market power data for domestic retail banking. The market power data are only available for the period October 2002-December 2009 (Annual report, Rabobank).

Due to the fact that the market power data are not available for all three banks for the total period and the expectation that the variables market power and market concentration will strongly correlate (Bikker and Haaf, 2002), market power will not be included in the primary equation used for the analyses regarding the combined data of all three banks. However, the variable market power will be included in an additional analysis conducted only for ABN AMRO and Rabobank.

(IV) Bank capital

Bank capital is measured by the tier 1 capital ratio. The European Central Bank (ECB) gives the following definition of tier 1 capital: 'equity represented by ordinary shares and retained profit or earnings plus qualifying non-cumulative preference shares (up to a maximum of 25%

of total tier 1 capital) plus minority interests in equity accounts of consolidated subsidiaries'. The amount of tier 1 capital is a measure of the capital adequacy of a bank. The tier 1 capital ratio is measured by dividing the bank's tier 1 capital by the total risk-weighted assets (ECB). The definition of tier 1 capital ratio ABN AMRO uses in its annual reports is 'shareholders' equity and qualifying subordinated liabilities less goodwill and some intangible assets as a percentage of risk-weighted assets' (Annual report, ABN AMRO).

ING defines its tier 1 capital ratio as shareholders' equity including core tier 1 securities plus hybrid capital less certain prudential filters and deductible items divided by risk weighted assets (Annual report, ING). The tier 1 capital ratios for ING are deduced from data about ING Bank and not the total ING Group.

Rabobank defines its tier 1 capital ratio as the core assets related to the risk-weighted assets (Annual report, Rabobank). For all three banks, the tier 1 capital ratio is in accordance with Basel II requirements since 2008.

The tier 1 capital ratios with regard to ING and Rabobank are available for the period 1995-2009; the Rabobank data is available for the period October 2002-December 2009.

(V) Liquidity

The definition of liquidity according to the Basel Committee of Banking supervision is the ability of banks to meet their liabilities, unwind or settle their positions as they come due (BIS, 2008). In this study, liquidity is measured by the liquidity ratio. ABN AMRO reports in its annual report the liquidity ratio as follows: stable funding divided by non-liquid assets. ABN AMRO is reporting its liquidity ratio since March 2003 so there are no data available for the period 1995-2005 (Annual report, ABN AMRO).

Unfortunately ING does not report liquidity ratios in their annual reports so this variable is not included in the analyses conducted for ING.

Rabobank measures its liquidity ratios by the CA/CL method, remaining core assets divided by remaining core liabilities. Rabobank does not report their actual liquidity ratio but states in its annual report that a ratio above 1.2 is a satisfying ratio. In addition, Rabobank states in its annual report the percentage whereby the actual liquidity exceeds the required liquidity. Combining these two elements, the liquidity ratio has been determined. The liquidity ratio is available for the period 2004-2009 (Annual report, Rabobank).

Due to the fact that the liquidity data are not available for all three banks for the total period and the expectation that the variables liquidity and bank capital will correlate (Berger and

Bouwman, 2009), liquidity will not be included in the primary equation used for the analyses regarding the combined data of all three banks. However, the variable liquidity will be included in an additional analysis conducted only for ABN AMRO and Rabobank.

(VI) Bank size

The factor bank size is measured by total assets for ABN AMRO (1995-2009) and Rabobank (October 2002-December 2009) (Annual reports, ABN AMRO & Rabobank).

Because of a lack of data for ING Bank (period 1995-2009) the size of ING is measured by the total assets of the ING Group, in contrast with the other variables which are measured for ING Bank (Annual report, ING).

(VII) Operational inefficiency

ABN AMRO measures operational inefficiency by the inefficiency ratio. The inefficiency ratio is the operating expenses as a percentage of net interest income and total non-interest income (Annual report, ABN AMRO).

ING uses the cost/benefit ratio to measure operational inefficiency. This data applies only to the ING Bank, not to the ING Group (Annual report, ING).

Rabobank measures operational inefficiency by their inefficiency ratio, which includes total operating expenses divided by total income (Annual report, Rabobank).

Most of the data described above are gathered from annual reports of ABN AMRO, ING and Rabobank. It must be noticed that since 2004 the accounting principles for the financial statements are based on IFRS for all three banks. Before 2004, the banks reported according to Dutch GAAP. This change in accounting standards leads to changes in the financial statements and measurement of certain ratios and data.

This change in reporting requirements has the following effects on the data: under IFRS standards:

- The total assets are higher;
- The tier 1 capital ratio is lower;
- The inefficiency ratio is also lower.

All three banks reported their financial statements in 2005 in accordance with both guiding principles (IFRS and Dutch GAAP). The data used in these analyses are compliant with Dutch GAAP standards for the period 1995-2003 and compliant with IFRS standards for the period 2004-2009.

Table I - Summary of variables, measurement, definitions, frequency and data source

	Measurement	Variable definition	Units	Frequency	Data Source
Dependent variable					
Deposit rate	Deposit rate (ABN AMRO)	Internet Spaarrekening (April 2001-2009) < € 1.2 million Riant Spaarrekening (1995-March 2001) > NLG 25,000	%	Monthly	Internal data ABN AMRO
	Deposit rate (ING)	Plusrekening (1995-2009) < € 500,000	%	Monthly	Internal data ING
	Deposit rate (Rabobank)	Rabo SpaarRekening (Oct.2002-Dec.2009)	%	Monthly	www.spaarinformatie.nl
Independent variables					
Market concentration	CR5 ratio	Share of the five largest CIs in total assets (%)	%	Yearly	Several publications ECB
Market rate	Euribor	Euribor for the period 1999-2009	%	Monthly	De Nederlandsche Bank
	Aibor	Aibor for the period 1995-1999			
ABN AMRO					
Market power	Market power	Market power 'Savings' incl. subsidiaries	%	Monthly	Internal data ABN AMRO
Bank capital	Tier 1 capital ratio	Shareholders' equity and qualifying subordinated liabilities less goodwill and some intangible assets/risk-weighted assets	%	Yearly	Annual report ABN AMRO
Liquidity	Liquidity ratio	Stable funding/non-liquid assets	%	Yearly	Annual report ABN AMRO
Bank size	Assets	Total assets in billions of Euros	Euros	Yearly	Annual report ABN AMRO
Operational inefficiency	Inefficiency ratio	Operating expenses/net interest income and total non-interest income	%	Yearly	Annual report ABN AMRO
ING					
Market power	*Not available*	*Not available*	-	-	-
Bank capital	Tier 1 ratio	Shareholders' equity including core tier 1 securities plus hybrid capital less certain prudential filters and deductible items/by risk weighted assets	%	Yearly	Annual report ING; Standard & Poor's comparative statistics
Liquidity	*Not available*	*Not available*	-	-	-
Bank size	Assets	Total assets in billions of Euros	Euros	Yearly	Annual report ING
Operational inefficiency	Cost/benefit ratio	Costs/benefits	%	Yearly	Annual report ING; Standard & Poor's comparative statistics

