STRATEGIC GROUPS AND BANKS' PERFORMANCE

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Abstract

The theory of strategic groups predicts the existence of stable groups of companies that adopt similar business strategies. The theory also predicts that groups will differ in performance and in their reaction to external shocks. We use cluster analysis to identify strategic groups in the Polish banking sector. We find stable groups in the Polish banking sector constituted after the year 2000 following the major privatisation and ownership changes connected with transition to the mostly-privately-owned banking sector in the late 90s. Using panel regression methods we show that the allocation of banks to groups is statistically significant in explaining the profitability of banks. Thus, breaking down the banks into strategic groups and allowing for the different reaction of the groups to external shocks helps in a more accurate explanation of profits of the banking sector as a whole. Therefore, a more precise ex ante assessment of the loss absorption capabilities of banks is possible, which is crucial for an analysis of banking sector stability. However, we did not find evidence of the usefulness of strategic groups in explaining the quality of bank portfolios as measured by irregular loans over total loans, which is a more direct way to assess risks to financial stability.

Keywords: strategic groups, financial stability, clustering, Ward algorithm, panel regression

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1 Introduction

The theory of strategic groups predicts that groups of similar entities are formed because of the convergent behaviour of some companies operating in a given market. According to the theory, the number of available strategies is limited. By choosing a given strategy a company assigns itself to a certain group. Strategic groups are relatively stable over time, which is a consequence of mobility barriers. In empirical research that applies strategic group theory to the banking sector, it was assumed that a bank's strategy was reflected in the structure of its balance sheet. The shares of particular balance sheet items in total assets or the shares of particular loan categories in total loan portfolio were called strategic variables or strategic dimensions. The aim of this paper is to verify whether strategic groups make it possible to model banks' performance more accurately. We identify strategic groups in the Polish banking sector and test whether their profitabilities differ significantly. Then we use group dummy variables in panel regression models. The statistical significance of a group variable in the panel models both supports the thesis of the significant differences between groups' performances and may improve modeling of banking sector profits, allowing for different reactions of particular groups to external shocks. This could improve the ex ante assessment of the profit-generating potential of banks and thus support a more forward looking approach to the analysis of the stability of the banking sector.

The composition of groups may be disturbed by ownership changes entailing a shift in the strategies of banks. Since there were many mergers and acquisitions in the second half of the 1990s in the Polish banking sector, the stability of groups over time may be hampered. On the other hand, the share of foreign capital in the Polish banking sector increased substantially at that time. This might have widened the scope of services offered by banks, which should be manifested through increased similarity of particular strategic groups.[1] If this is the case, privatisation of the Polish banking sector in the second half of 1990s might have led to the convergence of banks' strategies, followed by the formation of strategic groups.

This article reviews the history (Section 2) and the empirical research (Section 3) regarding strategic groups. The data we use are described in Section 4, whereas Section 5 focuses on the methods and tools used to identify groups and test the hypothesis of the significance of groups in explaining the performance of the banks. Section 6 presents the strategic groups identified in the Polish banking sector and Section 7 concludes and outlines some directions for further research.

2 Strategic groups in theory

The theory of strategic groups was introduced by Hunt (1972) and further developed by Newman (1978). A strategic group is usually defined as a group of companies operating within a single industry that adopt a similar strategy as regards products offered and resources used (Porter, 1979).

[1] This conclusion requires two assumptions: firstly, the scope of services offered by banks increases quicker than the scope of available services in the banking sector and secondly, the scope of available services in the banking sector has its limits.

Thus, within a strategic group, companies make similar decisions in key areas (Koller, 2001), their similar strategies being characterised by similar values of certain variables, called strategic variables or strategic dimensions. Within a group, the strategies of the companies are to a large extent homogeneous, while they differ substantially between groups.

