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The Swedish Banking Market

Competitive conditions undergoing change

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Abstract

This paper examines competitive conditions on the Swedish banking market over the years 2006-2016, a time period where the number of Swedish banks has decreased at the same time as concentration has decreased and a large number of structural changes have taken place as for example the establishment of firms offering financial innovations and services commonly supplied by only banks. Competition is measured using the Panzar-Rosse methodology, which analyses the effect of changes in input factor prices on a reduced form of bank revenue. The sample is divided in two subsamples; commercial banks and saving bank and analysed in two time periods, early and late years, in order to distinguish differences in competitive behaviour between banks with different owner forms and to observe the evolution of the competitive conditions during this time period. For all time periods the market is found to be in disequilibrium which complicates the interpretation of the estimated level of competition, although we find indications of stabilization during the second half of the time period.

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1. Introduction

The banking market is of crucial importance to the economic system of any country. It facilitates payments, savings and investments, by lowering the transaction costs of these activities, which is important to the whole economy. This means that in order to enable the economic system to work efficiently, so that economic resources are allocated as to benefit stakeholders the most, the functionality of the banking market is decisive (Finansinspektionen, 2017). By looking at the competitive conditions on a market, it is possible to get an indication of its functionality. For example, if the firms on the market are able to charge a higher price for a good than its production cost, they will potentially earn a profit and consumers will face higher transaction costs than would have been the case, had the price been equivalent to the production cost of the good. The existence of so called "mark-up pricing" increases transaction costs within all other markets, which are dependent on it, since the cost of savings and investments will increase, leading to a decreased demand for savings and investments. Consequently, economic activity and growth are dependent on the transaction costs induced by the competitive conditions on the financial market and hence, the subject is of high interest to study. In Sweden, the conditions of the banking market have undergone considerable changes during recent years, making the subject important to study and to analyse what effects the changes have had on competition. This paper evaluates the competitive conditions on the Swedish banking market during the years 2006-2016, using balanced data from all Swedish banks on the market during these years. In order to analyse competition, the so-called Panzar-Rosse (P-R) methodology is implemented enabling us to estimate an indicator of the level of competition, the *H-statistic*.

The P-R methodology has historically been widely implemented to analyse the competitive conditions on banking markets, as it requires relatively limited amounts of data. The P-R measures the strength of competition on the banks in the sample independent of whether all the competitors are included in the sample or not. This

allows us to measure the strength of competition on Swedish banks, although foreign banks and other firms are excluded from the sample.[1] Specifically, The P-R methodology measures the degree of competition on the market by analysing the effect of changes in factor input prices on a reduced form of the bank's revenue function. The P-R methodology is implemented on the panel data using both fixed effects and random effects. As the results of the fixed effects estimation turn out to be more reliable, and since it is common practice to use this technique, it is the main estimation of this paper. However, as will be discussed later, the results from the random effects estimation render additional information of interest.

As the P-R methodology with fixed effects is implemented to our sample we find that the market is not in equilibrium which makes the *H-statistic* unreliable. Since we observe that the market has undergone considerable structural changes the evidences suggesting market disequilibrium are not surprising. This suggests that structural changes have shifted the competitive conditions on the market, so that there is now a period of entry and exit to the market, where more efficient firms are able to make profits, whilst less efficient firms leave the market. When the analysis is conducted with random effects, the results suggest a trend towards equilibrium in the later years compared to the early years for commercial banks, which might indicate that this market is stabilizing.

In order to unbiasedly capture the effect of changes in factor input prices on revenues, a number of firm specific control variables are included in the linear regression model used to estimate the *H-statistic* in this analysis. Generally, it holds that the more control variables with explanatory power that are included, the better is the validity[2] of the estimated parameters. Therefore, the model estimated in the following analysis has been extended with two additional firm-specific variables, which are neither included in the original form of the model nor in previous studies that we know of, i.e. the number of branches and the bank's ratio of non-interest revenues to total revenues,

[1] As an example non-banking firms, e.g. fintech firms, often supply some of the services offered by banks but they do not fall into the same category of firm as banks, why they are not included in this analysis. In addition, due to limited access of data, foreign banks are not included in this analysis which does however not affect our results due to the properties of the P-R-methodology.

[2] As for both efficiency and consistency.

where the latter is also included to evaluate the effect of product differentiation on a bank's revenues, which is of interest as banks provide different services but it has not been analysed in previous studies[3]. These additional variables enable us to capture the possible endogeneity[4], caused by omitted variable bias, and improve the precision of our results. As the additional variable representing product differentiation is proved to be highly significant, and because the exclusion of this variable would plausibly induce endogeneity, it is remarkable that it has not been included in any previous studies.

To our knowledge, only one previous study has been made that specifically analyses the competitive conditions on the Swedish banking market following the P-R methodology[5], namely Habte (2012)[6]. Another study of the competitive conditions on the Swedish banking market was conducted by Sjöberg (2007) who covered the years 1996-2002 and implemented the Bresnahan-Lau methodology, in contrast to the methodology used in this study[7]. A more extensive example is Bikker and Haaf (2002) who conducted a cross-country study of European and non-European banking markets and implemented the P-R methodology, where also Sweden was included. However, none of these papers provide an up to date study why ours, covering recent years, offers an extensive analysis and accurate description of the current competitive conditions of the Swedish banking market.

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[3] This variable is shown to be highly significant why its inclusion provides a better estimation of the *H-statistic.*

[4] E.g. there is a high correlation between market shares and the ratio of non-interest revenues which would cause omitted variable bias had any of these two variables been excluded.

[5] Habte (2012) uses panel data with fixed effects.

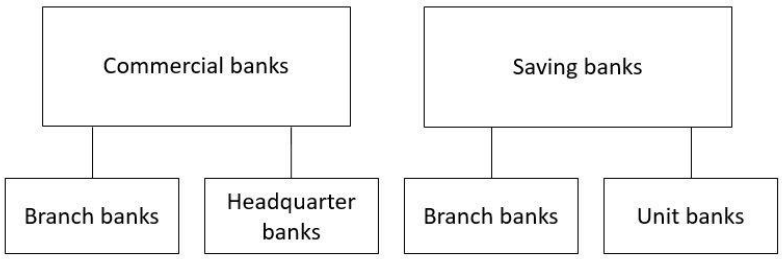
[6]However, Habte covers only 85 per cent of the market over seven years, 2004-2010, and no information about which specific banks are included in his analysis is provided, but only that 34 out of approximately 70 saving banks are included, which makes it impossible to measure the size and direction of the bias of his results. Therefore, we do not compare our empirical results to his.

[7] Attempts have been made to implement the B-L methodology following Sjöberg (2007) in this paper, without success. Specifically, the market demand function could not be identified due to an insufficient number of observations and weak control variables. It is reasonable to expect that Sjöberg (2007) also did encounter similar difficulties as that study covered even fewer years resulting in fewer observations.

1.2 The Swedish banking sector

The Swedish banking sector is composed by three types of banks, namely commercial banks[8], saving banks and member banks, which sum up to 117 banks in 2016. As depicted in figure 1 below commercial and saving banks can be classified into two groups depending on their number of branches. Regarding commercial banks, one group of banks has visitor offices (here forward referred to as *branch banks*) whilst the other group only has headquarter offices, which are not open for visitors (here forward referred to as *headquarter banks*). Further, saving banks can be classified into two groups, namely *branch banks* with several visitor offices and *unit banks* with only one office, which is the category with the smallest banks in our sample.

Figure 1: Type of branch for commercial and saving banks



Commercial banks are owned by stockholders with the aim to generate profits for owners, whereas saving banks are governed by locally elected representatives with the aim to invest any profits into the local community (Sparbankernas Riksförbund, 2017). The strong connection of saving banks to a defined geographical area, potentially gives them a competitive advantage against commercial banks, as local consumers might experience a higher attachment to their local bank than to commercial banks. This might result in a higher level of market power for saving banks in the local market. However, the geographical limitations reduce saving banks' possibilities to attract potential consumers from other locations, reducing their customer base. As a consequence, commercial banks have a competitive advantage as they are able to attract different types of consumers and are not limited by geographical boundaries. Hence, saving banks are also generally smaller than

[8] Swedish and foreign commercial banks.

commercial banks in financial terms, which might induce differences in performance. Thus, the differences between commercial and saving banks will plausibly result in different strategies to meet consumers' demand. Moreover, commercial banks and saving banks are regulated by different legislations[9]. Within commercial banks we find that the four largest banks on the market are Nordea, Handelsbanken, SEB and Swedbank[10]. Because of the pronounced differences between savings and commercial banks, these groups will be analysed separately in order to evaluate whether the competitive conditions that they experience differ.

1.3 Structural changes in recent times

During the past eleven years (2006-2016) the number of Swedish commercial banks grew from 27 to 38 whereas the number of foreign banks remained unchanged at 29. The number of saving banks decreased from 69 in 2006 to 47 in 2016 which is mainly due to mergers of small banks. The number of banks in the smallest category, member banks, remained unchanged at only two (Svenska bankföreningen, 2016). In terms of market shares measured by each bank's total assets, commercial banks exhibit a market share of approximately 90 percent whereas saving banks only have around 3 percent during the observed time period. It is intuitive that commercial banks are of interest to study because of their dominance on the market. However, saving banks are of interest to study as well, despite their negligible market share, as they also are part of the Swedish banking market and have a local presence in most parts of the country, potentially exerting competitive pressure on the local market. During the time period, several unit banks have merged with each other or with larger local saving banks, which has reduced the number of unit banks and saving banks in total. In 2006 the number of unit banks was 26, but in 2016 they had reduced to 15 as reported in table 3 below. The decreasing number of savings banks and small banks

[9] Savings banks are regulated under the laws "Lagen (2004:297) om bank- och finansieringsrörelse" and Sparbankslagen (1987:619). Commercial banks are regulated under the laws "lagen (2004:297) om bank- och finansieringsrörelse" and Aktiebolagslagen (2005:551). (Sparbankernas Riksförbund, 2016).

[10] Nordea, Handelsbanken, SEB and Swedbank held approximately 70 percent of the market shares of loans and deposits in Sweden between the years 2001-2015 (Swedish competition authority, 2016), and 90 percent in terms of total assets of Swedish banks (according to our sample).

might indicate that this group experiences a higher degree of competition over the time period.

In the following analysis, only Swedish commercial banks and saving banks are considered, which in average sum up to 86 banks every year 2006-2016[11]. The market share of foreign banks on the Swedish banking market varied between 5-9 percent during the observed time period (SCB, 2017).

Table 1: Evolution of number of banks

	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
All banks	96	91	82	84	83	83	86	86	85	85	85
Commercial banks	27	25	25	28	30	34	37	37	37	38	38
Saving banks	69	66	57	56	53	49	49	49	48	47	47
Branch banks	60	58	56	57	56	56	56	56	54	54	53
Unit banks	26	22	15	15	15	15	16	16	16	15	15
Headquarter banks	12	10	11	12	12	12	13	14	15	16	17

Notes: The 'all banks' row presents the total number of Swedish banks on the market. The 'commercial banks' row and 'saving banks' row present together the total number of Swedish banks on the market. The remaining rows present the number of commercial and/or saving banks in each category on the market.

In addition, the evolution of the number of banks on the market during the observed time period reflects the level of concentration of the market which can be evaluated by the Herfindahl-Hirschman index (*HHI*) and the so-called *k* bank concentration ratio[12]. The *HHI* and three the *k bank concentration ratio*[13] are reported in table 2 below:

[11] Some banks have been excluded due to ownership issues. See Appendix B.

[12] These are two of the most widely implemented concentration ratios in the related empirical literature. Their popularity is due to their simplicity and low data requirements, where the *HHI* reflects the level of concentration of the market by summing over the squared of banks' markets shares to reflect their size and the *k bank concentration ratio* by summing over the market shares of the *k* largest banks on the market (Bikker and Haaf, 2000). The HHI can take any value that is larger than zero ($100/n$, where *n* is the number of firms on the market) and smaller than or equal to 10 000 (if one firm has 100 percent of the market shares, the HHI will be $100^2 = 1000$).

Table 2: *HHI* and *k bank concentration ratio*

	HHI	C4	C10	C15
2006	2187,27	91.56	95.84	96.69
2007	2225,24	92.00	95.93	96.82
2008	2242,45	93.26	95.23	95.68
2009	2162,75	92.04	94.22	94.76
2010	2049,85	89.44	95.27	96.37
2011	2077,37	89.40	95.20	96.33
2012	2030,63	88.40	94.65	95.84
2013	1977,57	87.04	94.03	95.50
2014	2029,58	88.65	94.78	96.05
2015	1937,72	87.06	93.98	95.51
2016	1912,03	86.13	93.45	95.13

Notes: All the estimations are own calculations based on the sample used in this paper. C4, C10 and C15 are expressed in percentages.

The evolution of the first *k bank concentration ratio,* C4, suggests that during the last decade, the 4 largest banks have lost approximately 5 percentage points of market shares in total. Looking to the 10 largest banks, the decrease in market shares has been of approximately 2.4 percentage points and of 1.5 percentage points for the 15 largest banks over the recent eleven years. Thus, it can be argued that the largest banks have lost market shares to slightly smaller banks, and that the effect is diminishing with decreasing size of the banks. The decrease in concentration of market shares to the top-largest banks is reflected in decreasing values of the *HHI* over the time period. Thus, during the years 2006-2016 we observed a decreasing number of banks on the market, suggesting a higher level of concentration, at the same time as the market concentration reflected by the *HHI* has decreased. As these two indications of competition, i.e. number of firms on the market and market concentration, seem to go in opposite directions questions may arise such as: what is the level of competition on the market? or How has the level of competition developed during these years? which this paper aims to address.