Rabobank*					
Market power	Market power	Yearly market power Savings	%	Yearly	Annual report Rabobank
Bank capital	Tier 1 ratio	Core assets/risk-weighted assets	%	Yearly	Annual report Rabobank Standard & Poor's comparative statistics
Liquidity	CA/CL	Core assets divided by core liabilities	%	Yearly	Annual report Rabobank
Bank size	Assets	Total assets in billions of Euros	Euros	Yearly	Annual report Rabobank
Operational inefficiency	Inefficiency ratio	Total operating expenses/total income	%	Yearly	Annual report Rabobank Standard & Poor's comparative statistics

* Data only available for the period 10-2002/12-2009

3.4 Descriptive statistics

This section shows the descriptive statistics of the dependent and independent variables for ABN AMRO, ING and Rabobank separately and for the data of the banks combined. Due to the fact that the data of certain variables were not accessible for the period 1995-2009, some variables may have fewer observations. Table II shows the descriptive statistics of the data of respectively ABN AMRO, ING and Rabobank. The descriptive statistics include all variables used in this study.

The descriptive statistics in Table II Panel A show that the dependent variable, the *deposit rate*, differs among the three banks. ABN AMRO's average deposit rate is 3.24% and has a small standard deviation. The average deposit rate of ING is much lower with 1.85% and shows much more variation with a standard deviation of 1.01. Rabobank's average deposit rate is 2.57% and shows also a small standard deviation.

The differences in the descriptive statistics with regard to *market concentration* and *market rate* are caused by the fact that the Rabobank's data were only available for the period 10-2002/12-2009. The mean market power shows that Rabobank has a much larger share of the deposit market than ABN AMRO has (39.79% compared to 18.22%). Unfortunately there are no market power data available with respect to ING.

Furthermore there is quite some difference between the *bank capital* ratios of the banks. ABN AMRO shows a mean bank capital of 9.03%, ING's average bank capital is 7.58% and the average bank capital of Rabobank is 11.56%.

The average *bank size* show that, on average, ING is the largest bank in total assets with a mean of €771.87 compared to ABN AMRO's average total assets of €586.88 and the mean total assets of Rabobank of €528.81 (in billions of Euros).

The *operational inefficiency* ratio shows that ABN AMRO is rather inefficient with a mean of 80.46% compared to its competitors ING (72.78%) and Rabobank (66.87%).

Panel B includes the descriptive statistics where the data of all three banks are combined.

Table II - Descriptive statistics per bank (Panel A)

Variable	Obs.	Mean	Std. Deviation	Min	Max
ABN AMRO					
Deposit rate	180	3.24	0.68	1.7	4.6
Market concentration	180	82.36	3.20	75.36	86.8
Market power	180	18.22	1.14	15.5	19.82
Market rate	180	3.16	1.03	0.43	5.1
Bank capital	180	9.03	3.36	6.51	19.89
Liquidity	82	95.52	13.06	79	121
Bank size	180	586.88	228.67	248	1025.21
Operational inefficiency	180	80.46	21.20	67	131.7
ING					
Deposit rate	180	1.85	1.01	0.5	4
Market concentration	180	82.36	3.20	75.36	86.8
Market power	0	-	-	-	-
Market rate	180	3.16	1.03	0.43	5.1
Bank capital	180	7.58	0.91	.068	.102
Liquidity	0	-	-	-	-
Bank size	180	771.87	391.66	180	1331.66
Operational inefficiency	180	72.78	5.88	63.9	87.8
Rabobank					
Deposit rate	87	2.57	0.32	1.7	3.25
Market concentration	87	84.74	1.321078	82.7	86.8
Market power	87	39.79	0.86	38.9	41
Market rate	87	2.70	1.14	0.43	4.83
Bank capital	87	11.56	1.13	10.3	13.8
Liquidity	72	104.2	9.68	86.4	111.6
Bank size	87	528.81	74.61	374.72	612.12
Operational inefficiency	87	66.87	2.56	61.5	69.5

Descriptive statistics for ABN AMRO, ING and Rabobank separately

Table II - Descriptive statistics all banks combined (Panel B)

Variable	Obs.	Mean	Std. Deviation	Min	Max
Deposit rate	447	2.55	1.01	0.5	4.6
Market concentration	447	82.83	3.07	75.36	86.8
Market power	267	25.25	10.18	15.5	41
Market rate	447	3.07	1.07	.43	5.1
Bank capital	447	8.94	2.68	6.51	19.89
Liquidity	154	99.58	12.35	79	121
Bank size	447	650.07	306.74	180	1331.66
Operational inefficiency	447	74.72	14.91	61.5	131.7

Descriptive statistics for the banks combined

4. Methodology

4.1 Introduction

This section describes the steps that are taken in order to find the most appropriate model for analysis. This includes the discussion of several models and the econometric issues that arise by using these models. In this section, all the models and tests are only described. In the **results** section the tests are executed and the results of the analyses are presented. At the end of this section, a summary table will be given.

4.2 Statistical analysis

4.2.1 Panel data

The data described in the earlier sections are panel data. The characteristic of panel data which distinguishes them from cross-sectional data and time series data is that it combines both types of data. Panel data contain measurements on the same firms over several periods (Baum, 2006).

The following equation is primary used in the analyses:

Deposit Rate = β_0 - β_1 market concentration $_{i,t-1}$+ β_2 market rate $_{i,t-1}$ - β_3 bank capital $_{i,t-1}$ - β_4 bank size $_{i,t-1}$ - β_5 operational inefficiency $_{i,t-1}$ + α_i + $\upsilon_{i,t}$

The independent variables *market power* and *liquidity* are not included in the general equation due to correlation issues discussed in the theoretical foundation. However these variables will possibly be included in additional analyses.