The idea of strategic groups has been popularized by Caves and Porter (1977), who, apart from barriers to entry, introduced the term of barriers to mobility. The concept of mobility barriers was enforced to explain the rationale behind the creation of homogeneous groups of companies. Groups are formed as a result of discontinuity in available strategies, which are unevenly distributed over the space spanned by strategic variables. Porter (1980) states that available strategies prevent a company from taking an entrenched position midway between two strategies.

Mobility barriers may be perceived as a wall separating a given group from its external competition and discouraging a given company from moving to another group. It is believed that mobility barriers may result similar investments being taken by companies within R group that increase their competitiveness and profitability. At the same time, these financially motivated investments prevent or impede access to a given technology or patents to third parties. Such investments may include research into a new technology or invention as well as advertising. In the latter case, the barrier to mobility will comprise a good market position, a recognised brand or the reputation of companies in a group (Ferguson et al., 2000). In such a case mobility barriers emerge as a result of similar activities being undertaken by enterprises. However, they may also result from the provision of similar products. Empirical research confirms the existence of barriers to mobility (Mascarenhas and Aaker, 1989); however, the mechanism of their occurrence has not yet been ultimately identified.

The profitability of a financial institution depends to a large extent on its ability to keep existing and win new customers as well as on the quality of risk management. Therefore, investments that might prove to be significant mobility barriers should to a larger extent involve expenses related to the development of a branch network or risk management models. Expenses related to advertising which, on the one hand, build the bank's brand and, on the other hand, support sales of products that also serve as an indication of the strategy adopted by the bank, may also turn out to be material for the formation of strategic groups.

Adopting the assumption that mobility barriers do exist leads to three conclusions (Leask, 2004), which may be recognised as predictions of the strategic groups theory. First, the theory allows for the existence of strategic groups hierarchy. Groups comprising more effective companies with higher mobility barriers are separated from groups of companies with lower profitability. Second, changes in the environment exert a different influence on particular groups, based on the differences in the impact of external factors, related to various levels of protection regarding the mobility barriers. However, companies within the same group respond in a similar way to changes in external factors. Third, the theory suggests that the lack of mobility between groups results to a large extent from a company's history and its accumulated assets rather than from the nature of investments currently undertaken.

Porter (1979), on the other hand, argues that the existence of strategic groups reduces the level of competition within an industry. It results from co-ordination and co-operation between group members, which takes the competition within particular groups to a level lower than that of competition between groups. The scope of this dependency is conditioned by three factors: the number of groups and the distribution of their shares in the market, the diversity among the groups (the so-called strategic distance) and the level of diversity in the profiles of buyers of services and products (Heene and Houthoofd, 2002).

Co-ordination of activities rather than co-operation seems to be of greater importance for the formation of groups in the banking sector. This is because strategic groups may arise around the common strategies, which may result from following the strategy of a counterparty. For instance, smaller banks often imitate the behaviour of banks that have a stronger market position. This is particularly important in the case of changes in interest rates on loans and deposits. On the other hand, lasting co-operation among banks related to a particular project is rather difficult to imagine at the level of strategic groups, although exceptions occur. An example of interbank co-operation on the level of the whole banking sector might consist of private bank loan registers or private payment systems. Loan syndications are, on the other hand, an example of co-operation among banks, which may occur at the level of a strategic group or beyond.

The development of the strategic groups theory was based on the premise of the explanation of the differences in performance of particular companies operating within the same industry. The existence of mobility barriers does not explain, however, the differences in profits; it only implies that these differences may be sustained over time. In order to explain the origin of differences in the profitability of particular groups, the authors of the strategic groups theory (Porter, 1980) used the structure-conduct-performance (SCP) paradigm. This hypothesis is based on the assumption that the structure of the market, understood in a way that focuses on the size and number of particular players, determines the position of a company in a given market and defines its strategy, which influences its profitability. Thus, initially, the existence of strategic groups was linked to the relative sizes of companies operating in a given market (Caves and Porter, 1978; Caves and Pugel, 1980). Further research, however, expands the analysis to a larger number of strategic dimensions, which generally concern the structure of the balance sheets of particular companies (Passmore, 1985; Amel and Rhoades, 1988).