During this time period the banking market in Sweden has experienced several changes as for example the expansion of technological financial innovations, an increased number of firms opting for other sources of funding than bank loans as well

[13] Where C4 is the sum of market shares of the 4 largest banks, C10 is the sum of market shares of the ten largest banks and C15 is the sum of market shares of the 15 largest banks.

as an increased internationalization of the financial market through a more harmonized market legislation between EU countries (Swedish Competition Authority, 2016). For example, the European Central bank aims for integration of the financial market across the Eurozone (ECB, 2017) and although Sweden is not a member of the Eurozone, its financial market is likely to be affected by the ambitions of the European Union. A harmonization of the Swedish and European financial market enables both foreign banks to operate on the Swedish market as well as Swedish commercial banks to operate abroad, increasing competition.

Additional legislative changes have been implemented on the Swedish banking market during the observed time period with the aim to increase competition and consumer mobility, concerning capital adequacy and early repayment of housing mortgage loans. More specifically, new rules for capital adequacy, implemented at the beginning of the observation period, implied that financial institutions that chose more advanced methods to calculate their risks would obtain a lower capital adequacy and consequently increase their competitiveness as they would have lower costs. For consumer this meant that they would face lower prices as a lower capital adequacy means lower costs for the institution. Hence, this new rule should lead to a price differentiation between customers. However, in 2014, the rules for capital adequacy where changed once again leading to higher capital requirements and an equalized competitiveness between financial institutions. The changes in the legislation for early repayment of housing mortgage loans have implied a different way of calculation of the interest compensation that customers have to pay to the creditor when customers want to pay back a housing mortgage loan with fixed interest rate prematurely. Instead of calculating the interest compensation based on the interest on different types of government securities, the interest compensation is calculated on housing bonds resulting in lower interest compensation which in turn increases customer mobility. These changes were made to harmonize the Swedish legislation with that of the Eurozone (Riksdagen, 2006; 2013).

Moreover, the fast development and large investments in technical financial innovations seen under this time period have contributed to the establishment of new participants on the market, challenging the traditional banking market (Wesley-James,

et. al., 2015). Another exceptional shock to the banking market was the financial crisis in 2008 which reduced customers' general trust to traditional banks and consequently the number of non-bank firms providing typical banking services has increased dramatically since then[14] (Gromek, et al., 2016). Similarly, the expansion of internet-access and computers, particularly personal computers and smartphones, have drastically changed how customers purchase their goods and services and in what form they want them delivered, spurring on a higher demand for financial-technological (fintech) services and innovations. In addition, technological development has dissolved geographical boundaries enabling consumers to make use of financial services from far away increasing globalization. Thus, the technological improvements seen on the market are expected to have a positive effect for consumers who now might opt for different suppliers of financial services rather than having only a few traditional suppliers (banks) for all demanded financial services.

With the introduced structural changes in mind the hypotheses that are tested in the empirical analysis are:

1. The trend is expected to be towards a higher degree of competition on the market.
2. We expect a larger change towards more competition for saving banks than for commercial banks, as the diminishing number of saving banks over the time period suggests that the structural changes on the market have considerably increased saving banks' experienced level of competition.

The rest of the paper is organized as follows. In section 2 the related literature is presented. Section 3 introduces the methodology framework and the econometric model. Section 4 is devoted to the data. The results are presented and interpreted in section 5 and further discussed in section 6. Finally, section 7 concludes.

[14] For example, the number of fintech companies established in the Stockholm greater area has increased from 42 to 188 between 2009-2017 (Gromek, 2018).

2. Literature review

The literature on the measurement of competition can be divided into two major approaches, namely the traditional structural approach and the more recently developed non-structural approach.

Traditionally, competitive conditions have often been measured following the structure-conduct-performance (SCP) approach, developed by Bain (1951). The SCP approach assumes there to be a one-way, causal, positive and in most studies linear relationship between the market structure and the performance on the market. Firms on more concentrated markets will earn higher profits than firms on markets with less concentration, because their market power allows them to charge higher prices. The price and profit are considered to be endogenous to the market structure characteristics, whilst the market structure characteristics are assumed to be exogenous (Jensen and Waldman, 2012). The SCP approach can be based on any concentration ratio, as for example the k bank concentration ratio and the Herfindahl-Hirschman index *(HHI*), due to their ability to capture structural features of a market, for example, as higher market concentration is expected to indicate on more market power (Bikker and Haaf, 2002). Critics of the SCP approach put forward the efficiency structure (EFS) approach, arguing that firms with higher efficiency will get larger market shares and thus increase the average efficiency of the whole market. This leads to a positive relationship between profits and concentration, but the underlying structural mechanism is obviously opposite to the SCP approach (Jensen and Waldman, 2012). One of the main critics of the SCP approach is Demsetz (1973) who emphasises that deconcentration and anti-merger policies might actually increase the market inefficiency since the high market concentration is due to some firms being more efficient than others.

In the wake of the criticisms of the SCP approach, the "new empirical industrial organization" (NEIO) approach was developed. The NEIO aims to evaluate competition, the use of market power and the competitive conduct without enforcing any information or assumptions about the market structure. This approach emphasises

the importance to study individual industries, rather than broad cross-section studies, due to the different characteristics of the industries. NEIO studies aim to derive the behavioural equations that set the price and quantities of a specific industry (i.e. demand-, cost- and supply equations) in order to evaluate the existence of market power of that industry. The degree of market power is based on the market conduct of the relevant industry (Jensen and Waldman, 2013).

Within NEIO, three major empirical models have been developed, on one hand the conjectural variation approaches, namely the Iwata model and the Bresnahan-Lau methodology and on the other hand the Panzar-Rosse methodology. Iwata (1974) develops a method to analyse price level in an oligopoly with homogeneous product. The price level is argued to be determined by the price elasticity of demand, the marginal cost and the conjectural variation of each firm. The model provides a method to estimate the value of the conjectural variation for individual firms supplying a homogenous product on an oligopoly market (Bikker and Bos, 2008). The value of conjectural variation gives the ratio of variation of the supply of other firms that a firm believes will result if it increases its own supply.

The two remaining methods are usually implemented to identify the degree of banking competition. Bresnahan (1982; 1989) and Lau (1982), provide a conduct parameter that measures the extent to which firms can set a price higher than their marginal cost. The Bresnahan-Lau methodology has been widely implemented in different studies of competition on the banking market[15]. Finally, Panzar and Rosse (1987), define a model that measures the market conduct by the extent to which changes in factor input prices affect the firms' revenues, by implementing a reduced-form revenue test. The P-R methodology has been frequently used for analysis of competition on the banking market[16]. In terms of feasibility, the latter model is easier to estimate as only one equation is needed whilst the first requires the estimation of a simultaneous system of at least two equations. Also, the B-L methodology imposes more assumptions about the market characteristics (i.e. the demand- and marginal cost

[15] See Bikker and Haaf (2000), Rezitis (2010), Angelini and Cetorelli (2003).
[16] See Bikker, Shaffer and Spierdijk (2012), Huang and Liu (2014), Claessens and Laeven (2004).

function), which makes it more vulnerable to critics. However, the estimated results of these two methods should suggest a similar degree of competition if both were to be implemented on the same sample.

In an extensive analysis of the competitive conditions in the banking industry Bikker and Haaf (2002) implement the P-R methodology and different concentration ratios in 23 European and non-European countries among which Sweden was found to have a higher degree of competition compared to its neighbouring countries Denmark, Norway and Finland during the observed time period 1991-1997. In addition, both the *HHI* and three levels of the *k* bank concentration ratio for the included countries were estimated, revealing a lower market concentration in Sweden than what the result of our empirical analysis suggests[17]. However, as previously mentioned, to our knowledge there exist no empirical analyses of the competitive conditions on the banking market in Sweden in recent years. Additionally, we do not know of any other empirical analysis of the banking market using the P-R methodology that controls for market shares in order to control for the effect of scale, the number of firm branches and the share of non-interest revenues.

3. Methodology

3.1 The empirical framework

In order to be able to distinguish between monopoly, monopolistic and perfectly competitive markets, Panzar and Rosse (1987) derived a test statistic, *H*, that investigates the performance of markets using firm- and industry level data. The test is based on characteristics of a reduced form revenue equation with relatively limited data requirements and measures the effect of changes in factor input prices on equilibrium revenues. Firms are assumed to maximize profits so that each bank selects output where marginal revenue equals marginal cost as follows:

[17] Bikker and Haaf (2002) finds that the HHI and k bank concentration ratio in Sweden was as follows; HHI = 0.12, C3=0.53, C5=0.73 and C10=0.92, they did however only include 21 Swedish banks in their analysis.

$$R_i'(y_i, n, x_i) - C_i'(y_i, w_i, z_i) = 0 \quad (1)$$

Where R_i' is marginal revenue, y_i is the output of bank *i*, *n* denotes the number of banks on the market, x_i is a vector of exogenous variables that shift the bank's revenue function, e.g. a shift in the demand function faced by bank *i* due to changes in output of bank *j*. In the models for perfect competition and monopolistic competition the decisions of a bank will be influenced by the actions of other banks as well as other potential competitors on the market. Consequently, there is interdependence between the banks' individual revenue functions. C_i' is marginal cost, w_i is a vector of m factor input prices of bank *i* and z_i is a vector of exogenous variables that shift the bank's cost function, e.g. a change in the reference rate which is exogenously set by the central bank, which would affect the factor input price of deposits for banks.

In the case of monopolistic and perfect competition, the zero profit constraint will hold in long-run equilibrium, as a result of free entry and exit:

$$R_i^*(y^*, n^*, x) - C_i^*(y^*, w, z) = 0 \quad (2)$$

The *i*th bank's equilibrium revenue function derived from the zero profit constraint can be expressed as:

$$R_i^* = R(w_i, z_i, y_i^*, x_i) \quad (3)$$

The *H-statistic* is obtained by adding the elasticities of the reduced form revenue function of bank *i* with respect to factor input prices. The market power is reflected in the extent to which a change in factor input prices (∂w_{ki}) is reflected in the equilibrium revenues (∂R_i^*) of bank *i*:

$$H = \sum_{k=1}^{m} \frac{\partial R_i^*}{\partial w_{ki}} \frac{w_{ki}}{R_i^*} \quad (4)$$

Panzar and Rosse (1987) prove that *H* takes on different values depending on the level of competition. *H* is zero or negative in a monopoly market, the logic is that an

increase in a firm's factor input prices increases its marginal cost, reduces equilibrium output and consequently reduces its revenue. Thus, an increase of the monopoly's costs will lead to a decrease of its revenues in accordance with the monopoly profit maximization condition *(MC=MR)*.

When the market experiences monopolistic competition, *H* takes a value between zero and one. In a monopolistic market an increase in factor input prices, will lead to an upward shift of the marginal and average cost curves reducing the firm's output. Consequently, some firms will experience losses and leave the market. Hence, the remaining firms will face a higher demand for their products and consequently increase their revenues. Thus, on a monopolistic market the number of firms will decrease as a result of increased factor input prices, leading to a higher demand on each of the remaining firms supply inducing increased revenues.

Finally, under perfect competition *H* is equal to unity[18]. An increase in costs for firms operating in a perfectly competitive market, where there are no incentives for neither entry to nor exit from the market, will lead to a proportional increase in the firms' revenues. Thus, an increase in all factor input prices will shift the firms' average cost curve with the same magnitude as the increase in the factor input prices leading to a proportional increase in the firm's equilibrium revenues. Table 3 summarizes the different values that the *H-statistic* takes for the different market forms.

Table 3: The value of H for different market forms

H≤0	Monopoly
0<H<1	Monopolistic competition
H=1	Perfect competition

However, one important condition for these results to hold is that the market must be in long-run equilibrium, i.e. free entry into and exit from the market leads to zero profits for the individual firm operating in a market with either perfect or monopolistic competition whereas the market where a firm operates as a monopoly is

[18] See Panzar and Rosse (1987) for a detailed derivation of *H* in different states of conduct.

in long-run equilibrium when its long-run marginal cost equals marginal revenue *(LMC = MR).*

3.2 The econometric model

In the following analysis, the *H-statistic* is estimated for the whole dataset as well as for different subsamples divided according to the ownership characteristics of the banks. The dataset contains two categories of banks; saving banks and commercial banks. Commercial banks are in turn divided into two sub-groups; banks with visitor offices *(branch banks)* and banks with only headquarter but no visitor offices *(headquarter banks).* Savings banks are also divided into two subgroups; banks with several visitor offices *(branch banks)* and banks with only one visitor office *(unit banks*[19]*).* Commercial banks and saving banks are analysed in different groups, as their different characteristics plausibly affect their competitive behaviour[20]. Additionally, the data is analysed in two time periods, namely early (2006-2011) and late years (2012-2016), in order to enable the analysis of how the competitive conditions on the Swedish banking market have changed over time[21]. Alternatively, one *H-statistic* for each year could be estimated but then the number of observations would be insufficient in order to provide good estimations why we proceed with two estimations as explained above. The P-R methodology assumes a homogenous cost structure for the banks within the sample. As the sample is divided into subgroups, the cost structure is allowed to vary between the subgroups but remains homogeneous within each group.

The most common way of estimation for similar studies is to control for bank fixed effects, whilst the alternative is to allow for random effects. The main difference between estimations with fixed and random effects is that the first controls for the effect of unobserved and individual time-invariant characteristics of the bank that

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[19] See figure 1.

[20] Saving banks do invest any profits into the community whereas commercial banks generate profits for their shareholders. Savings banks may benefit from being local, whilst commercial banks may benefit from a larger geographical customer base.

[21] The use of different subsamples depending on time periods is preferable to the use of year-specific dummy variables, as it allows the independent parameters (and thus the *H-statistic*) to vary between the years, instead of the year-dummies shifting the value of the dependent variable. In addition, the results of the *H-statistics* during the whole time period are provided in the result tables in appendix A.

impact its revenues and due to correlation with the independent variables may cause omitted variable bias[22]. On the other hand, in the random effects estimation all such variables are assumed to be random and uncorrelated with the revenues and the independent variables, why they do not need to be controlled for. The advantage of the random effects estimation, compared with fixed effects, is that we are able to capture the effect of individual time-invariant variables on the banks' revenues that are included in the regression, which otherwise are captured by the intercept in the fixed effects estimation. The advantage of fixed effects estimation is obviously that the estimation can be valid despite the existence of unobserved endogenous time-invariant variables. In order to know which of these two estimations provide the most reliable results given our sample a Housman test is computed, which tests the suitability of the fixed effects estimation against that of the random effects estimation. Our results verify that the fixed effects estimation is the more suitable given our sample.