4.2.2 Correlation matrix & multicollinearity

First, there is a correlation matrix created in which all variables of interest are included. This matrix shows the correlations and their corresponding significance between the variables. The correlation matrix gives a first insight in the direction and the strength of the relationships between the variables.

When the correlation between two or more independent variables is (too) high, the problem of multicollinearity occurs (Wooldridge, 2000). The problem of multicollinearity may lead to less accurate results in the analyses; the coefficients may have very high standard errors and perhaps even incorrect signs or implausibly large magnitudes (Baddeley and Barrowclough, 2009; Baum, 2006). Multicollinearity can be detected by calculating the *variance inflation*

factors (VIF) for each independent variable. Multicollinearity is present when VIF values are larger than 10. Furthermore, the critical value can be calculated by 1/VIF. If this value is below 0.1, this would mean that more than 90% of the variation in the variable is explained by the other variables. The variable(s) with VIF values larger than 10 or 1/VIF values below 0.1 should be excluded from the analyses (Rabe-Hesketh and Everitt, 2004).

4.2.3 Ordinary Least Squares (OLS) analysis

The regression starts with the *Ordinary Least Squares (OLS) analysis* which shows the coefficients of the variables and the fit of the model. Although OLS is mostly used for analysing cross-sectional data, it can be used for analysing panel data, provided that the following assumptions, known as the Gauss-Markov assumptions, are not violated (Baddeley and Barrowclough, 2009).

The OLS method assumes the following:

- Linearity in parameters;
- The mean of the errors terms is zero;
- No perfect collinearity, which is already described above;
- Homoscedasticity - the variance of the error is constant across all observations;
- No serial correlation, which means that the covariance between error terms is zero;
- Exogeneity - the error term and explanatory variables are not correlated with each other (Wooldridge, 2000; Baddeley and Barrowclough, 2009).

Although some of the assumptions mentioned above will be violated because this study contains panel data, the OLS analysis will give insights in the relationship between *deposit rate* and the independent variables. In the following analyses, all the assumptions described above will be presumed, unless it is stated otherwise.

4.2.4 Heteroskedasticity

The OLS method assumes no heteroskedasticity, hence this issue is not taken into account in the OLS method. This means that in the OLS method, the variances in the unobservable error are constant across all observations (Wooldridge, 2000). Since the data used in this study are panel data, heteroskedasticity could become an issue.

The presence of heteroskedasticity, while not causing bias or inconsistency in the coefficients, does invalidate the usual standard errors, *t* statistics and *F* statistics. Hence it could bias the statistical significance concluded from the OLS analysis (Wooldridge, 2000).

To test for heteroskedasticity, the Breusch-Pagan / Cook-Weisberg test and the White's general test are conducted. The White's general test is a general test which does not presume a particular form of heteroskedasticity. Both tests show the χ^2 value and its significance. When the given χ^2 value exceeds the critical χ^2 value given *k* degrees of freedom, the null hypothesis of no heteroskedasticity is rejected (Baum, 2006).

4.2.5 Feasible Generalized Least Squares (FGLS) estimators

When the Breusch-Pagan / Cook-Weisberg test or the White's general test shows heteroskedasticity OLS will no longer be the best linear unbiased estimator. (F)GLS (*Feasible Generalized Least Square)* estimators are used to account for heteroskedasticity in the errors. Hence this regression will be conducted to determine whether the results obtained by the OLS regression remain valid after controlling for heteroskedasticity.

The GLS estimators for correcting heteroskedasticity are called *weighted least squares (WLS)* estimators, and less weight is given to observations with a higher error variance. The OLS method gives each observation the same weight because it fits best when the error variance is identical for all partitions of the population. The FGLS method estimates the structure of heteroskedasticity in stead of assuming it (Wooldridge, 2000). Hence the (F)GLS method can determine whether the results obtained by the OLS method remain valid after controlling for heteroskedasticity.

4.2.6 OLS or panel data models

Although the results of the OLS and FGLS give interesting insights, these models do not fit panel data perfectly. Panel data may have unobserved group effects, time effects or both included in the error term. These effects are either fixed effects, random effects or both. These effects may lead to heterogeneity or even endogeneity and the OLS estimators will be biased and inconsistent (Baddeley and Barrowclough, 2009). The panel data models, *fixed effects (FE) model* and *random effects (RE) model,* allow for heterogeneity across panel units (and possibly across time) but confines that heterogeneity to the intercept terms of the relationship (Baum, 2006).

The Breusch-Pagan Lagrangian Multiplier test is conducted to test whether the *random effects (RE)* estimators or the OLS estimators are more consistent. When the returned χ^2 value exceeds the critical χ^2 value given *k* degrees of freedom, the null hypothesis of no individual effects will be rejected and the RE estimator is appropriate (Greene, 2002).

4.2.7 Random effects (RE) model or fixed effects (FE) model

When the Breusch-Pagan Lagrangian Multiplier test gives evidence that the panel data model is more appropriate than the OLS method, there must be determined which model, the *random effects (RE) model* or the *fixed effects (FE) model* is most suitable for this dataset. The RE model assumes that the unobserved effect is uncorrelated with the independent variables; the individual-specific effects are parameterized as additional random disturbances (Baum, 2006). In the FE model the unobserved bank effects are permitted to correlate with the explanatory variables, hence this model allows a limited form of endogeneity (Cameron and Trivedi, 2009). The *fixed effects model* can be used to control for omitted variables that differ between the banks but are constant over time, hence it are bank fixed effects. The *random effects model* can be used to control for some omitted variables that are constant over time and vary between banks and other omitted variables that vary over time and are constant between banks (Data and statistical services, Princeton University).

The Hausman test is conducted to test which model, RE or FE, fits the data best. When the returned χ^2 value exceeds the critical χ^2 value given k degrees of freedom, the null hypothesis of valid RE estimators is rejected and the FE model is most suitable (Baum, 2006).

4.2.8 Serial correlation

Finally, the OLS method assumes no serial correlation (also called autocorrelation) which means that the errors in subsequent periods are not correlated (Wooldridge, 2000). However, the problem of serial correlation could be present in this research because time series panel data are used, incorporating data from the same firms for several periods of time. To control for serial correlation, the RE or FE models (dependent on which model suits best) are adjusted for this issue with a *first-order autocorrelation* - AR(1) - disturbance. AR(1) means that the variable is a function of just one lag of itself (Baddeley and Barrowclough, 2009).

