Master Thesis

Relationship banking: an advantage or disadvantage during the crisis?

In this paper I analyze the impact of a bank's business model on the net interest margin of banks for a pre-crisis, a crisis and a post-crisis period. A bank's business model is represented here by the relationship-oriented model and the transaction-oriented business model. In addition, the effect of the business model in the 2007 – 2009 financial crisis compared to the other periods is explicitly captured. The results show that more relationship banking leads to a higher net interest margin in all three periods, confirming previous research. The results also show that in the crisis the positive effect of relationship banking activities on the net interest margin is even stronger than in the pre-crisis period and the post-crisis period. This is contradictory to my expectations and questions the effect of loan rate smoothing. A possible explanation found in the theory of relationship banking is the lower default rates of relationship banks in economic adverse times, which is the main recommendation for further research. The analyses are conducted at the bank-level with quarterly data on more than 16,000 U.S. banks for the period Q4 1992 – Q1 2016.

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1. Introduction

Banks have a central role in the economy, in particular in financing economic activities in a country. Banking attempts to close the gap between seemingly opposing needs; the need for credit and the need for deposit. It tries to fulfill the first one by extending credit as well as liquidity through lines of credit to the ones needing the credit; the borrowers. The need for deposit is addressed by accepting deposits and assuring depositors that their deposits are liquid and secure (Kashyap, Rajan, & Stein, 2002). This channeling of funds is the primary intermediation function of banks, important for this function is the spread between lending and borrowing (Amidu & Wolfe, 2013). In accordance with this, the literature has concentrated on analyzing the bank interest margin determinants for which a model is developed by the fundamental paper of Ho and Saunders (1981) and the extensions by others (Allen, 1988; Angbazo, 1997; McShane & Sharpe, 1985; Wong, 1997). Although there has been previous research on the topic, Williams (2007) states that the study of bank net interest margins ('NIM') is still a relatively under-researched area of banking. It is therefore important to gain a better understanding of the factors that have an effect on the net interest margin (Williams, 2007). The net interest margin can be seen as profitability measure of banks but is also an indicator of stability, Köhler (2015) states that banks with a higher net interest margin are more stable compared to other banks. Looking at the development of the net interest margin, we have seen an decline over the last 15 years which has been putting pressure on the NIM of all banks, making it all the more relevant to investigate its determinants.

An important finding is that the business model of a bank in terms of relationship banking versus transaction-oriented banking has an impact on the net interest margin (van Ewijk & Arnold, 2014). Van Ewijk and Arnold (2014) have investigated how these business models drive interest margins. Where the shift to new activities of banks (transaction lending) in the literature is often explained by lower margins of traditional activities as a result of increased competition, they argue and find evidence for another explanation; namely that instead of the level of competition in traditional retail markets, rather the urge to grow has changed the balance sheets of banks and has reduced interest rate margins (van Ewijk & Arnold, 2014). They also show that the relationship banking business model has a positive effect on interest margins compared to the newer transaction-oriented business model. This paper continues with the research on the effects of relationship banking on the net interest margin.

Bolton *et al.* (2016) also studied the impact of relationship banking and included the effects of the 2007 – 2009 financial crisis. In the worst time of this crisis, in the fall of 2008, there was a banking panic that threw economies around the world into sever recession (Ivashina & Scharfstein, 2010). This breakdown raised serious concerns about the financial institutions stability and resulted in the failure of Lehman Brothers and the government takeovers of amongst others AIG, Freddie Mac and Fannie Mae in the U.S (Ivashina & Scharfstein, 2010).

The study of Bolton *et al*. (2016) implies that relationship banking has an important role in dampening the effects of negative shocks of a crisis. Firms that depend on relationship banks are less likely to default than firms that depend on transaction banks and due to the more favorable continuation lending terms they can get from relationship banks, are better able to withstand the crisis. This shows the importance of understanding the effects of relationship banking on the performance of banks during a crisis. Furthermore, Bolton *et al*. (2016) state that more relationship banking could decrease the risk of a major credit crunch, in particular for the firms that choose to depend on relationship banks. These arguments about the important role of relationship banking in a crisis lead me to investigate this further.

I focus on validating and strengthening previous research regarding the differences of interest margins of relationship lending and transaction-oriented lending banks by using data for a longer time period (van Ewijk & Arnold, 2014). In addition, the time period (1992-2016) makes it possible to clearly separate a pre-crisis period, a crisis period, and a post-crisis period which I will use to look at the effects of relationship banking on the net interest margin in a financial crisis. This will be one of the first papers were the effects of the relationship-orientated model on the net interest margin in a crisis will be investigated, and the first time the post-crisis period of the 2007 – 2009 crisis is defined and included.

The objective of this paper is to empirically examine the differences in the net interest margin in periods of economic prosperity and in a period of a financial crisis as a result of the amount of relationship banking activities of a bank. I formulate the following research question:

What is the effect of a bank's business model on the net interest margin in the periods before, during and after the recent financial crisis?

I investigate a bank's business model by looking at relationship banking versus transaction-oriented banking. In order to do this, I use four measures as indicators of a relationship-orientated business model. These four measures together represent relationship banking activities. This is measured relative to transaction banking activities. In other words, if these variables are higher for bank one than for bank two it means that bank 1 has relatively more relationship banking activities than the second bank. The effect of these variables on the net interest margin is tested. By taking a dataset with a large amount of U.S. banks and many different measures and over a long time frame (Q4 1992 to Q1 2016), I am able to select the relevant measures for both the explaining and the control variables. Furthermore, a pre-crisis period, a crisis-period and a post-crisis period will be identified.

In doing this, I try to contribute to the field of research of banks, in particular to the explanation of different business models and the effect thereof on the net interest rate in economically good and bad periods. As the NIM is of the key indicators of a bank's profitability, and banks are an important part of the financial system, this contributes to the research of the financial system.

Not only for researchers or analysts is it important to analyze the business models of banks, but it has also gained in importance of policymakers and supervisors (Köhler, 2015). All of the new regulations for the entire financial system that are being made and implemented put pressure on financial institutions, and banks in particular. The financial crisis has shown that besides the liquidity, capital and risk management measures, it is necessary to explore the effects of different business models (Köhler, 2015). This should lead to a better understanding of a bank's profits and stability and potentially provide a better approach regarding the strengthening of the financial system.

The possible implications of this paper for banks in particular is that this research can contribute to their strategy regarding which activities to exploit and where to allocate resources. A strong new insights into either direction could make banks reconsider their current mix of relationship lending and transaction-oriented lending. Indirectly this is also important for consumers as this may contribute to a solid and safe financial system.

The results of this study show that relationship banking activities relative to transaction-oriented banking lead to a higher net interest margin in all researched periods; the post-crisis period, the crisis period and the period after the crisis. In addition, the results show that the positive effect of relationship banking is even stronger in the crisis period than in the other periods. This is not as expected but is nonetheless an interesting results which deserves further investigation. In the next chapter the theoretical framework is

presented and the hypotheses are derived based both on the theory and previous empirical findings. After that I will elaborate on the data and discuss the method and main variables I used. In the fourth chapter the results are interpreted and discussed, by which the hypotheses are answered. Finally I conclude this paper with the main result and implications, the limitations and recommendations for further research.

2. Theoretical background

This chapter begins by explaining what relationship banking is, what the value of it is, and what the potential disadvantages are. Next, the different relationship banking theories are discussed to provide an overview of the existing views of this type of banking. In a similar way, the net interest margin of banks is explained; first, by showing what it is and why it is used in this paper, second an overview is given of the development of the net interest margin models beginning at the Ho and Saunders (1981) model. After that the characteristics of the crisis in terms of lending are explored. Lastly, empirical research leading up to this study is discussed and the hypotheses are derived.

1. Theory on relationship banking

1.1 What is relationship banking?

The term "relationship banking", apart from references to "close bank relationships", was not sharply defined in parts of previous research. Boot (2000) reviewed the literature on relationship banking and defined relationship banking as the provision of financial services by financial intermediary that;

I. Invests in obtaining customer-specific information, often proprietary;
II. Evaluates the profitability of investments through multiple interactions with the same client over time and/or across products.

In contrast, transaction-oriented banking focuses on a single transaction with a borrower, or several identical transactions with several borrowers (Boot, 2000). Where relationship lending is focused on an information-intensive relationship with a borrower, transaction lending can be viewed as arms-length finance focusing on a specific transaction (Boot & Thakor, 2000). Overall, this means that three conditions apply when relationship banking is present (Berger, 1999):

I. The bank gathers information other than readily available public information;
II. Information gathering happens over time through multiple interactions with the client, often through the provision of several financial services;
III. The gathered information remains confidential (proprietary).

1.2 How does relationship banking add value and what are the costs?

The first potential benefit of relationship banking is that a borrower might share more information than in a transaction-oriented interaction and hereby reduces the information asymmetry between them and the bank (Boot, 2000). Another benefit is that relationship lending can improve welfare for the borrower by providing special contractual features (Boot, 2000):

I. Room for flexibility and discretion in contracts that allow the utilization of non-contractible information, by which implicit long-term contracting is made possible;
II. Inclusion of specific covenants that allow for a better control of potential conflicts of interest;
III. The involvement of collateral that needs to be monitored; the proximity of a relationship lender may be critical here as otherwise lending might not occur at all;
IV. Funding of loans that are not profitable in the short run, but may become so if the relationship with the clients lasts long enough.