With this in mind, due to its more reliable estimates, the fixed effects estimation is considered the main estimation of this paper, whilst the random effects estimation is discussed with regard to the additional information that it may provide. In order to evaluate differences between the estimations, the results are compared to an ordinary least squares regression *(OLS).* When using panel data, *OLS* regression provides the least accurate estimation as it does not control for the endogeneity between observations of the same bank for different years[23]. When random effects and *OLS* are implemented, two time invariant bank characteristics are controlled for with dummy variables, namely whether the bank is a unit bank or a headquarter bank, since these two variables could otherwise lead to omitted variable bias.

The empirical application of the P-R methodology assumes the following log-linear reduced form revenue function where all variables are bank specific:

[22] For example, due to data constraints we are not able to control for the effect of the banks' location (e.g. size of town) and demography of the banks individual customer base, which might be fixed effects that affect revenues.

[23] Since the different estimation techniques differ in the level of endogeneity, we expect the *OLS* regression to provide the least accurate results and the fixed effects estimates to be the most reliable. The estimates from the random effects estimation are expected to take values between the estimates of the two just mentioned.

Fixed effects:

$$lnTR_{it} = \alpha_i + \beta_1 lnw1_{it} + \beta_2 lnw2_{it} + \beta_3 lnw3_{it} + \beta_4 lnz1_{it} + \beta_5 lnz2_{it} + \beta_6 lnz3_{it} + \beta_7 lnz4_{it} + \beta_8 lnMS_{it} + \beta_9 BR + \beta_{9+i} \sum_{i=1}^{n} year_t + \varepsilon_{it} \quad (5)$$

Random effects and *OLS:*

$$lnTR_{it} = \alpha_i + \beta_1 lnw1_{it} + \beta_2 lnw2_{it} + \beta_3 lnw3_{it} + \beta_4 lnz1_{it} + \beta_5 lnz2_{it} + \beta_6 lnz3_{it} + \beta_7 lnz4_{it} + \beta_8 lnMS_{it} + \beta_9 UNIT + \beta_{10} HQ + \beta_{11} BR + \beta_{11+i} \sum_{i=1}^{n} year_t + \varepsilon_{it} \quad (6)$$

where *TR* is total revenues of bank *i* in year *t.* Factor input prices are divided into the variables *w1*,*w2* and *w3* which represent input price of deposits, input price for physical capital and input price of labour respectively. Alternatively, *w2* could be divided into further different subgroups of costs, as marketing costs, administration costs and office costs but due to limitations in the annual report data we are not able to distinguish between all costs captured by *w2,* which is further discussed in section 3.3.

From model (5) and (6) the *H-statistic* is obtained by adding the factor input price elasticities in the revenue equation, i.e. $H = \beta_1 + \beta_2 + \beta_3$.

Additionally, six bank-specific continuous control variables are included in all three estimations (i.e. fixed effects, random effects and *OLS*) to control for differences between banks. Although the main purpose of this analysis is to evaluate the *H-statistics* information about the relationship between other relevant variables and the dependent variable is of interest since it provides information about market features. It is common practice to control for the risk-taking behaviour of the bank, since risk-taking may affect the revenues of the bank endogenously or exogenously from the

factor input prices. *z1* is a proxy for a risk component as the ratio of total loans to total assets, *z2* is a ratio of provision for non-performing loans to total loans which also is a proxy for a risk component[24]. *z3* is a proxy for the effect of capitalization as a ratio of total equity to total assets. Hence, risk-taking is controlled for by using three different measures, since banks may differ in the way and extent to which they expose themselves to risk. *z4* stands for the ratio of total non-interest revenues to total revenues, and is included in order to control for and evaluate the effect of off-balance sheet services[25] as a share of revenues which highly differs between saving and commercial banks. *BR* is a discrete variable, with information about how many visitor offices (branches) the bank has. Finally, *MS* is market share included to control for the size of the bank. In the original P-R methodology, the production technology is assumed to be unchanged over the observed time period (Bikker, Shaffer and Spierdijk, 2012). In order to control for efficiency changes in the production technology, as well as for other structural changes and year-specific shocks to the economy, yearly time dummies are included in the implemented model in the following analysis.

As previously mentioned, in the case of the estimations with random effects and *OLS* two dummy variables are included, namely *UNIIT* and *HQ*. *UNIT* is a dummy variable, which takes the value 1 if the bank has only one office, which is common for small and local saving banks and some commercial banks. *HQ* is a dummy variable, which takes the value 1 if the banks is a headquarter bank, which is common for large commercial banks with more internet based communication.

As mentioned above, a necessary condition in order for the observed *H* to be reliable is that the market is in long-run equilibrium. Specifically, in financial markets characterised by perfect or monopolistic competition, the risk-adjusted rate of return to assets (*ROA*) will not be dependent on the banks' factor input prices. This is because in a free-entry equilibrium market, the return to assets should equalize across firms and thus be independent of the factor input prices (Bikker, Shaffer and

[24] The value of *z2* can be either positive or negative. Therefore, the value "1" is added to the value of *z2* before the logarithmic value is generated, i.e. *ln(z2)=ln(z2+1)*

[25] The concept of off-balance-sheet services and non-interest revenues is discussed in detail in section 3.3.

Spierdijk, 2012). Therefore, a long run equilibrium test will be conducted where the hypothesis H^{ROA} = 0, will be tested, where H^{ROA} is defined as$H^{ROA} = \beta_{ROA1} + \beta_{ROA2} + \beta_{ROA3}$. Thus, H^{ROA}=0 is the hypothesis that the return on assets is not jointly correlated with the three factor input prices *w1*, *w2* and *w3*.

The equilibrium tests (7) and (8) below take the same functional form as equation 5 and 6, but the dependent variable is replaced by *ROA*. Since the value of *ROA* can be negative, and therefore cannot be converted into logarithmic form, the value 1 will be added to all values of *ROA*. Hence, the dependent variable will be presented as $ROA = \ln(1 + ROA)$ in accordance to the practice of Claessens and Laeven (2004).

Fixed effects:

$$lnROA_{it} = \alpha_i + \beta_1 lnw1_{it} + \beta_2 lnw2_{it} + \beta_3 lnw3_{it} + \beta_4 lnz1_{it} + \beta_5 lnz2_{it} + \beta_6 lnz3_{it} + \beta_7 lnz4_{it} + \beta_8 lnMS_{it} + \beta_9 BR + \beta_{9+i} \sum_{i=1}^{n} year_t + \varepsilon_{it} \quad (7)$$

Random effects and *OLS:*

$$lnROA_{it} = \alpha_i + \beta_1 lnw1_{it} + \beta_2 lnw2_{it} + \beta_3 lnw3_{it} + \beta_4 lnz1_{it} + \beta_5 lnz2_{it} + \beta_6 lnz3_{it} + \beta_7 lnz4_{it} + \beta_8 lnMS_{it} + \beta_9 UNIT + B_{10} HQ + \beta_{11} BR + \beta_{11+i} \sum_{i=1}^{n} year_t + \varepsilon_{it} \quad (8)$$

3.3. Methodological aspects

The P-R methodology does not require the inclusion of data from all competitors on the relevant market, since the *H-statistic* measures the degree of competition that the included banks experience and include the competitive effects from other competitors as well (Bikker and Haaf, 2002). Due to limited access to data, only Swedish banks are included in this analysis, which means that foreign banks and non-banks firms are

excluded, although it could be argued that they are part of the relevant market. However, in this case the exclusion of foreign banks and other firms will not bias the result, as mentioned above.

Another methodological issue concerns the estimation of the factor input prices represented by *w1*, *w2* and *w3*. As discussed by Mustafa and Toci (2017) these three variables represent all input costs of modern banking, but it is plausible that the input costs could theoretically be divided into more categories. However, due to data limitations the costs cannot be divided into more subgroups, why studies applying the P-R methodology rely on the intermediation approach[26] where the underlying assumption for the election of factor input prices is a uniform banking technology. The consequence of the implementation of the intermediation approach is that the parameters of the individual factor input prices in the sample are average values of the "real" factor input prices that they represent[27], but the sum of the parameters, and hence the *H-statistic*, should still be unbiased.

Moreover, it is common practice to control for scale by including the total asset variable in the analysis, since it is intuitive that larger firms in terms of total assets will also generate larger revenues (Bikker, Shaffer and Spierdijk, 2012). In this paper we use *"market shares"* instead of total assets, due to its more direct interpretation[28]. As the coefficient for *market share* is shown to be highly significant we choose to control for bank scale in this paper.

As previously mentioned, in order to control for product differentiation, the control variable "share of non-interest revenues" is included in the analysis. Non-interest revenues can be earned from for example commission fees and credit lines. Since

[26] This approach was developed by Sealey and Lindley (1977) who defined inputs and outputs of financial firms. According to this approach banks produce output (loans) by using deposits, capital and labour as inputs.

[27] e.g. the input factor variable "cost of physical capital" represents among other things the costs of physical investments, investments into R&D and articles of consumption, which might yield widely different parameters, would they be controlled for individually. However, the parameter of the variable "cost of physical capital" will still yield an unbiased contribution to the *H-statistic* as an average value of the effect of the input factors that it contains.

[28] However, since the market shares and the total assets are so closely related, the parameter of the logarithmic values will be identical.

these revenues have no directly corresponding post in the balance-sheet, they are often referred to as "off-balance sheet operations". According to Freixas and Rocker (2008), this category of services has increased in importance during the last decades due to the increased competitive pressure for more value-added products within the banking services. Presumably, this evolvement has proceeded during the last years, due to the structural changes mentioned earlier. It is plausible that the rate of product differentiation affects the performance of a bank, why it is important to control for it. Also, the rate of product differentiation differs between saving and commercial banks[29] as well as between larger and smaller banks[30], why the inclusion of this control variable will rid the parameters corresponding to bank form and market shares from endogeneity. Because of the importance of this variable, it is remarkable that it has not been included in previous studies similar to this, and we hope to contribute to the research by including the variable representing product differentiation.

As mentioned in section 3.1, firms are assumed to be profit maximizing according to the P-R methodology. In the empirical analysis that follows, this assumption is assumed to hold notwithstanding the differences between commercial and saving banks in terms of incentives[31]. If firms would not be profit maximizing, the result of the empirical analysis would be uninterpretable, since it would not possible to predict the behaviour of the firms and how a change in factor input prices would affect revenue with this methodology.

Additionally, according to the P-R methodology, there is a zero-profit constraint on markets under monopolistic and perfect competition in equilibrium, which means that no firms will be able to generate profits in the long-run. If the zero-profit constraint does not hold the market cannot be monopolistic or perfectly competitive, but must be either in long-run monopoly or collusion, or in a short-run disequilibrium state where firms are able to exert market power. In our sample, we find that banks generate

[29] For saving banks, which are generally smaller than commercial banks, interest revenues amount to 95 percent of total revenues. Commercial banks generate approximately only 50 percent of their revenues from interests.

[30] In our sample we find a high correlation between the market share of a bank and its non-interest revenues (86%).

[31] Remember that saving banks do invest any profits into the community whereas commercial banks generate profits for their shareholders.

profits corresponding to approximately 1 percent of their total assets per year. It can be argued that these profits are assumed to cover for risks or be consumed by investments, which would support that the zero-profit constraint holds for our sample. However, as our results in section 5 suggest market disequilibrium, it might be reasonable to assume that the zero-profit constraint does not hold for our sample making it difficult to interpret the estimated *H-statistic*. This issue is further discussed in section 6.

Finally, the NEIO approaches are criticized for relying on accounting data, which might be problematic since accounting costs and profits do not always correspond to the economic costs and profits. For example, accounting costs are often estimated according to specific depreciation rules resulting in a value that does not reflect the real economic cost, i.e. the opportunity cost (Jensen and Waldman, 2012. p.32). However, due to lack of a better source of data it is common practice to use accounting data in NEIO studies.

4. Data

All data required for our empirical analysis is available in the annual reports of the banks included in the sample. We use data from the annual reports of all banks registered in the internal database of Sweden's Financial Supervisory Authority in any of the years between 2006-2016[32], which enable us to cover the whole Swedish banking market. We do not include neither foreign banks, due to lack of necessary data, nor member banks, due to their negligible importance for the market. Thus, we compute a new data set of balanced panel data from approximately 86 banks over 11 years, summing up to totally 947 observations, including the variables listed in table 4 below where the upper part contains variables directly gathered from the annual reports whereas the second part contains composite variables, i.e. proxies for variables not directly observed in the annual reports. In order to gather data from all Swedish banks on the market, the data was collected from the annual reports available on the

[32] Lists of all included and excluded banks are provided in Appendix B.

banks' websites, bank offices, the database Retriever and from the Swedish authority Bolagsverket. The data has been cleansed and outliers[33] and banks with no major activity in Sweden have been excluded.