The Breusch-Godfrey test is used to test this first-order serial correlation. When the returned χ^2 value exceeds the critical χ^2 value given k degrees of freedom, the null hypothesis of no serial correlation is rejected and the adjusted AR(1) model is the most appropriate model and should be used to make inferences (Baum, 2006.)

Steps in order to find the most appropriate model	Test
1. Conduct OLS	
2. Check for multicollinearity	VIF
3. Check for heteroskedasticity	Breusch-Pagan / Cook-Weisberg test White's general test
4. Check for serial correlation	Breusch-Godfrey LM test
5. Conduct FGLS (*corrects for heteroskedasticity*)	
6. Conduct RE (*more suitable for panel data)*	
7. Check whether RE or OLS is more appropriate	Breusch-Pagan LM test
8. Conduct FE (*more suitable for panel data)*	
9. Check whether RE or FE is more appropriate	Hausman test
10. Conduct FE or RE with AR(1) (*corrects for serial correlation)*	

5. Regression results

5.1 Introduction

This chapter shows the results of the analyses discussed in chapter four, in order to answer the research question 'which factors influence interest rates offered by banks regarding their retail deposits within the Dutch market?' At first the correlation matrix will be presented and the variables will be tested for multicollinearity. Next, the statistical models and tests will be conducted to find the most appropriate model for this research. Third, the test results will be provided combined with their economic significance. Finally the results will be critically discussed.

5.2 Correlation matrix & multicollinearity

Table III presents the correlations and significances between the dependent variable and the independent variables. In this correlation matrix, only the variables included in the basic equation are considered. The correlation matrix shows some premature results regarding the hypotheses stated in the theoretical framework. The first column of the matrix shows the relationships between the dependent and independent variables.

The correlation between the dependent variable *deposit rate* and *market concentration* is negative and significant ($p < 0.01$) as expected in the theoretical framework. *Market power* is also significant ($p < 0.01$) and the direction of the correlation is positive.
The relationships between *deposit rate* and the bank related factors - *bank capital, bank size* and *inefficiency ratio* – are all in the same direction as expected beforehand; the correlation with *bank capital* is negative and statistically significant ($p < 0.01$), however the coefficient is quite small ($r = -0.1561$). The correlation between *deposit rate* and *bank size* is also negative and significant ($p < 0.01$) and the coefficient is very strong ($r = -0.8010$). Finally the *inefficiency ratio* is negative but not significant ($p = 0.4855$).

Correlations between the independent variables are also available. *Market concentration* correlates positively and significantly ($p < 0.01$) with *bank capital, bank size* and *operational inefficiency*. Especially the positive correlation between *market concentration* and *bank size* was expected. When the market concentration is increasing, this means that fewer banks possess a larger market share. When a bank is gaining a larger market share it is plausible that the banks are becoming larger in total assets and therefore the proxy for bank size is

increasing. However the correlation matrix gives no evidence about the direction of the causal relationship. Hence, there could be an effect from *bank size* on *market concentration.* This relationship also seems plausible; when the size of the banks is increasing, the market is more concentrated and the market concentration is increasing.
Market rate correlates negatively and significantly with *bank capital* ($p < 0.01$) and bank size ($p < 0.10$), but the coefficient *bank size* is quite small ($r = -0.0772$). *Bank capital* positively correlates relatively strong ($r = 0.5141$) with *operational inefficiency*. This seems to indicate that either banks with an increasing tier 1 capital ratio become more inefficient or banks that become less efficient increase their tier 1 capital ratio.

Table IV reports the test conducted to control for multicollinearity. As stated before, the issue of multicollinearity is present when the reported VIF test shows values above the critical values of 10 or when the reported 1/VIF test shows values below the critical value 0.1. The table reports no VIF values above 10 or 1/VIF values below 0.1, assuming that multicollinearity is not an issue in the analysis. Therefore none of the variables of interest is excluded from the following analyses.

Table III – Correlation matrix

	Deposit rate	Market concentration	Market rate	Bank capital	Bank size	Operational inefficiency
Deposit rate	1.000					
Market concentration	-0.547***	1.000				
Market rate	0.264***	-0.076	1.000			
Bank capital	-0.156***	0.386***	-0.412***	1.000		
Bank size	-0.801***	0.671***	-0.077*	0.045	1.000	
Operational inefficiency	-0.059	0.188***	0.040	0.514***	0.033	1.000

*** Significant at the 1% level
** Significant at the 5% level
* Significant at the 10% level

Table IV – Multicollinearity

Variable	VIF	1/VIF
Market concentration	2.50	0.40
Market rate	2.38	0.42
Bank capital	2.12	0.47
Bank size	1.54	0.65
Operational inefficiency	1.43	0.70
Mean VIF	1.99	

5.3 Statistical models & tests

5.3.1 Analyses with the basic equation

(I) Statistical models

In table V, the regression models described in the earlier section are conducted using the basic equation. The first column reports the OLS regression, the second column contains the results of the FGLS method, the third and fourth column present the RE (*random effects*) and FE (*fixed effects*) model and the last column reports the FE model with adjustment for serial correlation. This last model is used to accept or reject the hypotheses formulated in the theoretical foundation. A summary of the results is given in table VI.

The first column in table V reports the OLS coefficients and their significances. This column shows that only the independent variables *market rate* and *bank size* have a significant effect on *deposit rate* at the 1% level. The relationship between *deposit rate* and *market rate* is, as expected, positive (coefficient = 0.177). This indicates that, when the *market rate* is increasing (decreasing), the *deposit rate* is also increasing (decreasing). The relationship between *deposit rate* and *bank size* is, as expected, negative (coefficient = -0.003). This indicates that, when the total assets of the bank are increasing (decreasing), the deposit rate is decreasing (increasing). *Market concentration* is positive but not statistically significant, and this positive direction is against the expectation in the hypothesis. *Bank capital* and *operational inefficiency* are also insignificant but these variables do have the expected (negative) sign based on the hypotheses.

The F-test below the first column shows that the fit of the whole model is significant at the 1% level (F = 192.29). The Breusch-Pagan / Cook-Weisberg test shows there is no presence of heteroskedasticity because the null hypothesis is not significantly rejected. However the White's general test shows heteroskedasticity is present in the data with a significant χ^2 value at the 1% level. Hence these tests give ambiguous results about the presence of heteroskedasticity. The Breusch-Godfrey LM test indicates the presence of serial correlation. The R^2 of the OLS model is 68.56%, indicating that 68.56% of the variation in the dependent variable is explained by the model.