Looking at the potential downside, there are two main disadvantages related to relationship lending: the soft-budget constraint and the hold-up problem (Boot, 2000):

I. The soft-budget constraint problem considers the potential lack of toughness in enforcing credit contracts that may arise with relationship lending: the question is if a bank can realistically deny additional credit when problems occur. While a *de novo* lender would not lend to this borrower, a bank that has already loaned to this borrower might be inclined to increase the credit outstanding, in the hope to recover its previous loan;
II. The second potential cost is the hold-up problem: the proprietary information that banks acquire about borrowers may give them an information monopoly. This way, relationship banks may charge high (ex-post) loan rates (Rajan, 1992; Sharpe, 1990). The potential danger of information obtained by the bank, or being "locked-in", could make the borrower reluctant to borrow from a relationship bank. As a result, possible valuable investment opportunities might be lost.

Concluding, Boot (2000) notes that relationship banking plays an important role and can be a value-enhancing intermediation activity. He also notes that despite the previously acquired knowledge, much more research is needed to predict the viability and scale of relationship banking in the future.

1.3 Relationship banking theories

In this section four different views on relationship banking are discussed, with the fourth the most relevant for this research. Although there are similarities, also some differences in interpreting relationship banking exists.

The relationship banking literature contains various aspects of a long-term banking relation (Bolton et al., 2016). Although not all theories take into account how relationship lending evolves over the business cycle, it is useful to briefly discuss predictions of different theories. Bolton *et al.* (2016) identify four different strands of relationship banking theories, with different predictions regarding the cost of credit, default rates, and credit availability.

The first strand highlights relationship banks as banks that provide insurance to firms towards future access to capital and credit terms (Berger & Udell, 1992; Berlin & Mester, 1999). Although Berlin and Mester (1999) find that banks that are more heavily funded with core deposits provide more loan-rate smoothing in response to an interest-rate shock, it does not follow from this finding that firms with the lowest credit risk choose this loan-rate smoothing service. Hence, this strand does not imply that relationship banks experience different default rates (in crisis times) than transaction-oriented banks.

The second theory regarding the role of relationship banks emphasizes the monitoring role (Boot & Thakor, 2000). This monitoring theory entails that only companies with low equity capital choose to borrow from a relationship bank, where firms with sufficient cash or collateral select a cheaper loan from a transaction-oriented bank. This theory makes no explicit predictions regarding default rates of relationship banks in a crisis. However, it is likely that these theories would predict higher probabilities of default in crisis times for companies borrowing from relationship banks (Bolton et al., 2016).

The third strand emphasizes the ex-ante screening abilities of new loan applications of relationship banks as a result of their access to both hard and soft information about firms (Agarwal & Hauswald, 2010; Puri, Rocholl, & Steffen, 2011). According to this theory, in contrast to the previous one, a plausible prediction would be that relationship banks have lower default rates than transaction-oriented banks in bad times (Bolton et al., 2016). Also, this theory predicts that relationship banks would benefit from an ex-post information monopoly, and thus being able to charge higher lending rates than transaction-oriented banks in both good and bad times.

The fourth strand of relationship banking theories, the most relevant to this paper, focusses on (soft) information acquisition about borrowers' types over time. Here relationship banks are able to offer continuation lending terms that are better adjusted to the specific circumstances in which companies may be in the future (Bolton et al., 2016). This information acquisition theory predicts relationship banks to charge a higher lending rate in economically good times and lower rates in bad times to help their borrowers through the crisis. Transaction banks on the other hand offer lower loan rates on good times but roll over fewer loans in bad times (Bolton et al., 2016). Also, this theory predicts fewer defaults in bad times for relationship banks.

After having discussed the relationship banking theories, I will explain the net interest margin and the models to measure the effects on the net interest margin in more detail.

2. Theory on net interest margin models

2.1 Why do I use the net interest margin of banks and what is it?

Van Ewijk and Arnold (2014) state that in the two decades prior to the credit crisis, a strategic shift occurred from a relationships-oriented model to a transactions-oriented model of financial intermediation in developed countries. Together with the regulatory and technological changes, this makes it important for banks to know how their profitability parameters change. Although non-interest income is becoming increasingly important as a source of bank revenue, the net interest margin is one of the most important instruments to measure the performance of banks (Lall, 2016). In this study I will analyze the NIM of banks and compare how the NIM is impacted by relationship-banking activities in good times and in times of crisis. The net interest income reveals the difference between interest income and interest expense. Existing theory implies that this shift has a notable impact on the size of net interest margins. However, for a large part it has been overlooked in empirical research on bank interest margins (van Ewijk & Arnold, 2014).

2.2 Development of net interest margin models

The development of the net interest margin model is best described by Williams (2007), who's line of thought I follow. The literature on net interest margin models begins at Ho and Saunders (1981). Their model sees banks as risk-averse dealers for homogenous deposits and loans. An important role of a bank is to deliver an immediate service regarding both borrowers and depositors. Interest rate risk, caused by

interest rate volatility, is the key risk for banks. In this theoretical model, there is a single period where a bank is active (Ho & Saunders, 1981). The goal is maximization of end of period wealth by setting loan and deposit rates at the start of the period while confronted with a demand for loans and the arrival of deposits at different times. Any mismatches between loans and deposits are satisfied by the bank in the money market. If the amount of deposits is larger than the demanded loans, the remaining is invested at the risk-free rate *r*. At the time when the money market deposit matures, the bank is confronted with reinvestment risk. On the other hand, if the demand for loans is larger than the deposits, the gap is funded in the money market, at the risk-free rate. Here, the bank encounters refinancing risk when the short-term financing in the money market matures before the loaned amount (Williams, 2007).

The optimal spread between the fee charged by the bank for deposits and the risk premium charged for loans is in the Ho and Saunders (1981) framework determined by the bank's managerial risk aversion, the variance of the interest rate on deposits and loans, and the bank average transaction size. Although used as a starting point for a large range of net interest margin studies, this model has some restrictive assumptions (Williams, 2007). Lerner (1981) inclined that the production costs of a bank should be included, and McShane and Sharpe (1985) found that bank market power increases the net interest margins and thus the bank's degree of market power should be included. More adjustments came from Allen (1988) who assumed that bank product were no longer homogenous. He showed that the net interest margin may be decreased when cross-elasticities of demand for bank products are considered, which can be seen as a portfolio diversification effect. Further modifications were made by Angbazo (1997) who found that credit risk increases bank interest margins, and thus added credit risk to the explanatory factors of the net interest margin.

The most recent expansion of the Ho and Saunders model has been made by Maudos and Guevara (2004). They take into account the operating costs of a bank as an explaining factor, as originally suggested by Lerner (1981). In addition, implied payments and management quality are found to be important parts of the net interest margin model (Williams, 2007). The study of Williams (2007) also finds that the fundamentals of the Ho and Saunders (1981) model continue to be relevant. He shows that the net interest margin is a positive function of interest rate risk and bank managerial risk aversion, measured by capital ratios. The same research confirms the additions made by McShane and Sharpe (1985), where market power has a positive effect on the net interest margin (Williams, 2007).

According to Williams (2007), banks also face institutional and regulatory aspects that add more costs to its operations, which are; the opportunity costs of reserves, implied interest, liquidity risk and

management quality. As their overall goal is assumed to be profit maximization, these costs are expected to influence the net interest margin. Although such effects are not completely covered in the theoretical models, but should be taken into account in empirical research (Williams, 2007). Next, the financial crisis is discussed.

3. Financial crisis

3.1 Financial crisis of 2007-2009

As the relation between the crisis and the net interest margin plays an important part in this research, the characteristics of the crisis with regard to lending are explored here.

In August 2007, the end of the credit and housing boom in 2006 had led to the financial turmoil of massive write-downs by financial institutions, deleveraging and the re-pricing of risk (Flannery, Kwan, & Nimalendran, 2013). During this financial crisis, new lending declined substantially across all types of loans (Ivashina & Scharfstein, 2010). Part of this decline could be caused by a lower demand for credit as firms scaled back expansion plans. However, Ivashina and Scharfstein (2010) showed a decline in the supply of credit as well, and banks with less deposit financing reduced their lending more than other banks.

This drop in the supply of credit has important implications. Without a decline in supply, the decreased demand for credit would have put a downward pressure on interest rate spreads, which in its turn would likely have resulted in a reduction of this decline in demand due to more favorable lending conditions (Ivashina & Scharfstein, 2010). However, the drop in supply puts upward pressure on interest rate spreads, and results in a larger decline of lending than in a typical recession (Ivashina & Scharfstein, 2010). This combination of a banking crisis and a recession is especially challenging. Also the fact that some banks were worse off than others could affect the distribution of credit (Ivashina & Scharfstein, 2010). Borrowers of a liquidity-constrained bank might not be able to simply switch to another bank as a bank–borrower relationships is important (Slovin, Sushka, & Polonchek, 1993). In other words, certain banks may have enough capital to issue new loans, but are careful with extending credit to firms with which they have no prior relationship (Ivashina & Scharfstein, 2010). With this research I try to contribute to the understanding of the role of relationship banking in a crisis, by looking at the effect on the net interest margin. Next, some more empirical research is discussed and together with the literature above, the hypotheses are derived.