Table 4: List of variables

Annual report data	
TR_{it}	Total revenues of bank *i* in year *t*
TA_{it}	Total assets of bank *i* in year *t*
TD_{it}	Total deposits of bank *i* in year *t*
TC_{it}	Total costs of bank *i* in year *t*
TIR_{it}	Total interest revenues of bank *i* in year *t*
TIE_{it}	Total interest expenses of bank *i* in year *t*
TLC_{it}	Total labour costs of bank *i* in year *t*
EMP_{it}	Total number of employees of bank *i* in year *t*
$NPNP_{it}$	Net provision for non-performing loans of bank *i* in year *t*
$LOAN_{it}$	Total loans of bank *i* in year *t*
EQ_{it}	Total equity of bank *i* in year *t*
$UNIT_{it}$	Dummy variable that takes the value 1 if bank *i* is a unit bank in year *t*
BR_{it}	Discrete variable with the number of branches of bank *i* in year *t*
HQ_{it}	Dummy variable that takes the value 1 if bank *i* is an headquarter bank in year *t*
Composite variables	
TA_AGG_t	Aggregated total assets of all banks in year $t = \sum_i^n TA_{it}$
MS_{it}	Market share of firm *i* in year $t = TA_{it}/TA\_AGG_t$
TPC_{it}	Proxy for total costs for physical capital of firm *i* in year $t = TC_{it} - TLC_{it} - TIE_{it}$
wd_{it}	Proxy for input price of funds of bank *i* in year $t = TIE_{it}/TD_{it}$
wl_{it}	Proxy for input price of labour of bank *i* in year $t = TLC_{it}/EMP_{it}$
wp_{it}	Proxy for input price of physical capital of bank *i* in year $t = TPC_{it}/TA_{it}$
$TNIR_{it}$	Total non-interest revenues of bank *i* in year $t = TR_{it} - TIR_{it}$
$Z1_{it}$	Total loans to total assets of bank *i* in year $t = LOAN_{it}/TA_{it}$
$Z2_{it}$	Net provision for non-performing loans to total loans of bank *i* in year $t = PNPL_{it}/LOAN_{it}$
$Z3_{it}$	Total equity to total assets of bank *i* in year $t = EQ_{it}/TA_{it}$
$Z4_{it}$	Total non-interest revenues to total revenues of bank *i* in year $t = TNIR_{it}/TR_{it}$
ROA_{it}	Return on assets of bank *i* in year $t = ((TR_{it} - TC_{it})/TR_{it})$

From the evolution of the mean values of the variables over the years, reported in Table 5 below, it is evident that banks have become on average larger in terms of total assets, whilst total revenues, market shares and return on assets have remained unchanged. The share of non-interest revenues increases slightly. The share of unit

[33] E.g. one observation with a negative value of the variable "cost for physical capital" and a few firms that were bankrupt and had no activity. For a full list of excluded observations, see Appendix B.

banks decreases, whilst the share of banks with only headquarters and no visitor offices increases and the number of average branches decreases.

Table 5: Evolution of the mean values of the variables over the years 2006-2016

	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Total revenues	2270	2634	3438	2294	2225	2645	2916	2609	2889	2593	2252
Total assets	45800	56200	72200	40500	71600	77100	76100	79100	89300	87500	88600
Market shares	0.010	0.010	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.012
Return on Assets	1.018	1.015	1.010	1.011	1.009	1.009	1.013	1.014	1.016	1.012	1.012
Share of non-interest revenues	44.1	44.1	44.0	47.1	43.5	44.2	46.2	46.7	47.5	47.8	47.3
Number of branches	20	21	23	22	22	21	19	19	19	18	17
Share of unit banks	27	24	18	18	18	18	19	19	19	18	18
Share of HQ banks	12	11	14	14	14	14	15	16	18	19	20

Notes: "Total revenues" and "Total Assets" are expressed in millions of SEK and in the price level of 2006. The rows "Market shares", "Share of non-interest revenues", "Share of unit banks" and "Share of HQ banks" are expressed in percentage.

5. Results

In the following section, the econometric models (5) and (6) have been applied to the whole sample and to different subsamples of interest namely commercial banks and saving banks. The parameters of interest are reported in table 6 below and for two time periods: first half 2006-2011 and second half 2012-2016.

5.1 H-statistic

Table 6: Empirical results for H for various time periods and bank types with fixed effects

	All banks		Commercial banks		Saving banks	
	2006-2011	**2012-2016**	**2006-2011**	**2012-2016**	**2006-2011**	**2012-2016**
wd	0.130 (0.022)***	0.068 (0.018)***	0.178 (0.037)***	0.074 (0.035)**	0.058 (0.031)*	0.008 (0.011)
wl	0.202 (0.038)***	0.195 (0.028)***	0.134 (0.063)**	0.363 (0.056)***	0.107 (0.058)*	-0.015 (0.018)
wp	0.091 (0.022)***	0.055 (0.037)	0.072 (0.045)	0.031 (0.082)	0.075 (0.023)***	0.028 (0.022)
$Z4$	0.552 (0.039)***	0.533 (0.053)***	0.780 (0.086)***	0.518 (0.086)***	0.418 (0.036)***	0.441 (0.050)***
MS	0.654 (0.043)***	0.504 (0.065)***	0.696 (0.077)***	0.709 (0.132)***	0.539 (0.055)***	0.384 (0.091)***
BR	0.002 (0.001)***	0.001 (0.001)	0.002 (0.001)**	-0.000 (0.002)	0.008 (0.006)	0.025 (0.012)**
$H-stat$	0.42	0.32	0.38	0.47	0.24	0.02

R^2	0.9760	0.9482	0.9666	0.9023	0.9826	0.9559
$Wald\ test\ for\ H = 0$	0.00	0.0001	0.00	0.0530	0.0011	0.3798
$No.obs.$	520	427	169	187	351	240

Notes: The dependent variable in the regression in *lnTR* . The variables are explicitly defined in table 4. ***,** and * represent the significance levels 0.01, 0.05 and 0.1, respectively. Year dummies are included in the regression but not reported in the table. The parameters of all variables and an estimation of the *H-statistic* for the whole time period are provided in table 5 in Appendix A.

As explained in section 3.2 the variable of interest, the *H-statistic,* is obtained by adding the coefficients of the factor input prices $(\beta_1 + \beta_2 + \beta_3)$. As the model is estimated with fixed effects we observe that these, i.e. *wd*, *wl* and *wp,* are highly significant in almost all three time periods, except during the second half where the coefficient for the factor input price of physical capital, i.e. β_3, for the whole sample as well as for commercial and saving banks. Similarly, this variable is not significant during the first half of the time period for commercial banks. For saving banks, the coefficient of the factor input prices of funds and labour, i.e. β_1 and β_2 respectively, are not significant neither during the whole time period nor the second half but only in the first half of the time period. The joint significance test reveals that the assumption that a change in the factor input prices does not have any significant effect on the bank revenues is rejected for the whole sample as well as for commercial banks and saving banks throughout the observed time period, except for saving banks during the second half of the time period.

Further, the effect of market shares on revenue is positive and highly significant, supporting the argument that a bank with larger market shares has a larger customer base and higher turn-over. In addition, the effect of share of non-interest revenues on revenues is positive and statistically significant for all observations which, following the same argument as before may indicate that banks with higher product differentiation attract more customers and thus generate more revenues. Thus, the inclusion of *z4* provides better estimates of the *H-statistic* which otherwise would be higher if this variable was excluded[34]. The effect of having a larger number of branches is very small but often significant.

[34] For a comparison of the estimated *H-statistics* with and without the inclusion of *z4* see tables 5 and 6 in Appendix A. Only the estimation for saving banks during 2012-2016 is higher when *z4* is included than when it is not.

The results indicate that the *H-statistic* for the whole banking market decreases from 0.42 to 0.32 between the early and later years. For commercial banks the *H-statistic* increases from 0.38 to 0.47 between the early and later years. Regarding saving banks, a lower value of *H* is observed as it decreases from 0.24 to 0.02 between the early and later years.

Table 7 below reports the estimated *H-statistics* with random effects:

Table 7: Empirical results H for various time periods and bank types with random effects

	All banks		**Commercial banks**		**Saving banks**	
	2006-2011	**2012-2016**	**2006-2011**	**2012-2016**	**2006-2011**	**2012-2016**
wd	0.137 (0.022)***	0.067 (0.185)***	0.163 (0.033)***	0.100 (0.032)***	0.031 (0.033)	0.008 (0.014)
wl	0.150 (0.038)***	0.240 (0.031)***	0.043 (0.060)	0.388 (0.056)***	0.208 (0.053)***	0.008 (0.023)
wp	0.209 (0.216)***	0.274 (0.029)***	0.223 (0.042)***	0.305 (0.050)***	0.121 (0.021)***	0.165 (0.027)***
$Z4$	0.587 (0.042)***	0.441 (0.047)***	0.798 (0.088)***	0.370 (0.071)***	0.411 (0.040)***	0.399 (0.061)***
MS	0.912 (0.014)***	0.924 (0.019)***	0.869 (0.032)***	0.870 (0.034)***	0.963 (0.013)***	0.944 (0.021)***
$UNIT$	-0.098 (0.036)***	-0.134 (0.053)**	-0.077 (0.151)	-0.372 (0.165)**	-0.041 (0.023)*	-0.064 (0.033)*
HQ	0.223 (0.054)***	0.455 (0.066)***	0.057 (0.082)	0.253 (0.097)***	-	-
BR	0.001 (0.000)***	0.001 (0.000)	0.001 (0.000)**	0.001 (0.001)	0.001 (0.004)	0.018 (0.006)***
$H-stat.$	0.50	0.58	0.43	0.79	0.34	0.18
R^2	0.99	0.98	0.98	0.97	0.99	0.99
$No.obs$	520	427	169	187	351	240

Notes: The dependent variable in the regression in *lnTR* . The variables are explicitly defined in table 4. ***,** and * represent the significance levels 0.01, 0.05 and 0.1, respectively. Year dummies are included in the regression but not reported in the table. The parameters of all variables variables and an estimation of the *H-statistic* for the whole time period are provided in table 7 in Appendix A.

Remember that one of the drawbacks with the fixed effect analysis is that we are not able to evaluate the effect of bank-specific invariant characteristics. When the random effects analysis is conducted, we can conclude that the effect on the revenue of a bank having only one visitor office (unit banks) is highly significant and negative, compared to banks with more than one visitor office. Similarly, the effect of being a headquarter bank compared to a bank with visitor offices is positive and highly significant. Since the parameters of the variant regressors are more reliable in the

fixed effect analysis, the values of the parameters obtained by the random effects estimation are not commented here[35].

As expected, the obtained *H-statistics* from the fixed effects and random effects estimations differ in size, where the latter always generates larger estimations than the first, for all time periods and subsamples. Moreover, for the whole sample the fixed effects estimation suggests a decrease in the level of competition between the first and second half of the time period whereas the random effects estimation suggest an increase in the level of competition. For commercial and saving banks both estimations point on the same direction suggesting an increase in the level of competition for commercial banks and a decrease in the level of competition for saving banks between the first and second half of the time period.

5.2 Equilibrium test

As previously mentioned, the market needs to be in long-term equilibrium in order for the *H-statistic* be trustworthy, i.e. to represent the existing degree of competition, and interpretable, i.e. that the *H-statistic* is obtained according to theory. The market is in long-term equilibrium when the null hypothesis $H^{roa} = 0$ cannot be rejected, meaning that the joint effect of the factor input prices on *ROA* is not significantly different from zero. The significance of the joint effect is evaluated by a Wald-test and the empirical results from the equilibrium test are presented in the table 8 below.

Table 8: Empirical result of equilibrium test for different time periods and bank types with fixed effects

	All banks		**Commercial banks**		**Saving banks**	
	2006-2011	**2012-2016**	**2006-2011**	**2012-2016**	**2006-2011**	**2012-2016**
wd	-0.001 (0.003)	-0.001 (0.002)	0.004 (0.005)	-0.002 (0.004)	-0.006 (0.002)***	-0.000 (0.001)
wl	0.001 (0.004)	0.002 (0.003)	-0 003 (0.008)	0.004 (0.006)	-0.005 (0.003)	-0.000 (0.001)
wp	-0.031	-0.010	-0.047	-0.019	-0.011	-0.008

[35] As expected, the values of the *H-statistics* when the random effects are implemented is higher than those when fixed effects are implemented, but lower than when *OLS* is implemented, indicating that when fixed effects are controlled for, the estimates become less biased and more reliable. See Table 8 in Appendix A for the empirical results from the *OLS* analysis.

	(0.003)***	(0.003)***	(0.006)***	(0.009)**	(0.001)***	(0.001)***
$Z4$	0.031	0.017	0.048	0.014	0.015	0.011
	(0.005)***	(0.005)***	(0.011)***	(0.009)	(0.002)***	(0.003)***
MS	0.020	-0.003	0.031	-0.009	-0.006	-0.007
	(0.005)***	(0.006)	(0.010)***	(0.014)	(0.003)**	(0.005)
BR	0.000	-0.000	0.000	-0.000	-0.000	-0.001
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.001)
H^{ROA}	-0.03	-0.01	-0.05	-0.02	-0.02	-0.01
$Wald - test\ for\ HROA = 0$	0.00	0.0032	0.000	0.0459	0.00	0.00
R^2	0.0153	0.0002	0.0054	0.0000	0.0773	0.0025
$No.obs.$	520	427	169	187	351	240

Notes: The dependent variable in the regression is *lnROA.* The variables are explicitly defined in table 4. ***,** and * represent the significance level 0.01, 0.05 and 0.1, respectively. Year dummies are included in the regression but not reported in the table.

The hypothesis that the factor input prices have a significant effect on profits cannot be rejected for any observation. This means that the market is not in equilibrium in any of the observed time periods, neither when the whole sample nor any of the subgroups are considered. However, the power of rejection is lower in the later years for the whole sample and the commercial banks.

Although the main purpose of this test is to evaluate whether the market is in equilibrium it does also provide further information. For example, a bank's market share is shown to have a statistically significant effect on in the early years for both the whole sample and the subsamples. This suggests that larger banks performed better than smaller banks during the latest financial crisis. In addition, banks with higher product differentiation *(z4)* seem to have higher profitability.