Although heteroskedasticity is not conclusively established by the conducted tests, *Feasible Generalized Least Square (FGLS)* estimators are determined in order to control for the issue of heteroskedasticity. The second column shows that the coefficients reported by the OLS method are still consistent. The Wald (χ^2) test reports that the fit of the FGLS model is significant at the 1% level ($\chi^2 = 974.55$).

The Breusch-Pagan LM test gives evidence that the *random effects* (RE) model fits the panel data better than the OLS and FGLS models do because the null hypothesis of no individual effects is rejected at the 1% level ($\chi^2 = 15{,}089.03$).

The coefficients, standard errors and significances in the RE model in the third column show only slight changes with the OLS and FGLS models. However the R^2 is 80.83%, compared to 68.56% considering the OLS/FGLS model. This indicates that random effects add value to the model.

The fourth column reports the *fixed effects* (FE) model. The independent variable *operational inefficiency* shows significant negative results (coefficient = -0.014). *Market rate* and *bank size* remain their significant results. The F-test shows that the fit of the whole model is significant at the 1% level (F = 474.50). The Hausman test is conducted to determine whether the RE or FE estimators are more consistent. The Hausman test gives significant evidence that the RE estimators are not appropriate, hence the FE model should be used ($\chi^2 = 73.15$). This concludes that unobserved effects correlate with the independent variables. In the FE model, the R^2 increased to 84.39%, which means that fixed effects and the independent variables explain 84.39% of the variation in the dependent variable.

The last column gives the results of the most appropriate model, the *fixed effects* model with adjustment for first-order autocorrelation (FE with AR(1)), which is conducted to assess the robustness of the findings. Serial correlation is proved present by the significant Breusch-Godfrey LM test in the OLS method, therefore the FE estimators should be corrected for the issue of serial correlation.

(II) Hypotheses

The hypotheses formulated in the **theoretical foundation** are accepted or rejected based on the most appropriate model, FE with AR(1):

Hypothesis 1a: '*an increase in the degree of market concentration in the Dutch market for bank deposits leads to a decrease in the deposit rate'* is rejected because the market concentration coefficient (-0.009) is not significant at the 10% level. However the direction of the relationship is negative, as was expected in the theoretical foundation.

Hypothesis 2: '*an increase in the market rate leads to an increase in the deposit rate'* is rejected because the market rate coefficient (0.012) is not significant at the 10% level. The market rate coefficient was significant in all four earlier models but the significance is disappeared in this model which corrects for serial correlation; hence this indicates that serial correlation is especially an issue for this variable because this change in significance is not being seen at the other variables. The direction of the relationship meets the expectation of being positive.

Hypothesis 3a: '*an increase in the capital ratio of the bank leads to a decrease in the deposit rate'* is rejected because the bank capital coefficient (-0.006) is not significant at the 10% level. Also for this variable, the direction of the relationship with *deposit rate* is, as expected, negative.

Hypothesis 4: '*an increase in the size of the bank leads to a decrease in the deposit rate'* is accepted because the bank size coefficient (-0.001) is significant at the 1% level ($p < 0.01$). The minus sign before the coefficient gives evidence that the relationship with *deposit rate* is negative, as stated in the hypothesis.

Finally, hypothesis 5: '*a decrease in the inefficiency ratio of the bank leads to an increase in the deposit rate'* is accepted because the operational inefficiency coefficient (-0.005) is negative and significant at the 5% level.

The reported F-test of the FE with AR(1) model shows that the fit of the whole model is significant at the 1% level ($F = 3.35$). The R^2 of the model (3.70%) shows a large decrease compared to the R^2 of the FE model (84.39%), indicating that the correction for serial correlation removes an enormous part of the explanation of the variation in the dependent variable.

Table V – Regression models

The table below provides regression results of the basic equation. The data are from ABN AMRO, Rabobank and ING. The panel dataset is unbalanced, having data available in a period ranging from 1995 to 2009. The first column reports OLS results, with tests for serial correlation (Breusch-Godfrey test) and heteroskedasticity (Breusch-Pagan / Cook-Weisberg test & White's general test). The second column reports FGLS results, thereby controlling for heteroskedasticity. The third and fourth column report results regarding the random effects (RE) model and fixed effects (FE) model. The Breusch-Pagan LM test is conducted to test whether OLS or RE is more consistent. The Hausman test is used to conclude whether RE or FE fits best. The last column reports the FE model, with adjustment for serial correlation (AR(1)). For all regressions, the coefficient and standard errors (in brackets) are reported.

Dependent variable: Deposit rate						
Variables and direction of hypotheses		OLS	FGLS	RE	FE	FE with AR(1)
Intercept		3.304***	3.304***	3.304***	4.255***	3.153***
		(1.030)	(1.023)	(1.030)	(0.759)	(0.014)
Market concentration	(-)	0.008	0.008	0.008	0.002	-0.009
		(0.014)	(0.014)	(0.014)	(0.010)	(0.011)
Market rate	(+)	0.177***	0.177***	0.177***	0.189***	0.012
		(0.030)	(0.030)	(0.030)	(0.017)	(0.025)
Bank capital	(-)	-0.015	-0.015	-0.015	0.007	-0.006
		(0.015)	(0.015)	(0.015)	(0.013)	(0.010)
Bank size	(-)	-0.003***	-0.003***	-0.003***	-0.002***	-0.001***
		(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Operational inefficiency	(-)	-0.002	-0.002	-0.002	-0.014***	-0.005**
		(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
F-test		192.29***			474.50***	3.35***
Wald (Chi^2) test			974.55***	961.47***		
Breusch-Pagan / Cook-Weisberg test		0.65				
White's general test		150.50***				
Breusch-Godfrey LM test		8.507***				
Breusch-Pagan LM test				15089.03***		
Hausman test					73.15***	
Number of observations		447	447	447	447	444
Panels		-	3	3	3	3
R^2		68.56%	-	80.83%	84.39%	3.70%

*** Significant at the 1% level
** Significant at the 5% level
* Significant at the 10% level

Hypothesis	Factor of influence	Result	Level of significance	Coefficient
1.	Market concentration	Rejected	-	-0.009
2.	Market rate	Rejected	-	0.012
3.	Bank capital	Rejected	-	-0.006
4.	Bank size	Accepted	1%	-0.001
5.	Operational inefficiency	Accepted	5%	-0.005

Summary of hypotheses

5.3.2 Additional analysis with market power and liquidity included

Next to the tests described above, there are also additional tests executed which include the variables *market power* and *liquidity*. As stated in the theoretical foundation, there may be correlation between market power - market concentration and bank capital – liquidity. Therefore these variables were not included in the basic equation. Furthermore the data for these variables were not available for ING and not complete for ABN AMRO.