4. Hypotheses

4.1 Effect of relationship banking on the net interest margin

In line with the last three theories of relationship banking discussed in section 2, interest spreads of relationship lending are higher compared to transaction lending (Agarwal & Hauswald, 2010; Puri et al., 2011). As interest spreads are higher, I therefore expect a higher profitability in terms of the net interest margin for relationship banking. In other words, the effect of relationship banking on the NIM of banks is expected to be positive. This is strengthened by the research of Van Ewijk and Arnold (2014) who state that relationship banks are able to charge higher margins (DeYoung, Hunter, & Udell, 2004; DeYoung, 2007; DeYoung, 2010; Elyasiani & Goldberg, 2004; Rajan, 1992). Van Ewijk and Arnold (2014) conducted a comparable research as the one proposed here, and find a positive relationship between a bank's business model and net interest margins, using U.S. data for the period 1992 – 2010. Transaction-oriented banking lacks the advantages of relationship banking, but has the advantage of scalability (van Ewijk & Arnold, 2014). In accordance with these theories and the empirical research, my first hypothesis is:

Hypothesis 1: Relationship banking has a positive effect on the net interest margins of banks throughout the entire period compared to transaction banking

4.2 Effect of relationship banking in a crisis on the net interest margin

A lot of existing theories of relationship banking typically do not allow for aggregate shocks and crises (Bolton et al., 2016). In this research the fourth theory on relationship banking, focusing on (soft) information acquisition and helping clients through a crisis by offering continuation lending terms, is explored. Bolton *et al* (2016) investigate this by looking at how relationship lending and transaction lending vary over the business cycle, taking the crisis of 2007 - 2009 into account. The main predictions from the theoretical analysis are: firms will in general pursue a combination of relationship lending and transaction lending; also, firms that rely on relationship banks are more exposed to business-cycle risk and have more risky cash flows. These firms are prepared to pay higher borrowing costs on their relationship loans in normal times in order to secure better continuation financing terms in a crisis (Bolton et al., 2016). Moreover, the theoretical model predicts that firms who rely on a banking relation are better able to weather a crisis and are less likely to default than firms relying only on transaction lending, despite the higher underlying cash flow risk. Lastly, the model predicts interest rates on relationship loans to be countercyclical: generally they have a higher interest rate than transaction loans in normal times and lower interest rates in crisis times.

Using detailed credit registry data on corporate lending by Italian banks before and after the financial crisis, the empirical analysis of Bolton *et al*. (2016) confirms the predictions of their theoretical model: relationship banks charge a higher spread in normal times, they offer more favorable continuation-lending terms in a crisis, and had fewer defaults compared to transaction-oriented banks. This confirms the informational and financial flexibility advantage of relationship banking. With their study they provide more insights into the relationship-lending and what they realize in the real economy and state: "We have found that relationship banking is an important mitigating factor of crises." They showed that relationship banks dampen the effects of a credit crunch by helping profitable firms to retain access to credit in times of crisis. Their results suggest that the effects of crises on corporate investment and economic activity would be smaller if more firms could be persuaded to a long-term banking relation.

Where Bolton *et al*. (2016) looked at the effect on the interest spread and defaults, I investigate the effect of relationship banking in the crisis on the net interest margin, to gain insights as to what the effect is on the profitability of banks during the crisis from a business model perspective.

On the one hand, fewer defaults for relationship banks mean fewer loans which become non-performing, and are expected to lead to a higher net interest margin in a crisis. On the other hand, more favorable lending terms, the lower interest spreads that relationship banks offer in a crisis (Bolton et al., 2016), mean less net interest income, and are expected to lead to lower net interest margins for banks. Berlin and Mester (1998) found that the loan rate smoothing aspect of relationship banking, the offering of more favorable terms in economically bad times, reduces bank profits. They also state that they cannot fully explain these results and that more empirical research is necessary given the "tiny empirical literature exploring relationship lending" (Berlin & Mester, 1998). Ferri *et al.* (2001) suspect that the provision of liquidity insurance in general reduces bank profits. This would mean that financial crises may impose a greater burden on relationship banks than on transaction-oriented banks (Ferri et al., 2001). Considering this could lead to increasing losses, the stability of (some) relationship banks may be at risk (Ferri et al., 2001).

As the possibly different effects of relationship banking on the net interest margin in the recent financial crisis and in the periods before and after are not found to be explicitly researched prior to this research, this is an exploratory part of this field of research. I base my expectations on the deductions from research on the effect of relationship banking in a crisis on interest spreads, due to loan smoothing, and on research on the effect of relationship banking on the net interest margin. I expect that the (negative) effect of the lower interest spread of relationship banking in a crisis leads to lower net interest margins compared to

other periods . Combined with the positive effect of relationship banking in general, the (positive) effect of relationship banking on the NIM in a period of crisis is expected to be less strong then in good times. Therefore, the second hypothesis is:

Hypothesis 2: The (positive) effect of relationship banking on the net interest margins of banks is less strong in the crisis period than in the non-crisis periods compared to transaction banking

This approach is different compared to previous research in that it separates three different periods; two non-crisis periods and one crisis period, and investigates the effect in a crisis compared to the effect in other periods. In addition, a comprehensive dataset is used which contains recent and a large amount of data (including the first quarter of 2016).

3. Data and methodology

In this chapter the data and the methodology are explained. First, a description of the dataset and the way in which the dataset is prepared is given. After that I will explain the model for the analysis and the construction and rationale of the independent variables. As the control variables are based on models in previous research, for those a table is provided with the construction of these variables and the expected results. Some figures and descriptive statistics are used to support the reason of this paper and to provide a better understanding of the dataset. Lastly, the factor analysis and the correlation of the variables are discussed.

1. Data

1.1 Data description

I will use US bank-level data from call reports published on a quarterly basis by the Federal Deposit Corporation (FDIC). The dataset contains balance sheet and income statement data on every FDIC-insured commercial bank for the period Q4 1992 to Q1 2016. Every national bank, state member bank, insured state nonmember bank, and savings association in the United States is required to file Consolidated Reports of Condition and Income (a "Call Report") as of the close of business on the last day of each calendar quarter, i.e., the report date. An advantage of the fact that the database is constructed based on these call reports, is that selection bias is expected to be minimal because the FDIC insures deposits in virtually every bank and thrift in the country. The dataset contains over 16,000 different banks, resulting in 738,513 bank-quarter observations, and 94 periods making it well suited for panel analysis.

The data for the quarterly GDP growth are obtained from the OECD National Accounts and the data on inflation is collected from the OECD Economic Outlook. I obtained the interest rates on U.S. Treasury bills with different maturities from the Federal Reserve Bank, to calculate the interest rate level and volatility.

1.2 Data preparation

In this part I will explain how the dataset is prepared. I conduct my analysis on the bank-level and use unconsolidated data (Maudos & De Guevara, 2004; van Ewijk & Arnold, 2014). In the preparation of the data I follow Van Ewijk and Arnold (2014). As I also use balance sheet ratios, bank mergers and acquisitions could potentially mislead the results. Since I use lagged periods for most independent variables, a large

merger or acquisition in one quarter could lead to a big effect in the next quarter, not attributable to relationship banking versus transaction-oriented banking. Therefore, I follow Van Ewijk and Arnold (2014) and Cebenoyan and Strahan (2004) and remove all observations where asset growth was more than 100 percent or below -100 percent (quarter-on-quarter) and all observations where loan growth was more than 50 percent or below -50 percent (quarter-on-quarter), as these large increases or decreases are not often expected without a merger or acquisition. Also, the observations with incorrect and/or missing data are removed, resulting in a total of 738,513 (bank-quarter) observations.

2. Methodology

2.1 Model

Based on the model used by Van Ewijk and Arnold (2014) and on the theory of net interest models discussed in the theoretical background of this paper, the empirical model is constructed, including factors as operating costs, credit risk and managerial efficiency. To capture the degree to which banks operate according to either a relationship-oriented or a transactions-oriented model, four relationship variables are added (*relbank*). This results in the following equation for bank *i* in period (quarter) *t*:

$$\begin{aligned} margin_{i,t} = \alpha &+ \beta_1 \cdot relbank_{i,t-1} + \beta_2 \cdot capstruc_{i,t-1} + \beta_3 \cdot gdpgrowth_t + \beta_4 \cdot inflation_t + \beta_5 \\ &\cdot yield3month_t + \beta_6 \cdot sd3month_t + \beta_7 \cdot credrisk_{i,t-1} + \beta_8 \cdot opex_{i,t-1} + \beta_9 \cdot c5_t \\ &+ \beta_{10} \cdot implint_{i,t-1} + \beta_{11} \cdot oppcost_{i,t-1} + \beta_{12} \cdot riskexp_{i,t-1} + \beta_{13} \cdot maneff_{i,t-1} \\ &+ \beta_{14} \cdot scale_{i,t-1} + \pi_i + \sigma_t + \varepsilon_{i,t-1} \quad (1) \end{aligned}$$

This model will be used to test the first hypothesis. To test this hypothesis, I create three different periods: the pre-crisis period (Q4 1992 – Q2 2007), the crisis period (Q3 2007 – Q3 2009) and the post-crisis period (Q4 2009 – Q1 2016) and apply the same model to each of these periods.