In this regard, the theory implies that there may exist considerable differences in the profitability of companies among groups, which are sustainable over time. A company will find it difficult to move to a more effective group due to mobility barriers (Caves and Porter, 1977). The theory also predicts different reactions of companies to external shocks, which may entail certain differences in the mechanism of interest rate transmission in particular groups (Kashyap and Stein, 1995). To trigger the intended response of the system to a change in interest rates, the effective monetary policy must therefore take into account, among other things, different reactions of banks from different strategic groups.

Different profitabilities of banks may stem also from the different risk attitudes of banks. They may also be the result of specialisation in particular services on the market.

Regulatory constraints and the level of risk aversion of the shareholders force a bank to accept a particular return from efficient frontier coming out of Markovitz portfolio theory (Hart and Jaffee, 1974) applied to their assets and liabilities structure. Analysis of strategic groups may help to capture portfolio theory effect influencing bank profitability.

3 Review of empirical research

In spite of the criticism expressed towards both the theory and the methodology of identifying strategic groups (Barney and Hoskisson, 1990; Cool and Dierickx, 1993; Ferguson et al., 2000; Hatten and Hatten, 1987; Ketchen and Shook, 1996), the popularity of research on strategic groups has resulted in multiple empirical research aimed at identifying groups in particular industries. Research has been related both to manufacturing companies: the brewing (Tremblay, 1985: Heene and Houthoofd, 2002) and the pharmaceutical industry (Cool and Dierickx, 1993), and to service providers: healthcare (Nath and Grucka, 1907). IT (Duysters and Hagedoorn, 1905), and financial companies: the insurance sector (Fiegenbaum and Thomas, 1993) and the banking sector (Amel and Rhoades, 1988; Mehra, 1996).

Initially, research into strategic groups linked the membership of a company in a group to the relative size of the company (its market share), which resulted directly from the adoption of the structure-conduct-performance hypothesis. Such an approach was used by Porter (1979) and Caves and Pugel (1980). Newman (1978) noticed that the existence of strategic groups may stem from the adoption of various target functions by different companies.

Oster (1982), on the other hand, uses the ratio of advertising expenditure to sales revenues as a strategic variable. She also proposes basing the separation of groups on certain leading variables, i.e. predetermined variables, which would be used in all research related to the identification of strategic groups. It would be difficult, however, to identify such variables for various industries, since some balance sheet items may differ significantly among industries, reflecting different type of activities or the different environment in which companies operate. This, in particular, is the case of the banking sector, since the asset and liability structure of banks differ substantially from the balance sheets of companies from other industries. Oster's (1982) recommendation may be taken into consideration only when conducting research related to a certain industry.

All papers mentioned above assume that strategic groups exist and are defined by a certain variable selected a priori by the researcher (Amel and Rhoades, 1988). Hayes et al. (1983) conducted research aimed at determining whether strategic groups may be singled out within US investment banks without predefining strategic variables. However, to identify groups, they use a simple correlation vector analysis and measure co-movement of banks' earnings, which - as Amel and Rhoades (1988) demonstrated - does not necessarily determine the existence of groups. Passmore's (1985) works round this shortcoming by not predefining strategic variables but analysing the shares of particular balance sheet items in the total portfolios of the 50 largest commercial hanks in the United States. Passsmore divides banks into two groups on the basis of the correlation between particular variables. The identified breakdown overlaps with the classification of banks as wholesale and retail commercial banks.

Amel and Rhoades (1988) agree with Passmore's idea about identifying groups using the shares of particular assets in the total bank portfolio rather than variables based on the profit and loss account. Their justification is based on the assumption that the strategy adopted by a manager should be better reflected in the balance sheet rather than in the financial results. Moreover, such an approach is coherent with the theory that membership of a company in a given group sterns from its history, which is reflected in accumulated assets (cf. Chapter 2). Moreover, Amel and Rhoades (1988) also first used a more refined method of group identification - the cluster analysis, which also allows for grouping using more than one strategic variable. In addition, the authors test the stability of the breakdown into groups, checking whether banks migrate between the identified groups in three different years.