The VIF test for multicollinearity shows multicollinearity issues for the variables *market power, liquidity, market concentration and market rate.* When the variables *market power* and *market concentration* are excluded from the analysis the VIF test results in no issues of multicollinearity.

The most appropriate test FE with AR(1) is conducted and the results indicate that, in contrast with the earlier results, only the variable *market rate* has a positive (coefficient = 0.077) and significant effect ($p < 0.01$) on *deposit rate.* As can be seen in the table below, the other independent variables have no significant effect on *deposit rate.* The statistical power of the model is relatively low because there are only 152 observations and 2 panels and the fit of the model is only significant at the 10% level ($F = 1.89$). The results of this analysis are reported in table VI.

Hence this model which includes only data regarding ABN AMRO and Rabobank does not give additional insights in the relationship between the independent variables and *deposit rate* besides the significant effect of *market rate.*

Table VI – Results additional analysis

Dependent variable: Deposit rate	Period: February 2003-December 2009	
Variables and direction of hypotheses		FE with AR(1)
Intercept		2.375***
		(0.018)
Market rate	(+)	0.077***
		(0.028)
Liquidity	(-)	-0.001
		(0.002)
Bank capital	(-)	0.002
		(0.009)
Bank size	(-)	-0.000
		(0.000)
Operational inefficiency	(-)	-0.002
		(0.002)
F-test		1.89*
Number of observations		152
Panels		2
R^2		6.21%

*** Significant at the 1% level
** Significant at the 5% level
* Significant at the 10% level

5.4 Economic significance

Next to the statistical significances of the variables, the economic significances of the variables are of great interest. The variables can be statistical significant but the economic significance shows whether the effects between the dependent and independent variables have also some economic power, hence it shows the magnitude and implications of these effects, also called the size of effects (Thorbecke, 2004).

The economic significances are derived from the last column, the FE with AR(1) model. A one standard deviation increase in the significant variable *bank size* leads to a decrease of 0.307% in *deposit rate.* According to the descriptive statistics table, the *deposit rate* ranges between 0.5% and 4.6%, hence a decrease of 0.307% is economically significant. The other significant variable *operational inefficiency* has an economic significance of -0.075%. When *operational inefficiency* increases with one standard deviation, the *deposit rate* decreases with 0.075%. This percentage is also economically significant because a decrease of 0.075% has a relatively large effect on the *deposit rate* which ranges between 0.5% and 4.6%.

Economic significances are not determined for the insignificant variables *market concentration, market rate* and *bank capital* because those coefficients cannot be generalized outside the sample of ABN AMRO, ING and Rabobank.

Variable	Standard deviation	Beta	Economic significance
Bank size	306.74	-0.001	-0.307%
Operational inefficiency	14.91	-0.005	-0.075%

Economic significance of variables

5.5 Discussion of results

In this section the results provided in the earlier section will be critically discussed. The first part of this section contains the discussion of the variables included in the basic equation. The second part of this section contains the discussion of other issues that arise in this research.

5.5.1 Discussion of variables

(I) Market concentration

The independent variable *market concentration* shows no significant relationship with *deposit rate* in this research. The direction of the relationship between *deposit rate* and *market concentration* is negative. This supports the structure-conduct-performance hypothesis which states that higher market concentration leads to less favourable pricing to consumers. The opposing hypothesis in the research field of market concentration - the efficient-structure-hypothesis- assumes that banks in highly concentrated markets offer higher rates on deposits (Gropp, Sorensen and Lichtenberger, 2007). This hypothesis can be rejected, based on the negative relationship between *deposit rate* and *market concentration.*

One explanation for the lack of significant results could be the fact that only three Dutch banks are included in this research, making the power of the analyses relatively weak. However this explanation applies for all variables included in this research, not explicitly for *market concentration.*

Remarkably, the correlation matrix shows quite a strong negative correlation between *market concentration* and *deposit rate*. However this correlation is not present in any of the regression models. This may imply that there is a reverse negative relationship present; *deposit rate* has an influence on *market concentration*. It could be possible that, when the deposit rate increases, a bank acquires more customers or at least a higher amount of savings and therefore the bank also acquires a larger market share hence a higher market concentration.

(II) Market rate

The independent variable *market rate* also shows no significant relationship with *deposit rate*. Remarkably, as shown in table V, *market rate* reports significant coefficients in all four models before the final model FE with AR(1). This model corrects explicitly for serial correlation. Apparently the data collected for *market rate* include errors which are correlated among time periods and this was causing the significant results in the earlier models.

Furthermore, the literature in the theoretical foundation states that the adjustment of deposit rates based on movements in the market rate is sticky. This means that deposit rates adjust faster when the market rate is cut than when it is raised (Fuertes, Heffernan and Kalotychou, 2010). Neumark and Sharpe (1992) state that banks in more concentrated markets are slow to raise deposit rates in response to rising market rates but are faster to reduce them in response to declining market rates, hence *market concentration* reinforces the relationship between *market concentration* and *deposit rate*. The banking sector in the Netherlands is highly concentrated; therefore the problem of stickiness of deposits may be present. This stickiness may explain why there are no effects visible between *market rate* and *deposit rate.* Namely, in these analyses, the delta regarding the time series component is one month. It may be possible, that this delta of one month is too short to observe changes in the *deposit rate* because the adjustment of the *deposit rate* due to changes in the *market rate* is sticky and hence takes longer than one month to adjust.

The explanation of a delta of one month being too short to observe changes in the *deposit rate* as a reaction of changes in the independent variables is also applicable to the other independent variables.

(III) Bank capital

The last insignificant independent variable is *bank capital*. The direction of the relationship between *bank capital* and *deposit rate* is negative, as expected in the theoretical foundation. Hence the argumentation for this negative relationship in the theoretical framework is still valid. An explanation for the lack of statistical results can be again the small statistical power due to only three banks in the sample.