In order to test the second hypothesis, I create a dummy variable for the crisis period (=1 for quarters Q3 2007 to Q3 2009, 0 otherwise). Interactions with the relationship banking variable are created (*relbank*dcrisis*) to examine the differences of the effect of relationship banking in the crisis and non-crisis periods.

This leads to the second model:

$$margin_{i,t} = \alpha + \beta_1 \cdot relbank_{i,t-1} \cdot dcrisis + \beta_2 \cdot capstruc_{i,t-1} + \beta_3 \cdot gdpgrowth_t + \beta_4 \cdot inflation_t + \beta_5 \cdot yield3month_t + \beta_6 \cdot sd3month_t + \beta_7 \cdot credrisk_{i,t-1} + \beta_8 \cdot opex_{i,t-1} + \beta_9 \cdot c5_t + \beta_{10} \cdot implint_{i,t-1} + \beta_{11} \cdot oppcost_{i,t-1} + \beta_{12} \cdot riskexp_{i,t-1} + \beta_{13} \cdot maneff_{i,t-1} + \beta_{14} \cdot scale_{i,t-1} + \pi_i + \sigma_t + \varepsilon_{i,t-1} \quad (2)$$

The dependent variable, the net interest margin (*margin*), is calculated by dividing the net interest income by the average assets or (interest income – interest expense)/average assets (Maudos & De Guevara, 2004; van Ewijk & Arnold, 2014). The bank-specific independent variables are lagged by one period (van Ewijk & Arnold, 2014). As a robustness check I performed the regression with different lagged and unlagged periods and variables lagged by one period showed the best result. I use a pooled OLS regression because not all banks have the same number of observations, so the panel data are not balanced. Also, as I see the banks as comparable with each other, I choose a method where both the within and between variation are included. I include cross-section fixed effects and use state-clustered standard errors to account for serial correlation. As the states in the U.S. have a certain amount of autonomy I expect differences between them, for example due to different regulations regarding the financial sector. I do not foresee problems regarding omitted variable bias as I believe that the most important factors are accounted for. Possible differences regarding the behaviour of people in different regions is largely addressed by including state-clustered standard errors. Also reverse causality does not pose a large problem in this model. Although is it possible that as a result of a low or high NIM a bank decides to change the share of its core deposits or reduces the number of branches to save costs, this effect of the net interest margin on the independent variables is expected to be minimal. In addition, the independent variables are lagged by one period which weakens a potential effect of the net interest margin on the independent variables.

2.2 Main variables relationship banking

As I use the model of Van Ewijk and Arnold (2014) I will only elaborate on the most important variables and changes I made to their model. I will use four variables to account for the relationship-orientated

business model: an asset-based ratio, a liabilities-based measure, a ratio based on the income statement, and a measure of local presence. These measures together represent relationship banking activities versus transaction banking activities. In other words, if these ratios are higher for one bank, this indicates that this bank has more relationship banking activities versus transaction banking activities compared to a bank which has lower ratios. Banks are thus not necessarily full relationship banks when they score high on one of the indicators, but if all or almost all indicators are high compared to other banks this bank has relatively more relationship banking activities.

Relationship banking has an advantage for lending where there is need for soft information and loans are not easily securitized. Loans that typically fulfill these conditions are commercial, industrial and farm loans assets (Goldberg & White, 1998; Peek & Rosengren, 1995; van Ewijk & Arnold, 2014). As the first measure of relationship banking activity, I therefor take the amount of commercial and industrial loans plus farm loans divided by total assets (*corploass*).

Core deposits, in the form of retail deposits, to total liabilities (*depliab*) is the liabilities-base used as an indicator for relationship banking (van Ewijk & Arnold, 2014). Banks that are funded more with these type of deposits relative to other types of funding are better at applying loan rate smoothing in response to exogenous credit shocks (Berlin & Mester, 1999). The third measure of relationship banking is a ratio based on the income statement as follows: interest income divided by total income (*intincrel*). A higher share of interest income is associated with more traditional, relationship-based, banking activities where relatively more non-interest income is related to non-traditional activities such as investment banking, trading and securitization (DeYoung, 2007; van Ewijk & Arnold, 2014). The last variable representing relationship banking activities is a measure of local presence; a larger share of domestic offices is associated with a stronger branch network, which in turn is a feature of the relationship-banking model (van Ewijk & Arnold, 2014). The variable is constructed by taking the natural logarithm of the number of domestic offices by total loan volume (*branchnet*).

Opposed to some of the regressions in the Van Ewijk and Arnold (2014) paper I do not use a measure based on the size of a bank's assets. I do not think this measure adds enough to the concept of relationship banking and is rather a rough measure. A significant, positive relationship is expected between these four variables and a bank's net interest margin. As this research investigates the effects of relationship banking activities, it is not sufficient for one measure to have a positive and significant coefficient, but preferably three or all four. I follow previous research and use factor loadings for robustness purposes to draw conclusions about the concept of relationship banking (van Ewijk & Arnold, 2014). In order to use a factor

analysis, I construct two factors that account for the relationship banking models, based on the four different relationship banking variables (Diamantopoulos, Riefler, & Roth, 2008; van Ewijk & Arnold, 2014). The size of the coefficients of these factors is harder to interpret, but the sign and significance can contribute to the robustness of my findings.

Table 1. Independent variables representing relationship banking activities

Variable	Construction / description	Expected sign
depliab	Core deposits / Total liabilities	+
corploass	Industrial, commercial and farm loans / Total assets	+
intincrel	Interest income / Total income	+
branchnet	Log(Number of domestic offices / Total loan volume)	+

2.3 Crisis variable

A chronology of crisis events suggests that widespread challenges in the banking sector first emerged at the end of July 2007 (Flannery et al., 2013). I follow Flannery *et al.* (2013) and define the crisis period as Q3 2007 – Q3 2009. Hence, I create the variable *dcrisis* which contains value 1 for the quarters Q3 2007 through Q3 2009, and 0 otherwise. The reference period consists of both the pre-crisis and post-crisis period (Q4 1992 – Q2 2007 and Q4 2009 – Q1 2016).

Some research only focusses on the peak of the financial crisis, after the failure of Lehman Brothers in September 2008 or take that event as the start of the crisis (Chodorow-Reich, 2014). In order to make the results more robust, I perform two additional regression analyses. First, I follow Ivashina and Scharfstein (2010) and take only the fourth quarter of 2008 as the crisis period, here the variable *dcrisispeak* takes the value 1 for the period Q4 2008, and 0 for all other periods. Second in accordance with Chodorow-Reich (2014), I define the crisis period as the three quarters after the Lehman Brothers default. Here, the crisis variable (*dcrisis2*) takes the value 1 for the quarters Q4 2008 to Q2 2009, and 0 otherwise.

Table 2. Crisis variables and interactions with relationship variables

Variable	Construction / description	Expected sign
dcrisis	Dummy for the period Q3 2007 – Q3 2009	+
dcrisis2	Dummy for the period Q4 2008 – Q2 2009	+
dcrisispeak	Dummy for the quarter Q4 2008	+

*depliab*dcrisis*	Interaction with crisis dummy	-
*corploass*dcrisis*	Interaction with crisis dummy	-
*intincrel*dcrisis*	Interaction with crisis dummy	-
*branchnet*dcrisis*	Interaction with crisis dummy	-

2.4 Control variables

Because I use the model of Van Ewijk and Arnold (2014) as my first model and all control variables are also relevant for the second model in this paper, I will use the same set-up without discussing all these variables in great detail. These control variables are based on the theory and empirical papers on the net interest margin discussed in the previous chapter. Table 3 shows all the control variables, the way they are constructed and whether a positive or negative sign of the coefficient is expected.

Table 3. Control variables

Variable	Construction / description	Expected sign
capstruc	Core capital / Total assets	+
gdpgrowth	GDP growth per quarter	+
Inflation	Inflation per quarter	+ / -
yield3month	The interest rate level of 3-month U.S. Treasury bills	+ / -
sd3month	Interest rate volatility: quarterly standard deviation of daily interest rates	+ / -
credrisk	Net loan-charge offs / Total assets	+
opex	Operating expenses / Total assets	+
c5	Assets top 5 banks / Assets of all banks	+ / -
implint	Implicit interest payments: (operating expenses – non-interest income) / Total assets	+
oppcost	Opportunity costs: non-interest bearing reserves / Total assets	+ / -
riskexp	Risk exposure: Securities / Total assets	-
maneff	Managerial efficiency: Operating costs / Gross income	-
scale	Log (Total loan amount)	+ / -

2.5 Descriptive statistics

Figures 1 to 3 and Tables 4 to 7 provide descriptive statistics for the dataset. Figure 1 shows the average net interest margins for banks for the period Q4 1992 – Q1 2016. Overall a downward trend is observed starting at around 4.1 in 1992 and ending at just below 3.4 in 2016. In the crisis however, the net interest margin increased, especially around Q4 2008 – Q1 2009. After the crisis the NIM continued to decline. The average of the net interest margin is calculated by taking the NIM for each bank and dividing it by the total number of banks. It is also interesting to look at the weighted average of the net interest margin to see if this confirms the results found in the previous figure. I create Figure 2 by weighting the NIM for each bank by its average assets. Again we see a downward trend by looking at the whole period, but here a much steeper increase for the crisis period is observable. This sharp increase starts at the first quarter of 2008 and ends around Q2 2009. Where the increase in the average NIM in the unweighted graph was about 0.1, here it shows an increase of circa 0.5. The most obvious explanation in my opinion is that on average the smaller banks saw a smaller increase in the net interest margin than the larger ones, causing the weighted NIM to show a sharper increase. Concluding, the average NIM increased in the period of the crisis by which it goes against the general decreasing trend of the whole period, this strengthens my motivation to better understand the characteristics of this period. Next, I look at the development of total bank assets in the U.S in Figure 3. Also here a clearly different trend is observed in the time of the crisis. Total assets increase in almost all quarters except in the crisis, where the trend is interrupted and a decline in assets is observed.