The result from the equilibrium test with random effects is reported in table 9 below:

Table 9: Empirical results of equilibrium test for H statistic with random effects

	All banks		**Commercial banks**		**Saving banks**	
	2006-2011	**2012-2016**	**2006-2011**	**2012-2016**	**2006-2011**	**2012-2016**
wd	-0.003	-0.001	-0.002	-0.001	-0.007	-0.001
	(0.002)	(0.001)	(0.004)	(0.003)	(0.002)***	(0.001)
wl	-0.011	0.005	-0.023	0.008	0.000	0.000
	(0.004)***	(0.002)**	(0.007)***	(0.004)*	(0.002)	(0.001)
wp	-0.022	-0.003	-0.031	-0.000	-0.011	-0.006
	(0.002)***	(0.002)	(0.005)***	(0.003)	(0.001)***	(0.001)***
$Z4$	0.030	0.002	0.049	-0.002	0.014	0.011
	(0.004)***	(0.003)	(0.011)***	(0.005)	(0.002)***	(0.002)***
MS	-0.000	0.001	-0.000	0.001	0.001	0.001
	(0.001)	(0.001)	(0.003)	(0.001)	(0.001)	(0.001)
$UNIT$	-0.001	-0.001	0.004	-0.005	-0.001	0.000
	(0.003)	(0.003)	(0.018)	(0.009)	(0.001)	(0.001)
HQ	0.019	0.014	0.025	-0.000	-	-
	(0.004)***	(0.004)	(0.008)***	(0.006)*		
BR	-0.000	0.000	-0.000	-0.000	-0.000	-0.000

	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)*	(0.000)
H^{ROA}	-0.035	0.002	-0,053	0.007	-0.018	-0.006
$Wald - test\ for\ HROA = 0$	0.000	0.306	0.000	0.923	0.000	0.000
R^2	0.15	0.21	0.22	0.24	0.51	0.54
$No.obs.$	520	427	169	187	351	240

Notes: The dependent variable in the regression is *lnROA*. The variables are explicitly defined in table 4. ***,** and * represent the significance level 0.01, 0.05 and 0.1, respectively. Year dummies are included in the regression but not reported in the table.

Noteworthy is that banks with only headquarters are significantly more profitable than other commercial banks with visitor offices. As for unit banks, they seem not to perform significantly different than other saving banks.

For the estimation with random effects, the assumption that the factor input prices have a significant effect on profits cannot be rejected in any of the time periods, except during the later years for the whole sample and the commercial banks. This suggests that the whole banking market and the commercial banking market would be in equilibrium during the later years.

5.3 Robustness test

There are two alternative empirical forms of the P-R methodology, which have been widely implemented in the literature. The first empirical form is the model that has been implemented in the analysis above. The other form uses the ratio of total revenues to total assets, as proxy for the output price, as the dependent variable instead of only total revenues. The output price is closely related to the firm's revenue, as it is the first derivative of the revenue with respect to output. This means that the output price should be in percent equally affected by changes in the factor input prices as the revenue is and can therefore be used as an alternative dependent variable in the model. The model used to test the sensitiveness of our results is presented below, both with fixed effects and random effects and OLS:

Fixed effects:

$$ln\frac{TR_{it}}{TA_{it}} = \alpha_i + \beta_1 lnw1_{it} + \beta_2 lnw2_{it} + \beta_3 lnw3_{it} + \beta_4 lnz1_{it} + \beta_5 lnz2_{it} + \beta_6 lnz3_{it} + \beta_7 lnz4_{it} + \beta_8 lnMS + \beta_9 BR + \beta_{9+i}\sum_{i=1}^{n} year_i + \varepsilon_i \quad (9)$$

Random effects and *OLS:*

$$ln\frac{TR_{it}}{TA_{it}} = \alpha_i + \beta_1 lnw1_{it} + \beta_2 lnw2_{it} + \beta_3 lnw3_{it} + \beta_4 lnz1_{it} + \beta_5 lnz2_{it} + \beta_6 lnz3_{it} + \beta_7 lnz4_{it} + \beta_8 lnMS + \beta_9 UNIT + \beta_{10} HQ + \beta_{11} BR + \beta_{11+i}\sum_{i=1}^{n} year_i + \varepsilon_i \quad (10)$$

The results from the sensitivity tests are reported in table 10 and 11 below:

Table 10: Empirical results robustness test for different time periods and bank types with fixed effects

	All banks		**Commercial banks**		**Saving banks**	
	2006-2011	**2012-2016**	**2006-2011**	**2012-2016**	**2006-2011**	**2012-2016**
wd	0.130 (0.022)***	0.068 (0.016)***	0.178 (0.037)***	0.074 (0.035)**	0.058 (0.031)*	0.008 (0.011)
wl	0.202 (0.038)***	0.195 (0.037)***	0.134 (0.063)**	0.363 (0.056)***	0.107 (0.058)*	-0.015 (0.018)
wp	0.091 (0.023)***	0.055 (0.037)	0.072 (0.045)	0.031 (0.082)	0.075 (0.023)***	0.028 (0.022)
Z4	0.552 (0.039)***	0.533 (0.052)***	0.780 (0.086)***	0.518 (0.086)***	0.418 (0.036)***	0.441 (0.050)***
MS	-0.346 (0.043)***	-0.496 (0.065)***	-0.304 (0.077)***	-0.291 (0.132)**	-0.461 (0.055)***	-0.616 (0.091)***
BR	0.002 (0.001)***	0.001 (0.001)	0.002 (0.001)**	-0.000 (0.002)	0.008 (0.006)	0.025 (0.012)**
$H-stat.$	0.42	0.32	0.38	0.47	0.24	0.02
R^2	0.1029	0.0833	0.5870	0.3808	0.0671	0.0457
No.obs.	520	427	169	187	351	240

Notes: The dependent variable in the regression is *lnp=lnTR/lnTA*. The variables are explicitly defined in table 4. ***,** and * represent the significance level 0.01, 0.05 and 0.1, respectively. Year dummies are included in the regression but not reported in the table.

Table 11: Empirical results robustness test for different time periods and bank types with random effects

	All banks		Commercial banks		Saving banks	
	2006-2011	**2012-2016**	**2006-2011**	**2012-2016**	**2006-2011**	**2012-2016**
wd	0.137 (0.022)***	0.067 (0.019)***	0.163 (0.033)***	0.100 (0.032)***	0.031 (0.033)	0.008 (0.014)
wl	0.150 (0.038)***	0.240 (0.031)***	0.043 (0.060)	0.388 (0.056)***	0.208 (0.053)***	0.008 (0.023)
wp	0.209 (0.022)***	0.274 (0.029)***	0.223 (0.042)***	0.305 (0.050)***	0.121 (0.021)***	0.165 (0.027)***
$Z4$	0.587 (0.041)***	0.441 (0.047)***	0.798 (0.088)***	0.370 (0.071)***	0.411 (0.040)***	0.399 (0.061)***
MS	-0.088 (0.014)***	-0.076 (0.019)***	-0.131 (0.032)***	-0.130 (0.034)***	-0.037 (0.013)***	-0.056 (0.021)***
$UNIT$	-0.098 (0.036)***	-0.134 (0.053)**	-0.077 (0.151)	-0.372 (0.165)**	-0.041 (0.023)*	-0.064 (0.033)*
HQ	0.223 (0.054)***	0.455 (0.066)***	0.057 (0.082)	0.253 (0.097)***	-	-
BR	0.001 (0.000)***	0.001 (0.000)	0.001 (0.001)**	0.001 (0.001)	0.001 (0.004)	0.018 (0.006)***
$H-stat.$	0.495	0.58	0.43	0.79	0.36	0.18
R^2	0.73	0.78	0.81	0.81	0.79	0.73
$No.obs.$	520	427	169	187	351	240

Notes: The dependent variable in the regression is *lnp=lnTR/lnTA*. The variables are explicitly defined in table 4. ***,** and * represent the significance level 0.01, 0.05 and 0.1, respectively. Year dummies are included in the regression but not reported in the table.

From the estimated model we concluded that our main findings obtained by models (5) and (6) are shown to be robust as the *H-statistic* remains mainly unchanged when models (9) and (10) are applied instead. Moreover, the explanatory power of the models is now lower than it was in the models (5) and (6) which supports the choice of econometric model implemented in section 5.

6. Discussion

The *H-statistics* reported in the previous sections indicate that on the overall, competition on the banking market has increased between the years 2006 and 2016. However, the market is found not to be in equilibrium, why the *H-statistics* are not reliable. The disequilibrium confirms that the market undergoes considerable structural changes, which is also suggested by our descriptive statistics. In the absence of equilibrium more efficient banks, i.e. banks that are able to adapt to new market conditions, are able to generate profit while the least efficient banks leave the market. A clear indication of this is that during the last decade the number of commercial banks with only a headquarter have increased whereas the number of saving banks has decreased mainly through mergers of unit banks to larger banks. These trends are

examples of how banks lower their costs and reorganize in order to adapt to changing conditions.

Another explanation to the market disequilibrium might be that banks do not behave according to economic theory, i.e. they are not profit maximizing. However, this is highly unlikely for commercial banks as they have incentives to generate profits to stakeholders. What concerns the incentives of saving banks they might not be as motivated as commercial banks to maximize their profits since their main stakeholders might have other interests. If this is the case, the chosen methodology is not suitable for analysing this market with the existing data set.

Despite the evidence of market disequilibrium, as the estimation is conducted with random effects the results indicate that the whole market and the market for commercial banks are characterized by equilibrium during the later years which is also supported by a lower power of rejection of equilibrium when the estimation is conducted with fixed effects for the later years. Hence, there are indications that the market, and particularly the market for commercial banks, undergoes a period of stabilization. An explanation to this can be that commercial banks are more flexible and are expected to have a capacity to adapt to changes rapidly, although this is not tested in the analysis. In addition, the structural changes presented in this paper have by no means implicated totally new performing conditions but rather a reform of old rules which might had have a minor effect on the settings in which commercial banks operate.

Regarding saving banks, the observed downward trend in terms of number of banks could indicate that the advantage of geographical closeness to customers, which is assume to benefit saving banks, has decreased in importance due to the structural changes on the market. Additionally, the evidence for the importance of product differentiation for the banks' profitability, as well as the positive correlation between product differentiation and scale, might indicate that it is easier for larger banks to offer a sufficiently diverse range of services in order to attract customers, which serves as a disadvantage to smaller saving banks. If this is the reason behind the declining number of savings banks, it would mean that the saving banks will in the

long run disappear if the structural changes remain, by transformation to commercial banks or bankruptcy.

As discussed in section 3.3, the zero-profit constraint does not hold for our sample, as more cost efficient firms are able to generate larger profits. This supports the evidence of market disequilibrium, which makes the *H-statistics* unreliable when it comes to the interpretation of the level of competition on the market. The fact that smaller banks have left the market in a larger extent during the observed time period, in combination with the fact that more cost efficient firms perform better, could indicate that the banking market is characterized by high fixed costs and decreasing marginal costs to scale, which would require firms to increase production in order to be efficient. Hence, it could be the case that structural changes, increasing the requirements of technological investments and larger customer base, could explain the increase in fixed costs that may have forced the smallest banks off the market during the observed time period, although this is not tested in the analysis.

Another interesting result is that the estimated *HHI* has decreased despite the considerable decrease in number of banks on the market. This suggests that smaller banks have a negligible effect on the competitive conduct on the market, and that the general conditions are decided by the performance of the largest banks. Further, the decrease in the *HHI* over time suggests that the largest banks have started to compete harder with each other, and possibly also an increased competitive pressure from foreign banks, although their effect is not observed in our analysis.

7. Conclusion

The purpose of this paper is to empirically evaluate the competitive conditions on the Swedish banking market and its evolution during the last eleven years. The topic is of interest to study, because of the importance of the financial system to the whole economy and because of the considerable number of structural changes that the Swedish banking market has experienced during the last decade, in terms of technological advancements and integration with the European market, for example. In order to evaluate the level of competition on the market, the Panzar-Rosse methodology has been implemented with fixed and random effects.

From the main empirical results of the implemented Panzar-Rosse methodology, it can be concluded that the market is not in equilibrium during the last 11 years. This means that the *H-statistics* estimated in this paper are not reliable. This result supports the evidence of considerable structural changes that might have affected the competitive conditions on the market. However, there are indications on a trend toward stabilization on the market, in particular the commercial banking market, for which we observe a potentially higher level of competition during the later years.

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Appendix A

All prices in in the tables with summary statistics are expressed in thousands of SEK and in the price level of 2006. The value of the variables *UNIT* and *HQ* expresses the share of unit banks/headquarter banks on the market. The variable *BR* represents the number of branches per bank.