(IV) Bank size

The independent variable *bank size* shows a negative significant relationship with *deposit rate.* This means that an increase (decrease) in total assets results in a decrease (increase) in the deposit rate. This implies that the arguments of Bassett and Brady (2002), Hannan and

Prager (2006) and Ruthenberger and Elias (1996) as stated in the theoretical foundation remain valid. The argument given by Tokle and Tokle (2000) that bank size is a proxy for economies of scale and having these economies of scale results in higher deposit rates can be rejected for the Dutch market. The variable *bank size* is not only statistically significant but also economically significant.

(V) Operational inefficiency

Finally, the independent variable *operational inefficiency* also shows a negative significant relationship with *deposit rate.* This implies that a decrease (increase) in *operational inefficiency,* hence an increase (decrease) in *operational efficiency* leads to an increase (decrease) in *deposit rate*. Consistent with the arguments in the theoretical foundation, there could be assumed that efficient banks pass on part of their cost-effectiveness on to customers by higher deposit rates. Or banks become less efficient and they compensate these higher costs by decreasing their deposit rate.

(VI) Deposit rate

However, not only the explanatory variables contain the problem of serial correlation but also the dependent variable. The *deposit rate* of $year_t$ is influenced by the deposit rate of $year_{t-1.}$ Hence it may be that the *deposit rate* of $year_t$ is not only determined by the independent variables of the previous period but also by the *deposit rate* of the previous period.

5.5.2 Discussion of other issues

(I) Bank fixed effects

When considering the R^2 of the several models, there are quite some differences between the OLS model, the *fixed effects* model and the adjusted autocorrelation model (FE with AR(1)). The R^2 shows an increase from 68.56% to 84.39% when fixed effects are included in the model. This implies that the fixed unobserved error terms are correlated with the explanatory variables and that this unobserved error adds variance to the model.

There are several variables which possibly are present in the fixed unobserved error in this research, the bank fixed effects. Firstly, the culture of the bank may have an influence on one or more of the independent variables. For example, a particular bank may have a much more

conservative tier 1 capital ratio (proxy for *bank capital*) than required because of their conservative culture. This does not automatically have to lead to a decrease in deposit rate.
Furthermore some of the banks have received support from the Economic Commission because of financial difficulties. This support causes certain restrictions and therefore influences the pricing behaviour of these banks. Hence this support may weaken the relationships between the dependent and independent variables.
Also the focus of the banks may influence the relationship between the independent variables and *deposit rate*. One bank may have a larger emphasis on the Dutch retail market, another bank may have a larger emphasis on the wholesale market or may have a more international focus. When the main interest of banks is not the deposit market, the *deposit rate* may be less dynamic and that will influence the relationship between the explanatory variables and the *deposit rate.*
Finally there may be a difference in how dependent a certain bank is of their deposit savings with regard to their funding. Hence, when a bank is earning a great part of their income from deposit savings, they may adopt a different pricing behaviour than banks that are less dependent of their deposit savings because they acquire a lot of wholesale funding.

The large difference in R^2 between the FE model and the FE with AR(1) model can be explained by the *market rate* variable. *Market rate* is explaining a lot of the variance in the FE model; this is shown by a rather large coefficient of 0.189 significant at the 1% level. However, in the FE with AR(1) model there is a correction for serial correlation, resulting in an insignificant *market rate* coefficient of 0.012. Due to the correction for serial correlation, which especially weakens the influence of *market rate*, the R^2 decreases from 84.39% to 3.70%.

(II) Additional analysis
The additional analysis conducted with the initial inclusion of *market power* and *liquidity* shows that *market power* should not be included in the analysis due to multicollinearity issues. Hence the expected correlation between *bank capital* and *liquidity* seems not to exist. However *liquidity* has no significant effect on *deposit rate.*
In this analysis, which only includes ABN AMRO and Rabobank data, only the variable *market rate* has a significant effect on *deposit rate*. This is in contrast with earlier results.
In the discussion regarding *market rate* above, there is stated that the correction for serial correlation caused the disappearance of the significant effect of *market rate*. In this model,

there is also corrected for serial correlation but the variable is significant. The data in this analysis is from a different time period than the earlier analyses, namely February 2003-January 2009. Apparently the *market rate* in this period, does not suffer as much from the issue of serial correlation, as the *market rate* in the period 1995-January 2002.

The variables *bank size* and *operational inefficiency* were significant in the earlier analyses but are not significant in this analysis. However the directions of the coefficients are still in line with the expectations in the hypotheses.

The absence of significant results can be caused by the low statistical power of the model. There are only 152 observations, two panels and the F value is only significant at the 10% level. Therefore this additional analysis does not add any value to the earlier analyses.

6. Conclusion

6.1 Introduction

In this chapter, conclusions and management recommendations based on the hypotheses will be provided. Moreover, the limitations that this research carries will be described. Finally, there will be recommendations for future research provided.

6.2 Conclusion

The aim of this research is to answer the following research question: 'which factors influence interest rates offered by banks regarding their retail deposits within the Dutch market?' This research question is answered by defining several factors of influence in the **theoretical foundation**. Next the necessary data are gathered at ABN AMRO, ING and Rabobank, regarding the period 1995-2009, to measure the factors of interest and finally these data are analysed in several models described in the **methodology** section.

The factors assumed to influence deposit rate are *market concentration, market rate, bank capital, bank size* and *operational inefficiency.* Several models and tests were used to find the most consistent model to answer the research question. This has led to the most appropriate model being the *fixed effects* model with adjustment for first-order serial correlation (FE with AR(1) disturbance).

The results show that the variables *bank size* and *operational inefficiency* have a negative effect on *deposit rate*. This means that an increase (decrease) in *bank size* leads to a decrease (increase) in *deposit rate* and an increase (decrease) in *operational inefficiency* leads to a decrease (increase) in *deposit rate*.
The independent variables *market concentration, market rate* and *bank capital* have no significant impact on the *deposit rate.*
The proportion of variability that is accounted for by the model is rather low (3.70%). However, the significant variables *bank size* and *operational inefficiency* are also economic significant.

There is an extra analysis conducted in order to test whether the variables *market power* and *liquidity* influence the *deposit rate*. *Market power* is not included in the analysis due to

multicollinearity issues and *liquidity* does not have an impact on *deposit rate.* This additional analysis only includes data regarding ABN AMRO and Rabobank.