Table 4 displays the descriptive statistics. The dataset consists of 759,855 observations for the whole period, Q4 1992 to Q1 2016. Because I use lagged periods for most variables, the results in the next chapter are conducted with slightly less observations due to missing values generated by creating the these lagged variables. The average net interest margin is 3.82 with a standard deviation of 0.83. As seen in the table the net interest margin can take a negative value. Although it is not common that the interest expenses are larger than the interest income, I do believe this can be the case in certain circumstances and thus have those observations in the dataset. Inspecting the explanatory variables, interesting is to see the ratio of commercial and industrial loans plus farm loans to total assets to have a large range (from 0.00 to 97.52), which is attributable to the large variety of (type of) banks. The same holds for the ratio of retail deposits to total liabilities and ratio of interest income to total income. On average, over 80% of a banks liabilities comprise of retail deposits, making this by far the largest source of funding. Also interesting to highlight is that interest income account for almost 90% of all income, as shown by the ratio

interest income/total income. Of all assets, loans make up the largest part, about 61%. The minimum value column shows further that GDP growth per quarter, net loan-charge offs to total assets and the measure for implicit interest payments can take negative values. Here, the same holds as for the negative net interest margins, these variables can take negative values although is it is uncommon.

Figure 1. Net interest margin development

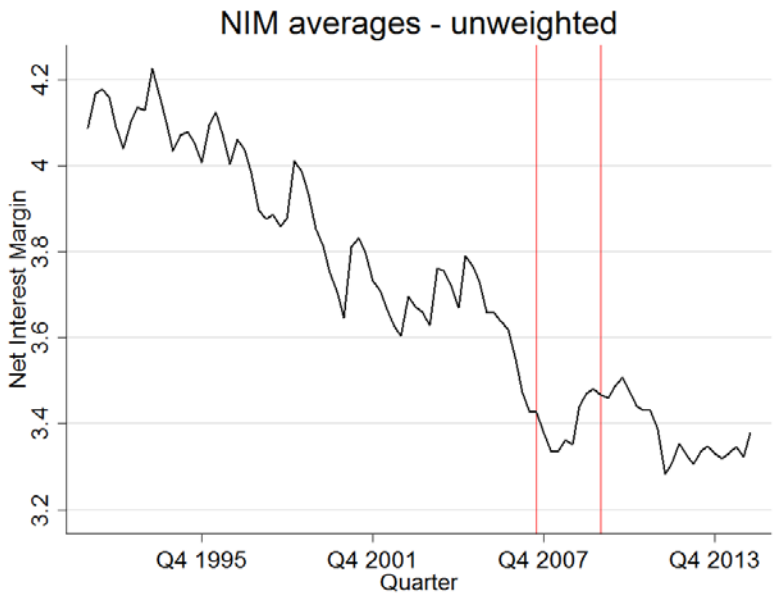

Figure 2. Weighted net interest margin development

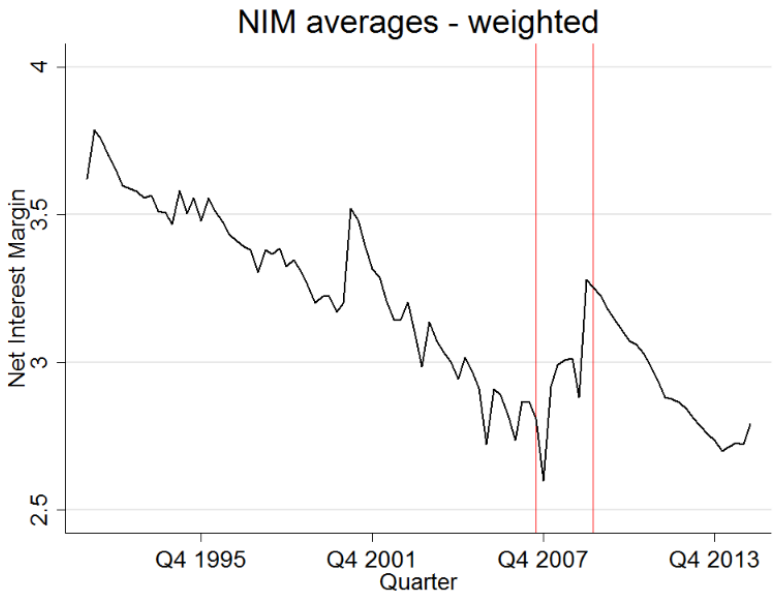

Figure 3. Total asset development

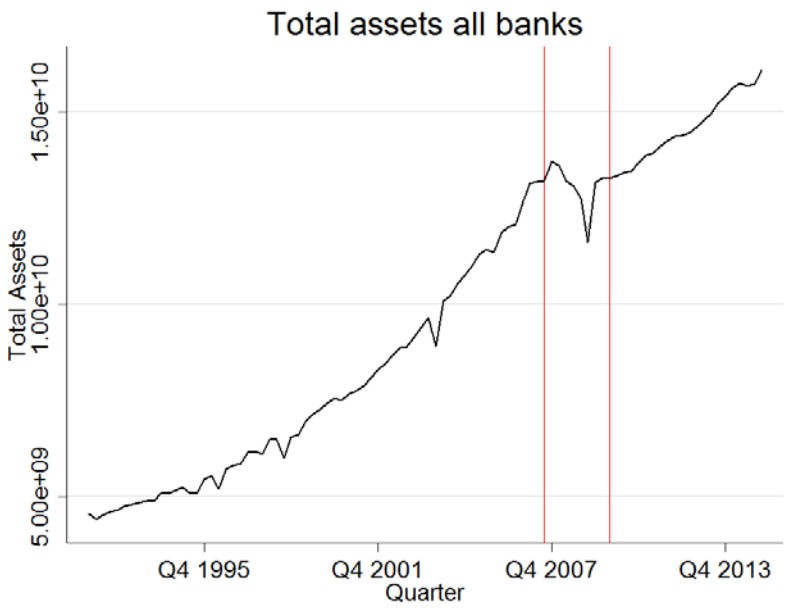

Table 4. Descriptive statistics

	mean	sd	min	max	count
Net interest margin	3.82	0.83	-3.42	10.00	759855
Commercial and industrial loans plus farm loans/Total assets	14.26	10.82	0.00	97.52	759855
Retail (core) deposits/Total liabilities	82.28	12.20	0.00	100.00	759855
Interest income/Total income	88.73	8.83	0.10	100.00	759855
Log(Number of domestic offices/Total loan volume)	-9.97	0.87	-18.92	-2.30	759855
Core capital/Total assets	10.18	3.66	0.01	98.02	759855
GDP growth per quarter	0.65	0.60	-2.11	1.89	759855
Inflation per quarter	1.83	0.44	0.97	2.82	759855
Interest on 3-month U.S. Treasury bills	2.93	2.15	0.01	6.18	759855
Average standard deviation of 3-month bills	0.06	0.08	0.01	0.52	759855
Net loan-charge offs/Total assets	0.12	0.35	-7.24	26.19	759855
Total loans/Total assets	61.49	15.62	0.02	100.00	759855
Loan loss allowance/Total assets	0.93	0.53	0.00	27.72	759855
Operating expenses/Total assets	5.42	1.80	0.01	50.00	759855
Assets top 5 banks/Assets of all banks	28.39	11.19	12.57	44.90	759855
Assets top 3 banks/Assets of all banks	21.19	9.03	9.05	37.01	759855
(Operating expenses minus non-interest income)/Total assets	4.57	1.48	-78.23	22.04	759855
Non-interest bearing reserves/Total assets	3.56	2.47	0.00	92.17	759855
Operating costs/Gross income	78.26	12.73	30.00	200.00	759855
Securities/Total loan amount	0.55	0.65	0.00	10.00	759855
Log(Total loan amount)	11.11	1.45	2.30	20.64	759855