Table 1: Summary statistics - all banks

	Mean	Median	Std. Dev	Min	Max
TR_{it}	2609576	148873	10300000	857	76700000
TA_{it}	73600000	2995550	304000000	32096	2010000000
TA_AGG_t	6300000000	6400000000	2040000000	152000000	589000000000
MS_{it}	0.012	0.00047	0.048	0.00000439	0.298
ROA_{it}	1.013	1.012	0.017	0.754	1.262
wd_{it}	0.015	0.012	0.016	0.0004	0.276
wl_{it}	750	712	219	39	2392
wp_{it}	0.017	0.011	0.022	0.001	0.231
$Z1_{it}$	0.804	0.832	0.141	0.077	0.998
$Z2_{it}$	0.003	0.001	0.006	-0.016	0.062
$Z3_{it}$	0.136	0.129	0.061	0.000	0.411
$Z4_{it}$	0.456	0.425	0.139	0.037	0.996
$UNIT_{it}$	0.20	0	0.40	0	1
HQ_{it}	0.15	0	0.36	0	1
BR_{it}	20	3	72	0	478

Table 2: Evolution of the mean values of the variables used in the empirical analysis

	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
TR	2270206	2634949	3437601	2294184	2224746	2644724	2916150	2609059	2888784	2592918	2251822
TA	45800000	56200000	72200000	40500000	71600000	77100000	76100000	79100000	89300000	87500000	8860000
MS	0.010	0.010	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.012
ROA	1.018	1.015	1.010	1.011	1.009	1.009	1.013	1.014	1.016	1.012	1.012
wd	0.015	0.025	0.031	0.010	0.009	0.020	0.019	0.014	0.010	0.008	0.004
wl	680	682	653	714	714	750	747	795	821	860	845
wp	0.015	0.015	0.020	0.019	0.018	0.020	0.020	0.017	0.017	0.017	0.015
$Z1$	0.841	0.806	0.853	0.850	0.829	0.810	0.795	0.769	0.762	0.766	0.762
$Z2$	0.0011	0.0012	0.0035	0.0035	0.0023	0.0031	0.0045	0.0031	0.0026	0.0028	0.0023
$Z3$	0.133	0.137	0.117	0.125	0.126	0.127	0.131	0.143	0.156	0.148	0.147
$Z4$	0.441	0.441	0.440	0.471	0.435	0.442	0.462	0.467	0.475	0.478	0.473
$BRANCH$	0.62	0.65	0.68	0.68	0.67	0.67	0.65	0.64	0.64	0.64	62
$UNIT$	0.27	0.24	0.18	0.18	0.18	0.18	0.19	0.19	0.19	0.18	0.18
HQ	0.12	0.11	0.14	.00.14	0.14	0.14	0.15	0.16	0.18	0.19	0.20

Table 3: Summary statistics - saving banks

	Mean	Median	Std. Dev	Min	Max
TR_{it}	130008	77479	149017	857	1184288
TA_{it}	3121780	1847990	4572012	32096	74100000
MS_{it}	0.0005	0.0003	0.0007	0.00000439	0.011
ROA_{it}	1.011	1.012	0.006	0.977	1.029
wd_{it}	0.014	0.012	0.014	0.001	0.276
wl_{it}	701	698	120	62	1283
wp_{it}	0.011	0.010	0.005	0.001	0.051
$Z1_{it}$	0.836	0.854	0.110	0.077	0.990

$Z2_{it}$	0.002	0.001	0.004	-0.011	0.033
$Z3_{it}$	0.149	0.139	0.049	0.0007	0.325
$Z4_{it}$	0.405	0.403	0.069	0.115	0.805
$UNIT_{it}$	0.293	0	0.450	0	1
BR_{it}	3.434	2	3.293	1	21

Table 4: Summary statistics - commercial banks

	Mean	Median	Std. Dev	Min	Max
TR_{it}	6726227	644020	16000000	47855	0.996
TA_{it}	190000000	9231709	473000000	329668	2010000000
MS_{it}	0.030	0.0014	0.074	0.000049	0.298
ROA_{it}	1.015	1.013	0.026	0.754	1.262
wd_{it}	0.018	0.014	0.019	0.0004	0.214
wl_{it}	831	745	305	39	2392
wp_{it}	0.028	0.012	0.033	0.002	0.231
$Z1_{it}$	0.751	0.780	0.169	0.212	0.998
$Z2_{it}$	0.004	0.001	0.008	-0.016	0.062
$Z3_{it}$	0.114	0.098	0.072	0.011	0.411
$Z4_{it}$	0.543	0.495	0.177	0.037	0.996
$UNIT_{it}$	0.037	0	0.188	0	1
HQ_{it}	0.404	0	0.491	0	1
BR_{it}	48	3	111	0	478

Table 5: Empirical results for H for various time periods and bank types with fixed effects

	All banks			Commercial banks			Saving banks		
	All years	2006-2011	2012-2016	All years	2006-2011	2012-2016	All years	2006-2011	2012-2016
wd	0.084 (0.014)***	0.130 (0.022)***	0.068 (0.018)***	0.128 (0.025)***	0.178 (0.037)***	0.074 (0.035)**	0.018 (0.013)	0.058 (0.031)*	0.008 (0.011)
wl	0.166 (0.023)***	0.202 (0.038)***	0.195 (0.028)***	0.259 (0.041)***	0.134 (0.063)**	0.363 (0.056)***	0.000 (0.020)	0.107 (0.058)*	-0.015 (0.018)
wp	0.146 (0.019)***	0.091 (0.022)***	0.055 (0.037)	0.185 (0.034)***	0.072 (0.045)	0.031 (0.082)	0.077 (0.018)***	0.075 (0.023)***	0.028 (0.022)
$Z1$	0.230 (0.015)***	0.376 (0.049)***	0.149 (0.050)***	0.030 (0.065)	0.127 (0.113)	0.046 (0.111)	0.282 (0.028)***	0.403 (0.056)***	0.047 (0.029)
$Z2$	-1.430 (1.516)	-1.657 (2.141)	5.607 (2.164)**	-0.909 (2.754)	3.848 (4.954)	3.427 (3.410)	-0.488 (1.532)	-1.979 (1.982)	3.765 (1.749)**
$Z3$	0.060 (0.015)***	0.031 (0.018)*	0.086 (0.027)***	0.075 (0.029)***	0.024 (0.047)	0.075 (0.037)**	0.029 (0.013)**	0.018 (0.014)	0.231 (0.087)***
$Z4$	0.536 (0.032)***	0.552 (0.039)***	0.533 (0.053)***	0.649 (0.059)***	0.780 (0.086)***	0.518 (0.086)***	0.429 (0.030)***	0.418 (0.036)***	0.441 (0.050)***
MS	0.696 (0.030)***	0.654 (0.043)***	0.504 (0.065)***	0.780 (0.048)***	0.696 (0.077)***	0.709 (0.132)***	0.511 (0.032)***	0.539 (0.055)***	0.384 (0.091)***
BR	0.002 (0.000)***	0.002 (0.001)***	0.001 (0.001)	0.002 (0.001)***	0.002 (0.001)**	-0.000 (0.002)	0.007 (0.005)	0.008 (0.006)	0.025 (0.012)**
$H-stat.$	0.40	0.42	0.32	0.57	0.38	0.47	0.10	0.24	0.02
$R^2\ adj.$	0.65	0.70	0.43	0.65	0.67	0.45	0.79	0.81	0.80
R^2:									
Within	0.7042	0.7745	0.5723	0.7161	0.7733	0.6148	0.8259	0.8572	0.8480
Between	0.9617	0.9790	0.9401	0.9228	0.9690	0.8938	0.9920	0.9895	0.9694
Overall	0.9690	0.9760	0.9482	0.9485	0.9666	0.9023	0.9816	0.9826	0.9559
$Wald\ test\ for\ H=0$	0.00	0.00	0.0001	0.000	0.00	0.0530	0.00	0.0011	0.3798
$No.obs.$	947	520	427	356	169	187	591	351	240

Table 6: Empirical results for H for various time periods and bank types with fixed effects without Z4

	All banks			Commercial banks			Saving banks		
	All years	2006-2011	2012-2016	All years	2006-2011	2012-2016	All years	2006-2011	2012-2016
wd	0.100 (0.016)***	0.172 (0.268)***	0.079 (0.020)***	0.128 (0.029)***	0.196 (0.047)***	0.106 (0.039)***	0.041 (0.016)***	0.152 (0.037)***	0.011 (0.013)
wl	0.169 (0.026)***	0.268 (0.467)***	0.173 (0.033)***	0.297 (0.049)***	0.239 (0.080)***	0.332 (0.063)***	-0.009 (0.024)	0.141 (0.071)**	-0.050 (0.021)**

wp	0.189 (0.021)***	0.139 (0.028)***	0.016 (0.042)	0.234 (0.040)***	0.133 (0.057)**	-0.103 (0.089)	0.091 (0.021)***	0.110 (0.029)***	0.017 (0.027)
Z1	0.178 (0.036)***	0.358 (0.060)***	0.108 (0.058)*	-0.084 (0.077)	0.035 (0.146)	-0.109 (0.121)	0.300 (0.034)***	0.387 (0.069)***	0.079 (0.035)**
Z2	-2.355 (1.762)	-0.480 (2.627)	6.775 (2.481)***	-5.745 (3.233)*	1.281 (6.426)	3.801 (3.837)	2.553 (1.811)	0.310 (2.434)	6.507 (2.053)***
Z3	0.067 (0.017)***	0.035 (0.060)	0.082 (0.031)***	0.082 (0.035)**	0.065 (0.061)	0.081 (0.042)*	0.044 (0.015)***	0.016 (0.017)	0.590 (0.092)***
MS	0.710 (0.034)***	0.718 (0.053)***	0.439 (0.074)***	0.797 (0.057)***	0.796 (0.099)***	0.553 (0.147)***	0.559 (0.038)***	0.554 (0.068)***	0.750 (0.096)***
BR	0.002 (0.000)***	0.002 (0.001)*	0.000 (0.001)	0.002 (0.001)***	0.002 (1.74)*	-0.001 (0.002)	0.008 (0.006)	0.011 (0.008)	0.023 (0.015)
$H-stat.$	0.46	0.58	0.25	0.66	0.57	0.34	0.12	0.40	-0.02
$R^2\ adj.$	0.53	0.55	0.25	0.50	0.45	0.30	0.70	0.70	0.71
R^2:									
Within	0.5994	0.6594	0.4346	0.5971	0.6140	0.5084	0.7519	0.7816	0.7823
Between	0.9702	0.9717	0.9494	0.9488	0.9499	0.8453	0.9899	0.9875	0.9568
Overall	0.9672	0.9682	0.9328	0.9511	0.9502	0.8339	0.9794	0.9792	0.9486
Wald test for H = 0	0.00	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.56
$No.obs.$	947	520	427	356	169	187	591	351	240

Table 7: Empirical results H for various time periods and bank types with random effects

	All banks			**Commercial banks**			**Saving banks**		
	All years	**2006-2011**	**2012-2016**	**All years**	**2006-2011**	**2012-2016**	**All years**	**2006-2011**	**2012-2016**
wd	0.102 (0.015)***	0.137 (0.022)***	0.067 (0.185)***	0.161 (0.025)***	0.163 (0.033)***	0.100 (0.032)***	-0.001 (0.016)	0.031 (0.033)	0.008 (0.014)
wl	0.181 (0.024)***	0.150 (0.038)***	0.240 (0.031)***	0.233 (0.043)***	0.043 (0.060)	0.388 (0.056)***	0.053 (0.023)**	0.208 (0.053)***	0.008 (0.023)
wp	0.234 (0.018)***	0.209 (0.216)***	0.274 (0.029)***	0.267 (0.032)***	0.223 (0.042)***	0.305 (0.050)***	0.143 (0.018)***	0.121 (0.021)***	0.165 (0.027)***
Z1	0.256 (0.031)***	0.376 (0.040)***	0.226 (0.047)***	-0.001 (0.066)	0.118 (0.093)	-0.003 (0.106)	0.464 (0.026)***	0.585 (0.035)***	0.235 (0.035)***
Z2	-2.270 (1.506)	-5.178 (2.227)**	0.776 (2.107)	3.535 (2.627)	5.770 (4.810)	4.667 (3.226)	-3.091 (1.675)*	-3.041 (2.040)	-3.682 (2.367)
Z3	0.080 (0.015)***	0.063 (0.017)***	0.087 (0.027)***	0.071 (0.030)**	0.052 (0.043)	0.051 (0.038)	0.078 (0.012)***	0.050 (0.013)***	0.362 (0.035)***
Z4	0.454 (0.031)***	0.587 (0.042)***	0.441 (0.047)***	0.464 (0.056)***	0.798 (0.088)***	0.370 (0.071)***	0.428 (0.034)***	0.411 (0.040)***	0.399 (0.061)***
MS	0.904 (0.012)***	0.912 (0.014)***	0.924 (0.019)***	0.845 (0.246)***	0.869 (0.032)***	0.870 (0.034)***	0.959 (0.011)***	0.963 (0.013)***	0.944 (0.021)***
UNIT	-0.093 (0.027)***	-0.098 (0.036)***	-0.134 (0.053)**	-0.260 (0.111)**	-0.077 (0.151)	-0.372 (0.165)**	-0.039 (0.017)**	-0.041 (0.023)*	-0.064 (0.033)*
HQ	0.408 (0.048)***	0.223 (0.054)***	0.455 (0.066)***	0.195 (0.074)***	0.057 (0.082)	0.253 (0.097)***	-	-	-
BR	0.001 (0.000)***	0.001 (0.000)***	0.001 (0.000)	0.002 (0.000)***	0.001 (0.000)**	0.001 (0.001)	0.003 (0.003)	0.001 (0.004)	0.018 (0.006)***
$H-stat.$	0.52	0.50	0.58	0.66	0.43	0.79	0.19	0.34	0.18
$R^2within$	0.68	0.75	0.50	0.68	0.74	0.54	0.78	0.82	0.76
$R^2between$	0.98	0.99	0.98	0.97	0.98	0.97	0.99	0.99	0.99
$R^2overall$	0.98	0.99	0.98	0.97	0.98	0.97	0.99	0.99	0.99
$No.obs.$	947	520	427	356	169	187	591	351	240

Table 8: Empirical results for H for various time periods and bank types with OLS