6.3 Management recommendations

Management recommendations are given to help management to interpret the results in their best interest. The aim of this research is to gain more insights in the dynamics of the deposit rate; hence this research is more exploring than predicting. Therefore the results of this research are mainly useful for understanding the pricing behaviour of other banks. Before specific recommendations based on the results are given, first more broad recommendations will be given.

However there is one critical issue regarding the design of this research: in most studies, the independent variables could be used to influence the deposit rate. In this research however, the dependent variable, *deposit rate*, can be changed directly by the management and not necessarily through the independent variables. Nevertheless the results of this research can be useful for the management.

The pricing strategy of the bank determines whether the bank prefers margin or volume. When a bank focuses on volume, it will probably set a relatively high *deposit rate* in order to attract a high amount of savings. However, when a bank focuses on margin, it will probably set a relatively low *deposit rate* in order to gain a high internal margin. So this means that having a high *deposit rate* is not automatically 'good' or 'bad', it depends on the pricing strategy of the bank. Each bank will try to find the optimal deposit rate to maintain or increase its volume but also its margin. The trade-off between margin and volume is also dependent of the pricing behaviour of the bank's competitors. An increase of the deposit rate of one bank may lead to an increase in the volume of the bank. However when all banks will increase their deposit rates, the retail clients will not transfer their savings and the only result of the increase in deposit rate will be a decrease in the margin of the bank.

Firstly, it is important that a bank has a well-defined pricing strategy, that it behaves in line with that strategy and that the *deposit rate* strategy is aligned with pricing strategies of other products. Furthermore, the pricing strategy can also emphasize the strategy and/or reputation of the bank. Consumers seem to link the reputation of the bank with the *deposit rate* it offers; a risky bank offers higher *deposit rates,* a save and stable bank offers lower *deposit rates.*

Management should be aware of this, develop a well-defined strategy and align this bank strategy with the pricing strategy of all its products.

The finding that *deposit rate* is influenced by *bank size* and *operational inefficiency* can be helpful in building expectations about the pricing behaviour of competitive banks.
An increase in the *deposit rate* may make other banks think that the concerning bank has funding issues because it decreases its margin. However it may be possible that the bank has an increased efficiency ratio and that it can use the cost savings due to this efficiency to attract more volume, without losing margin. Hence this knowledge helps the management to understand the increases or decreases competitors have in their *deposit rates* and the management can adjust their pricing strategy taking into account the behaviour of their competitors.

Of course the management of a bank should also stimulate the decrease of *operational inefficiency* at their bank. The money that is saved thanks to the increased efficiency can be used to increase the *deposit rate* and may lead to an increase in volume.

At last, the management of a particular bank should wonder why the relationships between *deposit rate* and *bank size* and *operational inefficiency* are as they are and if this is in line with the pricing strategy. This should be expanded, the management should investigate what other effects in the bank are caused by changes in *bank size* and *operational inefficiency* and if these effects are in line with the (pricing) strategy of the bank.

6.4 Limitations

This research contains some limitations regarding the research design, data sources and analyses. First, only three Dutch banks are part of this research. The inclusion of more Dutch banks could possibly lead to a more complete picture of the Dutch retail savings market. Furthermore, when this research had taken banks in other (European) countries into account, differences between countries could have been detected and researched. In addition to this limitation is the fact that a lot of the empirical studies and articles used as a basis for the primary equation are deduced in the USA. The results of those studies might not be applicable in the Dutch context.

Furthermore, the data file contains some limitations. In general, some variables are measured on a monthly basis and some variables are measured on a yearly basis. This is caused by the availability of the data. A lot of data are gathered from annual reports and especially for ING and Rabobank it was more difficult to gather monthly data. However, there is chosen to work with different time intervals, because using only yearly data would lead to a loss in variation, especially with respect to the dependent variables. In addition to this, unfortunately not all the data are available for the complete time period of interest (1995-2009) or are not available at all. This was particular an issue for ING and, to a lesser degree, for Rabobank and ABN AMRO. The problem of missing data is larger for variables with yearly data because this leads to twelve missing data points. The data regarding Rabobank are only available for the period October 2002 until December 2009. This leads to an unbalanced dataset because the number of observations is not equal for all included banks.

Another limitation regarding the dependent variable is the quality of the data. The deposit rate data of the Rabobank is not received from the Rabobank itself so this may question the quality of this data. Furthermore, INGs savings account is no longer available for sale. This may have an effect on the dynamics of its deposit rate.

6.5 Recommendations for future research

Although this research is given interesting results and material for discussion, there are recommendations to improve or alter this research in the future to obtain more insights in the (Dutch) retail savings market. Some of the recommendations for future research are in line with the limitations given above.

First, it would be interesting to investigate the relationships between the deposit rate and factors of influence for more Dutch banks than only ABN AMRO, ING and Rabobank or even include banks outside the Netherlands. Furthermore, this research would be improved when the availability of the data was better and more frequent. All these recommendations would improve the generalizability of this study.

In this research, the consumer is not taken into account. Initially, consumer-related factors were also included in this research but the necessary data were unavailable to gather. However, the behaviour of retail consumers, like interest rate sensitivity, demand for deposits, and search and switch costs, may have an effect on the deposit rate offered by banks. It would

be very interesting if future research is dedicated to the relationship between consumers and deposit rate. Another factor which is not taken into account is the volume of savings. In this research, only the factors that influence the *deposit rate* are included. However, it would have been interesting to also test the reaction in volume after an increase or decrease of the *deposit rate*.

In this research, the time interval at which the relationship between the independent and dependent variables is studied is one month. This implicates that changes in one of the independent variables should be visible in the dependent variable in the next month. The time interval in this research is for all variables the same. However is might be interesting to investigate if another time interval than one month captures the effect of a change in the independent variable better. Or maybe several time intervals within the dataset suit this research even better.

Finally, in the discussion of results there are several possible fixed effects described, namely bank culture; support from Economic Commission; focus or positioning of the bank; importance of deposit savings for funding. It may improve this research to try to measure these effects (when possible) and include them in the analyses to see whether these effects add value and have an effect on the *deposit rate*.

When these recommendations are taken into account, this will lead to an even more interesting research which can help banks to gain understanding in their own deposit pricing strategy and the deposit pricing strategy of other banks.

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