Table 5. Mean statistics per period

	Whole period	Pre-crisis Q4 1992 – Q2 2007	Crisis Q3 2007 – Q3 2009	Post-crisis Q4 2009 – Q1 2016	Peak of crisis Q4 2008
Net interest margin	3.82	4.00	3.49	3.39	3.44
Commercial and industrial loans plus farm loans/Total assets	14.26	14.86	14.21	12.34	14.36
Retail (core) deposits/Total liabilities	82.28	81.95	73.48	86.68	73.06
Interest income/Total income	88.73	89.56	89.17	85.89	89.24
Log(Number of domestic offices/Total loan volume)	-9.97	-9.84	-10.25	-10.30	-10.28
Core capital/Total assets	10.18	10.04	10.48	10.53	10.31
GDP growth per quarter	0.65	0.80	-0.32	0.53	-2.11
Inflation	1.83	1.93	1.77	1.51	1.64
Net loan-charge offs/Total assets	0.12	0.09	0.19	0.18	0.36
Total loans/Total assets	61.49	60.74	67.08	61.77	67.94
Loan loss allowance/Total assets	0.93	0.90	0.95	1.03	0.99
Operating expenses/Total assets	5.42	5.94	5.33	3.78	5.27
Assets top 5 banks/Assets of all banks	28.39	22.25	39.92	43.70	40.98
Assets top 3 banks/Assets of all banks	21.19	16.28	31.40	33.03	32.39
(Operating expenses minus non-interest income)/Total assets	4.57	5.07	4.56	2.98	4.52
Non-interest bearing reserves/Total assets	3.56	3.90	2.93	2.72	3.07
Operating costs/Gross income	78.26	78.09	82.50	77.22	83.32
Securities/Total loan amount	0.55	0.59	0.41	0.50	0.40
Log(Total loan amount)	11.11	10.89	11.54	11.66	11.57
Observations	759855	531115	63224	165516	6962

Table 5 shows the averages of the variables per period of interest: the whole period, the pre-crisis period, the crisis, after the crisis and the peak of the crisis. Although the net interest margin in the crisis is lower compared to the net interest margin of the whole period, I still expect the crisis to have a positive effect on the net interest margin because, as shown in Figures 1 and 2, the values for the NIM found in this table can be explained by the overall downward trend visible in the graphs. The ratio of core deposits to total liabilities is lower in the crisis and in the peak of the crisis than in the periods before and after the crisis, which may well be an indicator for more risky banks on average during these periods. The operating costs/gross income ratio on the other hand is higher in the crisis than in the periods before and after, indicating that the managerial efficiency in the crisis was lower than in the other periods.

Table 6. Factor analysis

	factor 1	*factor 2*	Uniqueness
corploass	-0.1375	0.8123	0.3427
depliab	0.8474	-0.0918	0.2884
intincrel	0.1807	0.6486	0.5242
branchnet	0.8265	0.0429	0.3083
N	759,855		
χ^2	170,000		
p-value	0.0000		

Table 6 shows the rotated factor loadings of the factors that will be used in the analysis. I used the principal-component factors method with oblique promax rotation in order to construct the factors. The first factor loads mostly on the ratio of retail deposits to total liabilities (*depliab*) and the logarithm of domestic offices divided by loan volume (*branchnet*). The second common factor loads for the largest part on the asset-based measure of relationship banking (corploass) and the relative interest income (*intincrel*). I will refer to these two factors with *factor1* and *factor2*.

In the correlation matrix (Table 7) the multi-collinearity between all the variables is investigated. Most of the relationship banking variables are positively correlated, as expected. The proxy for transaction size (*scale*) is quite highly correlated with *branchnet* which could cause a problem. Also Van Ewijk and Arnold (2014) find this variable to be often insignificant. Hence, I remove *scale* from the model. Further no big problems due to the multi-collinearity between the variables is found. Although there is some correlation between the variable for the market structure (*c5*) and the interest rate on U.S. bonds (*yield3month*) and between *implint* and *yield3month*, *opex* and *c5*, I do not expect these to bias my results. In the next chapter the results will be presented and discussed.

Table 7. Correlation matrix

	corploass	*depliab*	*intincrel*	*branchnet*	*factor1*	*factor2*	*capstruc*	*gdpgrowth*	*inflation*	*yield3month*	*sd3month*	*credrisk*	*opex*	*c5*	*implint*	*oppcost*	*maneff*	*riskexp*	*scale*
corploass	1.00																		
depliab	-0.03	1.00																	
intincrel	0.09	0.08	1.00																
branchnet	0.04	0.43	0.11	1.00															
factor1	-0.06	0.84	0.24	0.83	1.00														
factor2	0.80	-0.01	0.67	0.12	0.10	1.00													
capstruc	-0.01	0.04	0.06	0.09	0.08	0.03	1.00												
gdpgrowth	0.03	0.11	0.03	0.11	0.13	0.04	-0.02	1.00											
inflation	0.01	0.04	0.06	0.14	0.11	0.05	-0.05	-0.01	1.00										
yield3month	0.09	-0.03	0.19	0.22	0.13	0.19	-0.03	0.34	0.33	1.00									
sd3month	0.04	-0.13	0.09	0.04	-0.04	0.10	0.00	-0.20	0.13	0.27	1.00								
credrisk	0.00	-0.10	-0.10	-0.13	-0.14	-0.06	-0.08	-0.02	-0.06	-0.12	-0.02	1.00							
opex	0.05	-0.12	-0.30	0.16	-0.02	-0.12	-0.09	0.12	0.21	0.52	0.23	0.13	1.00						
c5	-0.08	-0.10	-0.16	-0.31	-0.25	-0.16	0.08	-0.37	-0.43	-0.74	-0.15	0.09	-0.51	1.00					
implint	0.11	-0.02	0.38	0.27	0.18	0.32	-0.15	0.13	0.24	0.63	0.29	0.04	0.61	-0.60	1.00				
oppcost	0.09	0.16	-0.16	0.29	0.23	-0.02	-0.02	0.10	0.11	0.17	0.03	-0.01	0.20	-0.25	0.10	1.00			
maneff	-0.08	-0.02	0.03	0.19	0.11	-0.03	-0.06	-0.06	0.00	0.03	0.07	0.12	0.37	-0.01	0.48	0.06	1.00		
riskexp	-0.20	0.11	0.02	0.33	0.27	-0.12	0.18	0.06	0.09	0.07	-0.02	-0.10	-0.11	-0.13	-0.12	0.05	-0.03	1.00	
scale	-0.14	-0.36	-0.26	-0.69	-0.63	-0.27	-0.24	-0.11	-0.14	-0.21	-0.04	0.12	-0.15	0.29	-0.29	-0.24	-0.18	-0.32	1.00

4. Results and discussion

In this chapter I will present the results of this research and compare the overall outcomes to previous empirical findings and the predictions of the relationship banking theories. The first regression table, Table 8, contains the relationship banking variables and shows the effect in four different periods. Table 9 shows the results of the second model, where the interaction effects are included to assess the effect of relationship banking in the crisis compared to the other periods. Table 10 shows the same model as the previous one, but with different crisis periods in order to test the robustness of the results in Table 9.

1. Four different periods

Table 8 shows the effect of relationship banking on the net interest margin for different periods relative to the crisis. This way the effect of the variables in various times can be examined to get an idea of the differences and similarities. I consider the model to have sufficient explanatory power based on the adjusted R-squared, which lies between 0.7 and 0.9 for every regression in the table. Also, almost all variables are statistically significant at a 0.1% level.

Column 1 shows the effect of the four relationship banking variables on the net interest margin, as well as the effects of the control variables, for the whole dataset; the period Q4 1992 through Q1 2016. All four explanatory variables are significant (at the 0.1% level) and positive, as expected, resulting in the conclusion that relationship banking has on average a positive effect on the net interest margin for the whole period. The second column contains the outcome of the regression of the factors variables on the net interest margin. Again, a positive and significant effect is observed for the explanatory variables. This, together with the first regression, confirms the results of the effect of relationship banking on the net interest margin found by Van Ewijk & Arnold (2014). The third and fourth column show the results of the same regression with only observations in the pre-crisis period (Q2 1992 – Q2 2007). The same as for the whole period is observed here; all explanatory variables are statistically significant and have a positive effect on the net interest margin. The columns (5) and (6) show the results for the crisis period (Q3 2007 – Q3 2009) and columns (7) and (8) for the post-crisis period (Q4 2009 – Q1 2010). Again, almost all explanatory variables are statistically significant at the 0.1% level and have a positive effect on the net interest margin. Whether the effect of the relationship banking variables is less strong in the crisis than in the other periods is unclear: the coefficients of *depliab*, *corploass* and *factor1* are smaller in the crisis