	All banks			**Commercial banks**			**Saving banks**		
	All years	**2006-2011**	**2012-2016**	**All years**	**2006-2011**	**2012-2016**	**All years**	**2006-2011**	**2012-2016**
wd	0.121 (0.024)***	0.115 (0.035)***	0.098 (0.030)***	0.139 (0.028)***	0.114 (0.043)***	0.135 (0.036)***	-0.009 (0.013)	0.020 (0.036)	-0.023 (0.011)*

wl	0.130 (0.061)**	-0.040 (0.060)	0.273 (0.087)***	0.149 (0.087)*	-0.081 (0.098)	0.343 (0.143)**	0.067 (0.032)**	0.244 (0.064)***	0.013 (0.028)
wp	0.393 (0.034)***	0.320 (0.045)***	0.464 (0.045)***	0.448 (0.046)***	0.361 (0.070)***	0.504 (0.046)***	0.150 (0.024)***	0.140 (0.030)***	0.207 (0.047)***
Z1	0.106 (0.072)	0.138 (0.138)	0.086 (0.102)	0.011 (0.080)	0.158 (0.090)*	-0.054 (0.114)	0.404 (0.118)***	0.424 (0.141)***	0.347 (0.160)**
Z2	4.702 (3.727)	0.253 (5.086)	4.511 (4.582)	10.182 (4.514)**	13.980 (6.485)**	6.560 (4.812)	-1.189 (2.057)	-3.349 (3.102)	-4.487 (3.471)
Z3	0.102 (0.027)***	0.084 (0.033)***	0.139 (0.036)***	0.082 (0.037)**	0.087 (0.042)**	0.103 (0.045)**	0.080 (0.032)**	0.061 (0.029)**	0.152 (0.051)***
Z4	0.346 (0.086)***	0.572 (0.095)***	0.249 (0.108)**	0.317 (0.123)***	0.726 (0.171)***	0.183 (0.125)	10.393 (0.054)***	0.364 (0.063)***	0.367 (0.104)***
MS	0.957 (0.012)***	0.955 (0.011)***	0.8972 (0.018)***	0.934 (0.023)***	0.967 (0.022)***	0.928 (0.026)***	0.992 (0.012)***	0.978 (0.015)***	0.999 (0.020)***
UNIT	-0.085 (0.018)***	-0.040 (0.019)**	-0.121 (0.027)***	-0.186 (0.065)***	-0.009 (0.051)	-0.229 (0.092)**	-0.037 (0.012)***	-0.030 (0.014)**	-0.057 0.019)***
HQ	0.160 (0.043)***	0.121 (0.057)**	0.141 (0.063)**	-0.017 (0.046)	-0.010 (0.067)	-0.029 (0.063)	-	-	-
BR	0.001 (0.000)***	0.001 (0.000)**	0.000 (0.000)	0.001 (0.000)***	0.000 (0.000)	0.000 (0.000)*	-0.002 (0.002)	-0.001 (0.003)	0.001 (0.004)
$H-stat.$	0.64	0.40	0.84	0.74	0.39	0.98	0.21	0.40	0.20
$adj.R2$	0.99	0.99	0.99	0.98	0.99	0.98	0.99	0.99	0.99
$No.obs.$	947	520	427	356	169	187	591	351	240

Table 9: Empirical result of equilibrium test for different time periods and bank types with fixed effects

	All banks			**Commercial banks**			**Saving banks**		
	All years	**2006-2011**	**2012-2016**	**All years**	**2006-2011**	**2012-2016**	**All years**	**2006-2011**	**2012-2016**
wd	-0.003 (0.013)*	-0.001 (0.003)	-0.001 (0.002)	-0.002 (0.003)	0.004 (0.005)	-0.002 (0.004)	-0.001 (0.001)**	-0.006 (0.002)***	-0.000 (0.001)
wl	0.001 (0.002)	0.001 (0.004)	0.002 (0.003)	0.001 (0.005)	-0 003 (0.008)	0.004 (0.006)	-0.001 (0.001)	-0.005 (0.003)	-0.000 (0.001)
wp	-0.019 (0.002)***	-0.031 (0.003)***	-0.010 (0.003)***	-0.029 (0.004)***	-0.047 (0.006)***	-0.019 (0.009)**	-0.010 (0.001)***	-0.011 (0.001)***	-0.008 (0.001)***
Z1	0.010 (0.003)***	0.033 (0.006)***	-0.004 (0.004)	0.005 (0.007)	0.011 (0.014)	-0.009 (0.012)	0.004 (0.001)***	0.010 (0.003)***	-0.001 (0.001)
Z2	0.195 (0.143)	0.811 (0.249)***	-0.029 (0.193)	-0.143 (0.301)	0.541 (0.620)	-0.164 (0.364)	-0.005 (0.072)	-0.007 (0.107)	0.128 (0.087)
Z3	0.008 (0.001)***	0.009 (0.002)***	0.017 (0.002)***	0.016 (0.003)***	0.023 (0.006)***	0.015 (0.004)***	0.001 (0.001)	0.001 (0.001)	0.005 (0.004)
Z4	0.023 (0.003)***	0.031 (0.005)***	0.017 (0.005)***	0.031 (0.006)***	0.048 (0.011)***	0.014 (0.009)	0.011 (0.001)***	0.015 (0.002)***	0.011 (0.003)***
MS	0.001 (0.003)	0.020 (0.005)***	-0.003 (0.006)	0.005 (0.005)	0.031 (0.010)***	-0.009 (0.014)	-0.008 (0.002)***	-0.006 (0.003)**	-0.007 (0.005)
BR	-0.000 (0.000)	0.000 (0.000)	-0.000 (0.000)	-0.000 (0.000)	0.000 (0.000)	-0.000 (0.000)	-0.000 (0.000)	-0.000 (0.000)	-0.001 (0.001)
H^{ROA}	-0.02	-0.03	-0.01	-0.03	-0.05	-0.02	-0.01	-0.02	-0.01
Wald- test for HROA=0	0.000	0.00	0.0032	0.000	0.000	0.0459	0.00	0.00	0.00
$R^2within$	0.2548	0.4091	0.1846	0.3269	0.5833	0.2021	0.5327	0.5920	0.4825
$R^2between$	0.0271	0.0035	0.0236	0.0798	0.0081	0.0117	0.0010	0.0358	0.0058
$R^2overall$	0.0052	0.0153	0.0002	0.0003	0.0054	0.0000	0.0112	0.0773	0.0025
$No.obs.$	947	520	427	356	169	187	591	351	240

Table 10: Empirical results of equilibrium test for different time periods and bank types with random effects

	All banks			**Commercial banks**			**Saving banks**		
	All years	**2006-2011**	**2012-2016**	**All years**	**2006-2011**	**2012-2016**	**All years**	**2006-2011**	**2012-2016**
wd	-0.001 (0.001)	-0.003 (0.002)	-0.001 (0.001)	0.000 (0.002)	-0.002 (0.004)	-0.001 (0.003)	-0.002 (0.001)***	-0.007 (0.002)***	-0.001 (0.001)

wl	0.001 (0.002)	-0.011 (0.004)***	0.005 (0.002)**	-0.001 (0.004)	-0.023 (0.007)***	0.008 (0.004)*	0.000 (0.001)	0.000 (0.002)	0.000 (0.001)
wp	-0.015 (0.001)***	-0.022 (0.002)***	-0.003 (0.002)	-0.016 (0.003)***	-0.031 (0.005)***	-0.000 (0.003)	-0.009 (0.001)***	-0.011 (0.001)***	-0.006 (0.001)***
Z1	0.006 (0.003)**	0.008 (0.004)**	-0.003 (0.003)	-0.002 (0.007)	-0.001 (0.011)	-0.009 (0.008)	-0.002 (0.068)***	0.012 (0.002)***	0.003 (0.001)**
Z2	0.456 (0.128)***	0.006 (0.002)***	0.270 (0.144)*	0.759 (0.262)***	2.148 (0.603)***	0.336 (0.255)	-0.002 (0.068)	0.061 (0.094)	0.022 (0.083)
Z3	0.007 (0.001)	0.006 (0.002)***	0.010 (0.001)***	0.013 (0.003)***	0.011 (0.005)**	0.012 (0.003)***	0.002 (0.000)***	0.002 (0.001)***	0.005 (0.001)***
Z4	0.015 (0.003)	0.030 (0.004)***	0.002 (0.003)	0.015 (0.005)***	0.049 (0.011)***	-0.002 (0.005)	0.011 (0.001)***	0.014 (0.002)***	0.011 (0.002)***
MS	-0.000 (0.001)	-0.000 (0.001)	0.001 (0.001)	-0.000 (0.002)	-0.000 (0.003)	0.001 (0.001)	0.000 (0.000)	0.001 (0.001)	0.001 (0.001)
UNIT	-0.002 (0.002)	-0.001 (0.003)	-0.001 (0.003)	-0.006 (0.010)	0.004 (0.018)	-0.005 (0.009)	-0.001 (0.000)	-0.001 (0.001)	0.000 (0.001)
HQ	0.024 (0.004)***	0.019 (0.004)***	0.014 (0.004)	0.022 (0.006)***	0.025 (0.008)***	-0.000 (0.006)*	-	-	-
BR	-0.000 (0.000)	-0.000 (0.000)	0.000 (0.000)	-0.000 (0.000)	-0.000 (0.000)	-0.000 (0.000)	-0.000 (0.000)*	-0.000 (0.000)*	-0.000 (0.000)
H^{ROA}	-0.015	-0.035	0.002	-0.018	-0,053	0.007	-0.011	-0.018	-0.006
Wald − test for HROA = 0	0.000	0.000	0.306	0.000	0.000	0.923	0.000	0.000	0.000
$R^2within$	0.23	0.33	0.10	0.23	0.42	0.09	0.50	0.57	0.45
$R^2betwee$	0.04	0.09	0.31	0.04	0.08	0.39	0.56	0.55	0.62
$R^2overall$	0.07	0.15	0.21	0.07	0.22	0.24	0.49	0.51	0.54
No. obs.	947	520	427	356	169	187	591	351	240

Table 11: Empirical result of equilibrium test for different time periods and bank types with OLS

	All banks			**Commercial banks**			**Saving banks**		
	All years	**2006-2011**	**2012-2016**	**All years**	**2006-2011**	**2012-2016**	**All years**	**2006-2011**	**2012-2016**
wd	-0.002 (0.002)	-0.004 (0.005)	-0.001 (0.001)	-0.000 (0.002)	-0.003 (0.006)	-0.002 (0.002)	-0.002 (0.000)**	-0.008 (0.002)***	-0.002 (0.001)**
wl	-0.002 (0.005)	-0.019 (0.011)*	0.010 (0.005)**	-0.006 (0.009)	-0.029 (0.018)	0.013 (0.008)	-0.001 (0.001)	0.005 (0.003)*	0.000 (0.001)
wp	-0.006 (0.003)*	-0.014 (0.008)*	0.001 (0.001)	-0.005 (0.006)	-0.020 (0.013)	0.003 (0.002)	-0.006 (0.001)***	-0.010 (0.002)***	-0.006 (0.001)***
Z1	0.000 (0.003)	0.002 (0.005)	-0.003 (0.004)	-0.003 (0.008)	-0.001 (0.012)	-0.006 (0.008)	0.005 (0.002)***	0.008 (0.003)***	0.004 (0.002)*
Z2	0.770 (0.313)**	1.181 (0.716)*	0.517 (0.234)**	0.992 (0.444)**	2.285 (1.235)*	0.604 (0.287)**	-0.143 (0.135)	0.110 (0.175)	-0.013 (0.137)
Z3	0.007 (0.002)***	0.005 (0.002)**	0.010 (0.003)***	0.011 (0.004)***	0.010 (0.005)	0.012 (0.005)**	0.003 (0.001)**	0.002 (0.001)**	0.003 (0.001)***
Z4	0.006 (0.004)	0.021 (0.008)**	-0.002 (0.005)	0.007 (0.008)	0.034 (0.016)**	-0.004 (0.007)	0.010 (0.002)***	0.012 (0.003)***	0.011 (0.004)***
MS	0.001 (0.001)*	0.001 (0.001)	0.002 (0.001)**	0.002 (0.002)	0.003 (0.003)	0.003 (0.002)	0.001 (0.000)**	0.001 (0.001)	0.001 (0.001)
UNIT	-0.000 (0.001)	0.001 (0.001)	-0.001 (0.001)	-0.003 (0.002)	0.008 (0.006)	-0.002 (0.003)	0.000 (0.001)	-0.001 (0.001)	0.000 (0.001)
HQ	0.011 (0.003)***	0.013 (0.005)**	0.008 (0.003)**	0.009 (0.004)**	0.017 (0.010)*	0.005 (0.004)	-	-	-
BR	-0.000 (0.000)	-0.000 (0.000)	-0.000 (0.000)	-0.000 (0.000)	-0.000 (0.000)	-0.000 (0.000)	-0.000 (0.000)***	-0.000 (0.000)*	-0.000 (0.000)*
HROA − stat.	-0.009	-0.04	0.009	-0.01	-0.053	0.01	-0.005	-0.01	-0.007
adj. R2	0.12	0.17	0.22	0.10	0.20	0.21	0.35	0.52	0.54
Wald-test for HROA=0	0.232	0.15	0.50	0.58	0.32	0.23	0.00	0.00	0.00
No. obs.	947	520	427	356	169	187	591	351	240

Table 12: Empirical results robustness test for different time periods and bank types with fixed effects

	All banks			Commercial banks			Saving banks		
	All years	2006-2011	2012-2016	All years	2006-2011	2012-2016	All years	2006-2011	2012-2016
wd	0.084 (0.014)***	0.130 (0.022)***	0.068 (0.016)***	0.128 (0.025)***	0.178 (0.037)***	0.074 (0.035)**	0.018 (0.020)	0.058 (0.031)*	0.008 (0.011)
wl	0.166 (0.023)***	0.202 (0.038)***	0.195 (0.037)***	0.259 (0.041)***	0.134 (0.063)**	0.363 (0.056)***	0.000 (0.018)	0.107 (0.058)*	-0.015 (0.018)
wp	0.146 (0.019)***	0.091 (0.023)***	0.055 (0.037)	0.185 (0.034)***	0.072 (0.045)	0.031 (0.082)	0.077 (0.018)***	0.075 (0.023)***	0.028 (0.022)
$Z1$	0.230 (0.031)***	0.376 (0.049)***	0.149 (0.050)***	0.030 (0.065)	0.127 (0.113)	0.046 (0.111)	0.282 (0.028)***	0.403 (0.056)***	0.047 (0.029)
$Z2$	-1.430 (1.516)	-1.657 (2.141)	5.607 (2.164)**	-0.909 (2.754)	3.848 (4.954)	3.427 (3.410)	-0.488 (1.532)	-1.979 (1.982)	3.765 (1.749)**
$Z3$	0.060 (0.015)***	0.031 (0.016)*	0.086 (0.027)***	0.075 (0.029)***	0.024 (0.047)	0.075 (0.037)**	0.029 (0.013)**	0.018 (0.014)	0.231 (0.087)***
$Z4$	0.536 (0.032)***	0.552 (0.039)***	0.533 (0.052)***	0.649 (0.059)***	0.780 (0.086)***	0.518 (0.086)***	0.429 (0.030)***	0.418 (0.036)***	0.441 (0.050)***
MS	-0.304 (0.030)***	-0.346 (0.043)***	-0.496 (0.065)***	-0.220 (0.048)***	-0.304 (0.077)***	-0.291 (0.132)**	-0.489 (0.032)***	-0.461 (0.055)***	-0.616 (0.091)***
BR	0.002 (0.000)***	0.002 (0.001)***	0.001 (0.001)	0.002 (0.001)***	0.002 (0.001)**	-0.000 (0.002)	0.007 (0.005)	0.008 (0.006)	0.025 (0.012)**
$H-stat.$	0.40	0.42	0.32	0.57	0.38	0.47	0.10	0.24	0.02
$R^2within$	0.8157	0.8314	0.8127	0.7329	0.7483	0.7257	0.9314	0.923	0.9663
$R^2between$	0.0793	0.0312	0.0352	0.4325	0.5454	0.2748	0.0168	0.0096	0.1226
$R^2overall$	0.2156	0.1029	0.0833	0.6112	0.5870	0.3808	0.1143	0.0671	0.0457
$No.obs.$	947	520	427	356	169	187	591	351	240