Table 8. The impact of relationship banking in different periods

Dependent variable: $margin_{i,t}$	(1) Whole period	(2) Whole period	(3) Pre-crisis	(4) Pre-crisis	(5) Crisis	(6) Crisis	(7) Post-crisis	(8) Post-crisis
intercept	4.962***	4.905***	5.111***	5.142***	1.337	2.896***	2.240***	2.829***
	(0.177)	(0.057)	(0.207)	(0.075)	(0.688)	(0.458)	(0.412)	(0.448)
$depliab_{i,t-1}$	0.009***		0.010***		0.003***		0.007***	
	(0.001)		(0.001)		(0.001)		(0.001)	
$corploass_{i,t-1}$	0.008***		0.007***		0.006***		0.009***	
	(0.001)		(0.001)		(0.001)		(0.001)	
$intincrel_{i,t-1}$	0.007***		0.005***		0.017***		0.010***	
	(0.001)		(0.001)		(0.003)		(0.001)	
$branchnet_{i,t-1}$	0.151***		0.137***		0.037		0.082*	
	(0.014)		(0.016)		(0.036)		(0.031)	
$factor1_{i,t-1}$		0.203***		0.214***		0.085***		0.145***
		(0.011)		(0.010)		(0.017)		(0.012)
$factor2_{i,t-1}$		0.112***		0.098***		0.150***		0.127***
		(0.009)		(0.008)		(0.022)		(0.011)
$capstruc_{i,t-1}$	0.033***	0.034***	0.040***	0.040***	0.040***	0.038***	0.030***	0.030***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.003)	(0.003)	(0.003)	(0.003)
gdpgrowth	0.028***	0.029***	0.025***	0.026***	0.033***	0.033***	-0.011*	-0.011*
	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.005)	(0.005)
inflation	0.134***	0.134***	0.166***	0.167***	-0.093***	-0.094***	0.022**	0.018*
	(0.006)	(0.006)	(0.007)	(0.007)	(0.013)	(0.013)	(0.008)	(0.007)
yield3month	-0.011*	-0.011**	-0.002	-0.003	0.019	0.018	0.204***	0.223***
	(0.004)	(0.004)	(0.004)	(0.003)	(0.010)	(0.010)	(0.045)	(0.035)
sd3month	-0.629***	-0.629***	-0.583***	-0.582***	0.100***	0.099***	-1.517***	-1.513***
	(0.017)	(0.018)	(0.020)	(0.020)	(0.011)	(0.011)	(0.167)	(0.166)
$credrisk_{i,t-1}$	0.033**	0.032**	0.039**	0.040**	-0.075***	-0.077***	-0.037***	-0.038***
	(0.012)	(0.012)	(0.012)	(0.012)	(0.017)	(0.018)	(0.006)	(0.006)
$opex_{i,t-1}$	0.091***	0.109***	0.075***	0.095***	0.103**	0.080**	0.128***	0.133***
	(0.009)	(0.009)	(0.008)	(0.007)	(0.032)	(0.025)	(0.018)	(0.018)
c5	-0.001	-0.001*	-0.001	-0.001	0.049***	0.048***	0.026*	0.030**
	(0.001)	(0.001)	(0.001)	(0.001)	(0.010)	(0.010)	(0.012)	(0.010)
$implint_{i,t-1}$	0.180***	0.156***	0.181***	0.154***	0.148***	0.177***	0.226***	0.218***
	(0.012)	(0.012)	(0.014)	(0.011)	(0.038)	(0.032)	(0.017)	(0.014)
$oppcost_{i,t-1}$	0.000	0.001	-0.001	0.000	-0.009***	-0.009***	-0.010***	-0.010***
	(0.002)	(0.002)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
$riskexp_{i,t-1}$	-0.246***	-0.252***	-0.235***	-0.245***	-0.108***	-0.100***	-0.228***	-0.238***
	(0.019)	(0.019)	(0.022)	(0.020)	(0.021)	(0.020)	(0.031)	(0.027)
$maneff_{i,t-1}$	-0.036***	-0.035***	-0.039***	-0.039***	-0.033***	-0.033***	-0.026***	-0.027***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Bank fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	738513	738513	513832	513832	62265	62265	162416	162416
adj. R^2	0.777	0.777	0.789	0.788	0.862	0.862	0.869	0.869

State-clustered standard errors in parentheses
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 9. The impact of relationship banking in the crisis compared to other periods

Dependent variable: $margin_{i,t}$	(1) Whole period	(2) Whole period
intercept	4.888***	4.879***
	(0.180)	(0.058)
dcrisis	0.696***	-0.022
	(0.143)	(0.014)
$depliab_{i,t-1}$	0.008***	
	(0.001)	
$dcrisis*depliab_{i,t-1}$	0.002***	
	(0.001)	
$corploass_{i,t-1}$	0.008***	
	(0.001)	
$dcrisis*corploass_{i,t-1}$	0.002**	
	(0.001)	
$intincrel_{i,t-1}$	0.007***	
	(0.001)	
$dcrisis*intincrel_{i,t-1}$	-0.002*	
	(0.001)	
$branchnet_{i,t-1}$	0.143***	
	(0.014)	
$dcrisis*branchnet_{i,t-1}$	0.076***	
	(0.010)	
$factor1_{i,t-1}$		0.190***
		(0.010)
$dcrisis*factor1_{i,t-1}$		0.079***
		(0.010)
$factor2_{i,t-1}$		0.112***
		(0.009)
$dcrisis*factor2_{i,t-1}$		0.008
		(0.008)
$capstruc_{i,t-1}$	0.034***	0.034***
	(0.001)	(0.001)
gdpgrowth	0.020***	0.020***
	(0.002)	(0.002)
inflation	0.136***	0.135***
	(0.006)	(0.006)
yield3month	-0.013**	-0.013**
	(0.004)	(0.004)
sd3month	-0.583***	-0.582***
	(0.014)	(0.014)
$credrisk_{i,t-1}$	0.031*	0.030*
	(0.012)	(0.012)
$opex_{i,t-1}$	0.093***	0.110***
	(0.009)	(0.009)
c5	-0.001	-0.001
	(0.001)	(0.001)
$implint_{i,t-1}$	0.183***	0.161***
	(0.012)	(0.012)
$oppcost_{i,t-1}$	0.000	0.001
	(0.002)	(0.002)
$riskexp_{i,t-1}$	-0.243***	-0.247***
	(0.019)	(0.018)
$maneff_{i,t-1}$	-0.036***	-0.035***
	(0.001)	(0.001)
Bank fixed effects	Yes	Yes
N	738513	738513
adj. R^2	0.778	0.777

Standard errors in parentheses
State-clustered standard errors in parentheses
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

period than in the pre-crisis period and the post-crisis period, however, the coefficient of *intincrel* and *factor2* are larger in the regression for the crisis period than in the other periods.

The estimates in Table 8 show that relationship banking has a positive effect on the net interest margin of banks over both the whole period and the three separated periods (pre-crisis, crisis and post-crisis), compared to transaction banking. This confirms the first hypothesis and is in line with other literature that state that relationship banks are able to charge higher margins than transaction-oriented banks (DeYoung & Rice, 2004; DeYoung, 2007; DeYoung, 2010; Elyasiani & Goldberg, 2004; Rajan, 1992). The positive effect found for the whole period (Q4 1992 – Q1 2016) confirms the results of Van Ewijk and Arnold (2014), and thus strengthens this notion in the existing empirical literature that relationship banking has a positive effect on the net interest margin. Whether the crisis leads to a stronger or weaker effect of relationship banking cannot be concluded based on these result. For this, the regressions in Table 9 are created.

2. The impact of the crisis

Following the same set-up as the first table, the first column of Table 9 contains the four relationship banking variables and the second column the two factor variables. Interactions between those variables and the dummy for the crisis period (*dcrisis*) have been included to capture the effect of the crisis. I consider both models to have a good fit based on the adjusted R-squared of 0.78. Again, almost all variables are statistically significant at the 0.1% level. The interaction between the crisis and the relative interest income (*dcrisis*intincrel*) is significant only at the 5% level, *corploass* at 1%, and the interaction between the crisis and the second factor variable is not significant at the 5% level.

In the crisis the net interest margin is on average 69.6 basis points higher than in other periods (pre-crisis and post-crisis), ceteris paribus, according to the results in the first column. This is in line with the trend in Figures 1 and 2 were an increase of the net interest margin in the crisis period is observed. If the core deposits-to-total liabilities ratio increases with 10%, this leads (the next quarter) to an increase of the net interest margin by 8 basis points (*depliab* = 0.008), ceteris paribus. In the crisis this leads to an additional 2 basis point increase if the core deposits-to-total liabilities ratio increases with 10% (see *dcrisis*depliab*). An increase of the commercial, industrial and farm loans-to-total assets by 10% also leads to an increase of the net interest margin with 8 basis points. In the crisis this leads to an additional 2 basis points increase if the commercial, industrial and farm loans-to-total assets increases by 10%. If the ratio of interest

income-to-total income increases by 10%, the net interest margin increase by 7 basis points. This effect is reduced by 2 basis points in the crisis period compared to other periods. If in the crisis this ratio increases by 10%, the net interest margin increases by 5 basis points on average. An 10% increase in the ratio of domestic offices divided by total loan volume increases the net interest margin by 1.43 basis points. This effect is even stronger in the crisis, where an additional 0.76 basis points increase on average is observed due to an increase of the ratio of domestic offices divided by total loan volume by 10%.

Concluding, three of the four interactions (*dcrisis*depliab*, *dcrisis*corploass*, *dcrisis*branchnet*) in the first column have a positive effect on the net interest margin. In other words, in the crisis these three relationship banking variables have a positive effect on the net interest margin compared to transaction banking, compared to the other periods. Only the interaction *dcrisis*intincrel* has a small negative effect on the net interest margin. The second column shows one interaction (*dcrisis*factor1*) with a positive effect on the net interest margin, the second (*dcrisis*factor2*) does not show a significant effect. Table 10 shows the results for the same model in order to strengthen the robustness of the results found in the prior table. The first two columns show the results for the peak of the crisis in Q4 2008 and the last two show the results for the crisis defined as the period Q4 2008 to Q2 2009. The coefficient estimates in these models are less strong but the interactions with the relationship banking variables that are statistically significant show a positive effect. Hence, these regressions support the results found in Table 9.