Table 13: Empirical results robustness test for different time periods and bank types with random effects

	All banks			Commercial banks			Saving banks		
	All years	2006-2011	2012-2016	All years	2006-2011	2012-2016	All years	2006-2011	2012-2016
wd	0.103 (0.015)***	0.137 (0.022)***	0.067 (0.019)***	0.161 (0.025)***	0.163 (0.033)***	0.100 (0.032)***	-0.001 (0.016)	0.031 (0.033)	0.008 (0.014)
wl	0.181 (0.024)***	0.150 (0.038)***	0.240 (0.031)***	0.233 (0.043)***	0.043 (0.060)	0.388 (0.056)***	0.053 (0.023)**	0.208 (0.053)***	0.008 (0.023)
wp	0.234 (0.018)***	0.209 (0.022)***	0.274 (0.029)***	0.267 (0.032)***	0.223 (0.042)***	0.305 (0.050)***	0.143 (0.018)***	0.121 (0.021)***	0.165 (0.027)***
$Z1$	0.256 (0.030)***	0.376 (0.040)***	0.226 (0.047)***	-0.001 (0.065)	0.118 (0.093)	-0.003 (0.106)	0.464 (0.026)***	0.585 (0.035)***	0.235 (0.035)***
$Z2$	-2.271 (1.506)	-5.178 (2.227)***	0.776 (2.107)	3.535 (2.627)	5.770 (4.810)	4.677 (3.226)	-3.091 (1.675)*	-3.0541 (2.040)	-3.682 (2.367)
$Z3$	0.080 (0.015)***	0.063 (0.017)***	0.087 (0.027)***	0.071 (0.030)**	0.052 (0.043)	0.051 (0.038)	0.078 (0.012)***	0.050 (0.013)***	0.362 (0.035)***
$Z4$	0.454 (0.031)***	0.587 (0.041)***	0.441 (0.047)***	0.464 (0.056)***	0.798 (0.088)***	0.370 (0.071)***	0.428 (0.034)***	0.411 (0.040)***	0.399 (0.061)***
MS	-0.096 (0.012)***	-0.088 (0.014)***	-0.076 (0.019)***	-0.155 (0.025)***	-0.131 (0.032)***	-0.130 (0.034)***	-0.041 (0.011)***	-0.037 (0.013)***	-0.056 (0.021)***
$UNIT$	-0.093 (0.027)***	-0.098 (0.036)***	-0.134 (0.053)**	-0.260 (0.111)**	-0.077 (0.151)	-0.372 (0.165)**	-0.039 (0.017)**	-0.041 (0.023)*	-0.064 (0.033)*
HQ	0.408 (0.048)***	0.223 (0.054)***	0.455 (0.066)***	0.195 (0.074)***	0.057 (0.082)	0.253 (0.097)***	-	-	-
BR	0.001 (0.000)***	0.001 (0.000)***	0.001 (0.000)	0.002 (0.000)***	0.001 (0.001)**	0.001 (0.001)	0.003 (0.003)	0.001 (0.004)	0.018 (0.006)***
$H-stat.$	0.51	0.495	0.58	0.66	0.43	0.79	0.19	0.36	0.18
$R^2within$	0.79	0.80	0.77	0.70	0.71	0.67	0.90	0.90	0.94
$R^2between$	0.64	0.69	0.76	0.73	0.84	0.80	0.54	0.43	0.17
$R^2overall$	0.74	0.73	0.78	0.78	0.81	0.81	0.83	0.79	0.73
$No.obs.$	947	520	427	356	169	187	591	351	240

Table 14: Empirical results robustness test for different time periods and bank types with OLS

	All banks			Commercial banks			Saving banks		
	All years	2006-2011	2012-2016	All years	2006-2011	2012-2016	All years	2006-2011	2012-2016
wd	0.121 (0.024)***	0.115 (0.035)***	0.098 (0.030)***	0.139 (0.028)***	0.114 (0.042)***	0.135 (0.036)***	-0.009 (0.013)	0.020 (0.036)	-0.023 (0.012)*
wl	0.130 (0.061)**	-0.040 (0.060)	0.273 (0.087)***	0.149 (0.087)*	-0.081 (0.098)	0.343 (0.143)**	0.067 (0.032)**	0.244 (0.064)***	0.013 (0.027)
wp	0.393 (0.034)***	0.320 (0.045)***	0.464 (0.045)***	0.448 (0.046)***	0.361 (0.070)***	0.504 (0.046)***	0.150 (0.024)***	0.140 (0.030)***	0.207 (0.047)***
$Z1$	0.106 (0.072)	0.138 (0.105)	0.086 (0.102)	0.011 (0.080)	0.158 (0.090)*	-0.054 (0.114)	0.404 (0.118)***	0.424 (0.141)***	0.347 (0.160)**
$Z2$	4.702 (3.727)	0.253 (5.085)	4.511 (4.581)	10.182 (4.514)**	13.980 (0.042)**	6.560 (4.812)	-1.189 (2.057)	-3.349 (3.102)	-4.487 (3.471)
$Z3$	0.102 (0.027)***	0.084 (0.033)***	0.139 (0.036)***	0.082 (0.037)**	0.087 (0.042)**	0.103 (0.045)**	0.080 (0.032)**	0.061 (0.029)**	0.152 (0.051)***
$Z4$	0.346 (0.086)***	0.572 (0.095)***	0.249 (0.108)**	0.317 (0.123)**	0.726 (0.171)***	0.183 (0.125)	0.393 (0.054)***	0.364 (0.063)***	0.367 (0.104)***
MS	-0.043 (0.011)***	-0.045 (0.011)***	-0.028 (0.018)	-0.066 (0.022)***	-0.033 (0.022)	-0.072 (0.026)***	-0.008 (0.012)	-0.022 (0.015)	-0.001 (0.020)
$UNIT$	-0.085 (0.017)***	-0.040 (0.019)**	-0.121 (0.027)***	-0.186 (0.065)***	-0.009 (0.051)	-0.229 (0.092)**	-0.037 (0.012)***	-0.030 (0.014)**	-0.057 (0.019)***
HQ	0.106 (0.043)***	0.121 (0.057)**	0.141 (0.063)**	-0.017 (0.046)	-0.010 (0.067)	-0.029 (0.063)	-	-	-
BR	0.001 (0.000)***	0.001 (0.000)**	0.000 (0.000)	0.001 (0.000)***	0.000 (0.000)	0.000 (0.000)*	-0.002 (0.002)	-0.001 (0.003)	0.001 (0.004)
$H-stat.$	0.64	0.40	0.84	0.74	0.39	0.98	0.21	0.40	0.20
$R^2\ adj.$	0.80	0.79	0.83	0.83	0.84	0.85	0.84	0.80	0.82
$No.obs.$	947	520	427	356	169	187	591	351	240

Appendix B

Table 1: Included Banks

Almundsryds Sparbank (2006-2007)
Attmars Sparbank (2006-2010)
Avanza Bank AB (2006-2016)
Bank2 Bankaktiebolag (2006-2009)
Bergslagens Sparbank AB (2006-2016)
Dalslands Sparbank (2006-2016)
EFG Bank AB (2006-2012)
Ekeby Sparbank (2006-2016)
Erik Penser Bank AB (200
Falkenbergs Sparbank (2006-2016)
Farstorps Sparbank (2006-2007)
Forex Bank Aktiebolag (2006-2016)
Frenninge Sparbank (2006-2014)
Fryksdalens Sparbank (2006-2016)
Färs & Frosta Sparbank AB (2006-2013)
Glimåkra Sparbank (2006)
Göteryds Sparbank (2006-2007)
HQ Bank AB (2006)
Hudiksvalls Sparbank (2006-2016)[36]
Häradssparbanken Mönsterås (2006-2016)
Högsby Sparbank (2006-2016)
ICA Banken AB (2006-2016)
Ikano Bank AB (2006-2016)
Ivetofta Sparbank i Bromölla (2006-2016)
Järvsö Sparbank (2006)
Kinda Sparbank (2006-2007)
Kind-Ydre Sparbank (2008-2016)
Kyrkhults sparbank (2006-2007)
Laholms Sparbank (2006-2016)
Landshypotek Bank AB (2012-2016)
Lekebergs Sparbank (2006-2016)
Leksands Sparbank (2006-2016)
Länsförsäkringar Bank Aktiebolag (2006-2016)
Bjursås Sparbank (2006-2016)
Bluestep Bank AB (2016)
Carnegie Investment Bank AB (2006-2015)
Collector Bank AB (2015-2016)
Långasjö Sockens Sparbank (2006-2007)
Lönneberga-Tuna-Vena Sparbank (2006-2016)
Marginalen Bank Bankaktiebolag (2010-2016)
Medmera Bank Aktiebolag (2007-2016)
Markaryds Sparbank (2006-2016)
Mjöbäcks Sparbank (2006-2016)
Nordax Bank AB (2014-2016)
Nordea Bank AB (2006-2016)
Nordnet Bank AB (2006-2016)
Norrbärke Sparbank (2006-2016)
Närs Sparbank (2006-2016)
OKQ8 bank AB (2009-2016)
Orust Sparbank (2006-2016)
Resurs Bank Aktiebolag (2007-2016)
Roslagens Sparbank (2006-2016)
Röke Sockens Sparbank (2006-2007)
Sala Sparbank (2006-2016)
SBAB Bank AB (2010-2016)
SEB Kort Bank AB (2012-2016)
Sidensjö Sparbank (2006-2016)
Skandiabanken Aktiebolag (2006-2016)
Skandinaviska Enskilda Banken AB (2006-2016)
Skatelövs och Västra Torsås Sparbank (2006-2007)
Skurups Sparbank (2006-2016)
Snapphanebygdens Sparbank (2006-2016)
Sparbanken 1826 (2006-2013)
Sparbanken Alingsås (2006-2016)
Sparbanken Boken (2006-2016)
Sparbanken Eken AB (2008-2016)
Sparbanken Finn (2006-2009)
Sparbanken Gotland (2006-2016)

[36] renamed to Hälsinglands Sparbank from year 2011

Sparbanken Gute (2006-2009)
Sparbanken Göinge AB (2007-2016)
Sparbanken Lidköping AB (2006-2016)
Sparbanken Nord (2006-2016)
Sparbanken Rekarne AB (2006-2016)
Sparbanken Skaraborg AB (2006-2016)
Sparbanken Skåne AB (2014-2016)
Sparbanken Syd (2006-2016)
Sparbanken Tanum (2006-2016)
Sparbanken Tranemo (2006-2016)
Sparbanken Västra Mälardalen (2006-2016)
Sparbanken i Enköping (2006-2016)
Sparbanken i Ingelstorp (2006)
Sparbanken i Karlshamn (2006-2016)
Sparbanken Öresund AB (2010-2013)
Stadshypotek Bank AB (2006)
Svea Bank AB (2012-2016)
Svenska Handelsbanken AB (2006-2016)
Swedbank AB (2006-2016)
Swedbank Sjuhärad AB (2006-2016)
Söderhamns Sparbank AB (2006)
Södra Dalarnas Sparbank (2006-2016)
Södra Hestra Sparbank (2006-2016)
Sölvesborg-Mjällby Sparbank (2006-2016)
Sörmlands Sparbank (2006-2016)
Tidaholms Sparbank (2006-2016)
Tjustbygdens Sparbank Bankaktiebolag (2006-2016)
Tjörns Sparbank (2006-2016)
TF Bank AB (2012-2016)
Tyringe Sparbank (2006)
Ulricehamns Sparbank (2006-2016)
Vadstena Sparbank (2006-2016)
Valdemarsviks Sparbank (2006-2016)
Varbergs Sparbank AB (2006-2016)
Vimmerby Sparbank AB (2006-2007)
Vinslövs Sparbank (2006-2007)
Virserums Sparbank (2006-2007)
Volvofinans Konto Bank AB (2006-2007)
Volvofinans AB (2008-2016)
Westra Wermlands Sparbank (2006-2016)
Ydre sparbank (2006-2007)
Älmeboda Sparbank (2006-2007)
Ålems Sparbank (2006-2016)
Åryds sparbank (2006-2007)
Åse Viste Sparbank (2006-2016)
Åtvidabergs Sparbank (2006-2016)
Ölands Bank AB (2006-2016)

Table 2: Excluded Banks

Santander Consumer Bank AB (2006-2008)
Ålandsbanken Asset Management AB (20016-2016)
Volvo Finans Konto bank 2008 (due to merger with Volvofinans AB)
HQ Bank AB (due to cancelled bank licence and no activity)
Ceptum 2007 (due to bankruptcy and no activity)
Carnegie Investment Bank 2008 (due to extreme value in the variable net provision for non-performing loans)
Carnegie Investment Bank 2010 (due to negative value in the variable input price for physical capital)
Carnegie Investment Bank 2016 (due to no published annual report)
Glimåkra sparbank 2007 (due to no published annual report)