Based on the results of Table 9, I conclude that the positive effect of relationship banking compared to transaction-oriented banking is even stronger in the crisis period than in the other periods. Thus, I reject hypothesis 2 as I predicted the effect to be less strong in the crisis period. As mentioned in the theoretical background, I expected the (negative) effect of lower interest spreads of relationship banking in a crisis to have a negative effect on the net interest margin. The results however indicate the opposite. Because there existed no prior empirical research on this particular effect, the goal of this research was an exploratory one, and consider these results as very interesting. I therefor think it is valuable to know the cause of why relationship banking has a stronger positive effect in the crisis. Bolton *et al*. (2016) showed that relationship banks, by offering more favorable lending terms, have a lower interest spread in the crisis than transaction-oriented banks, but also suffer fewer defaults. Opposing to the deduction in the theoretical background, the results found in this study may indicate that the fewer defaults in a crisis of relationship banks compared to transaction banks have a stronger positive effect on the net interest margin than the negative effect of the lower interest spreads. This paper focusses on the effects on the profitability of banks in terms on the net interest margin, a next step in order to get a better understanding

of relationship banking in a crisis is to investigate this claim further. As a problem of the financial crisis was the strong decline in new lending (Ivashina & Scharfstein, 2010), these results that relationship banking activities might not only be good for borrowing firms (Bolton et al., 2016), but also for the net interest margin of the banks, may make relationship banking part of a solution of weathering a financial crisis better.

Comparing the outcome here to the different theories of relationship banking, the results of this study are most supportive of the third and fourth strand. The third strand emphasizes the ex-ante screening abilities of new loan applications of relationship banks (Agarwal & Hauswald, 2010; Puri et al., 2011) and a plausible prediction is lower default rates than transaction-oriented banks in bad times, which is congruent with my results. In addition, this theory predicts that relationship banks are able to charge higher lending rates in both good and bad times, which might explain the stronger positive effects found of relationship banking in the crisis. The fourth strand focusses on (soft) information acquisition over time and predicts lower default rates but also lower lending rates in economically bad times for relationship banks (Bolton et al., 2016). My results make a case for the lower default rates but question whether the lending rates in a crisis for relationship banks compared to transaction-oriented banks are higher or lower.

Concluding, the results found show that relationship banking activities have a stronger positive effect on the net interest margin of banks in a crisis. This leads to the suspicion that the default rates of relationship banks in economically bad times are lower. Whether lending rates of relationship banking are lower of higher in a crisis, is according to the results found in this study ambiguous. In the next chapter I will elaborate on the implications of these findings.

Table 10. Robustness check: taking different crisis periods

Dependent variable:	(1)	(2)	(3)	(4)
$margin_{i,t}$	Whole period	Whole period	Whole period	Whole period
intercept	5.348***	4.498***	4.948***	4.917***
	(0.246)	(0.079)	(0.150)	(0.056)
dcrisispeak	0.109	-0.105***		
	(0.191)	(0.011)		
*dcrisispeak*depliab*$_{i,t-1}$	0.002*			
	(0.001)			
*dcrisispeak*corploass*$_{i,t-1}$	-0.000			
	(0.001)			
*dcrisispeak*intincrel*$_{i,t-1}$	0.004*			
	(0.002)			
*dcrisispeak*branchnet*$_{i,t-1}$	0.073***			
	(0.013)			
*dcrisispeak*factor1*$_{i,t-1}$		0.079***		
		(0.012)		
*dcrisispeak*factor2*$_{i,t-1}$		0.022		
		(0.012)		
dcrisis2			0.856***	0.010
			(0.122)	(0.016)
*dcrisis2*depliab*$_{i,t-1}$			0.001	
			(0.001)	
*dcrisis2*corploass*$_{i,t-1}$			0.001*	
			(0.000)	
*dcrisis2*intincrel*$_{i,t-1}$			-0.000	
			(0.001)	
*dcrisis2*branchnet*$_{i,t-1}$			0.090***	
			(0.008)	
*dcrisis2*factor1*$_{i,t-1}$				0.072***
				(0.012)
*dcrisis2*factor2*$_{i,t-1}$				0.009
				(0.011)
depliab$_{i,t-1}$	0.009***		0.009***	
	(0.000)		(0.000)	
corploass$_{i,t-1}$	0.001**		0.008***	
	(0.000)		(0.000)	
intincrel$_{i,t-1}$	-0.009***		0.007***	
	(0.003)		(0.001)	
branchnet$_{i,t-1}$	0.089***		0.148***	
	(0.009)		(0.010)	
factor1$_{i,t-1}$		0.161***		0.200***
		(0.013)		(0.010)
factor2$_{i,t-1}$		-0.014		0.112***
		(0.020)		(0.009)
capstruc$_{i,t-1}$	0.026***	0.023***	0.033***	0.034***
	(0.002)	(0.002)	(0.001)	(0.001)
gdpgrowth	0.054***	0.057***	0.023***	0.023***
	(0.002)	(0.005)	(0.001)	(0.003)
inflation	0.180***	0.180***	0.131***	0.131***
	(0.004)	(0.008)	(0.003)	(0.007)
yield3month	-0.034***	-0.036***	-0.011***	-0.012**
	(0.002)	(0.005)	(0.001)	(0.004)
sd3month	-0.907***	-0.930***	-0.643***	-0.646***
	(0.022)	(0.035)	(0.011)	(0.025)
credrisk$_{i,t-1}$	0.157***	0.159***	0.033***	0.032**
	(0.014)	(0.032)	(0.007)	(0.012)
opex$_{i,t-1}$	0.098***	0.143***	0.091***	0.109***
	(0.021)	(0.016)	(0.010)	(0.009)
c5	0.007***	0.007***	-0.001**	-0.001*
	(0.001)	(0.001)	(0.000)	(0.001)
implint$_{i,t-1}$	0.354***	0.293***	0.180***	0.157***
	(0.033)	(0.023)	(0.012)	(0.012)
oppcost$_{i,t-1}$	0.038***	0.042***	0.000	0.001
	(0.003)	(0.005)	(0.001)	(0.002)
riskexp$_{i,t-1}$	-0.243***	-0.260***	-0.246***	-0.251***
	(0.010)	(0.023)	(0.009)	(0.018)
maneff$_{i,t-1}$	-0.044***	-0.044***	-0.036***	-0.035***
	(0.001)	(0.001)	(0.000)	(0.001)
Bank fixed effects	No	No	Yes	Yes
N	738513	738513	738513	738513
adj. R^2	0.510	0.504	0.777	0.777

State-clustered standard errors in parentheses
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

5. Conclusion

In this paper, I analyze the impact of a bank's business model on the net interest margin for a pre-crisis, a crisis, and a post-crisis period. In addition, I look at the effect of the 2007 – 2009 crisis on the relationship between the business model of a bank and profitability in terms of the net interest margin. The goal is to see if this positive effect is stronger or weaker in the crisis, with a suspicion of this effect to be weaker to the loan rate smoothing applied by relationship banks. I use quarterly bank-level data of U.S. banks between 1992 and 2016, obtained from the FDIC database. A bank's business model is represented by either relationship banking activities or transaction banking activities.

I show that more relationship banking leads to a higher net interest margin in all three periods; the pre-crisis period, the crisis period, and the post-crisis period. This confirms previous research on the first two periods and adds the insight of the post-crisis period, according to my expectations. The second finding of this paper shows that in the crisis the positive effect of relationship banking on the net interest margin is even higher compared to the other periods. This is contradictory to my expectations based on previous research that showed that relationship banks offer lower interest rates in a crisis to help their clients through this economically bad period. This raises the question how much loan rate smoothing is applied by relationship banks and what other effects exist. A possible explanation could be found in research indicating that relationship banks might have lower default rate in the crisis compared to transaction-oriented banks. Concluding, my results show that relationship-banking activities have a positive effect in all researched periods and this positive effect is even stronger in the financial crisis of 2007 – 2009.

A limitation of this study is that the data only covers one country, the U.S. This might make the results difficult to generalize, in particular for countries that have a different banking environment like developing countries. A second limitation is that this study did not focus on the possibly lower default rates of relationship banks compared to transaction-oriented banks in the crisis. This effect could explain the stronger positive effect of relationship banking activities in the crisis.

For policymakers and supervisory bodies these results could indicate that relationship banking activities lead to more stable banks in the crisis, as bank stability requires banking profitability to be sufficient (Demirgüç-Kunt & Huizinga, 1999). Thus, understanding the determinants of interest margins is thus a requirement in order to formulate effective banking policies. A solid and safe financial system is of course important to consumers, making this research indirectly relevant to that group as well. Because banks

face challenging times and risk management is an important issue, banks themselves could use these results to reconsider their current mix of relationship banking and transaction-oriented banking activities in order to better weather a financial crisis. These aspects for policymakers, supervisory bodies and banks are also of interest to researchers. This research adds to the understanding of bank business models on the profitability of banks in terms of the net interest margin and the influence of the crisis on this relationship by strengthening previous research and gaining a deeper understanding of bank profits and stability.

The main recommendation for further research is to investigate the role of default rates in a crisis, in particular by looking at the effects of a bank's business model on this. This way the impact of different bank activities on the profitability and stability during the crisis can be further explained. Another recommendation for further research is to collect data on different countries, for example starting with Europe, and see if the results hold. This way the results of the research can be better generalized. Lastly, I recommend further research to focus on possible differences between countries, which may be very interesting and can lead to more and new questions and insights about the effects of relationship banking in different time periods.

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