In this respect, the empirical identification of groups thatare sustainable over time is of particular significance, since the definition of a strategic group is related to a time horizon that is longer than one year. A breakdown identified in a given year may stem from adopting short-term strategies or may be accidental (Amel and Rhoades, 1988). The authors identified six groups that were stable over time. The allocation of a bank to a given group does not depend on the size of a bank's assets nor its location (small-large cities, particular slates). The groups identified by Amel and Rhoades (1988) do not overlap with the common classification of banks as wholesale and retail commercial banks.

The concept of strategic groups was created to explain the systematic differences in financial results among companies in an industry. Thus, most of the empirical research was focused on the significance of differences in profitability between particular groups. To that end, most researchers found significant differences in financial results between groups identified, using cluster analysis (Dess and David, 1984: Reger and Huff, 1993; Heene and Houthoofd, 2002). Some of the authors, however, did not detect significant differences in profitabilities that could be explained by allocation to particular groups (Frazier and Howell, 1983; Cool and Schendel, 1987; Martens, 1988). Nevertheless, papers that analysed the banking sectors generally identified significant differences between groups in terms of profitability (Mehra, 1996; Koller, 2001). In addition, the research carried out by Hackethal (2001) showed that only the allocation of a bank to a group based on market variables helped in explaining differences in profitabilities. On the other hand, there were no significant differences in ROA or ROE between the groups identified using resource based variables.[2]

To that end, none of the studies which identified strategic groups in the banking sector has been aimed at explaining earnings while taking profit-risk interdependence into consideration. The earnings of a company operating in the financial sector may be significantly influenced - apart from the quality of management - by the adopted risk profile. Nevertheless, assuming that the risk profile has been already reflected in the balance sheet structure of a bank, the classification of banks into strategic groups, using variables that represent ratios of particular assets over total assets, should make it possible to identify

[2] HilckethaI (2001) introduced two kinds of breakdowns of 624 European commercial banks: one was based on resource-based-view variables, e.g. share of deposits in total assets or the ratio of deposits placed to deposits accepted on the interbank market, whereas the other was based on market-based-view variables, e.g. the average growth in assets or share of loans ill total assets. Thus, each bank was classified into two groups.

groups, which take also the bank's risk profile into account. In the banking sector significant differences should occur not only between profitabilities but also between adopted risk profiles. In this regard, it is worth noting that off-balance sheet positions could be a major source of the risk exposure profile of banks. However, we assume that off-balance sheet positions are mostly used for hedging and therefore do not influence t risk profile to a large extent. This assumption is fully justified for Polish banks but not necessarily for large and complex financial institutions or global investment banks.

Amel and Rhoades (1988) set a kind of benchmark for research on strategic groups in the banking sector. Most of the studies concerning this sector take into account their conclusions that balance sheet-based variables should be used for the identification of strategic groups (Koller, 2001; Hackethal, 2001). Similarly to Amel and Rhoades (1988) and Koller (2001) for Austrian banks, Hackethal (2001) for European banks uses a non-hierarchical cluster analysis as a tool of classification of banks into groups. The basic idea behind breaking down banks into clusters is merging banks using the minimum distance between standardised strategic variables as a criterion.

Since 1979 when Porter first announced his theory and since Amel and Rhoades (1988) applied the theory for banks, the banking sector has undergone a significant transformation, related to deregulation, increased competition, improved risk management techniques and increased reliance on off-balance sheet financing (via securitisation) and exposures (via off-balance sheet special purpose vehicles), which all might have affected the performance of the theory in this new banking environment. Nevertheless, the Polish banking sector is still in its infancy and many of the techniques of the modern banking sector (e.g.: securitisation, off-balance sheet risk management, financing via covered bonds) have yet to be implemented or developed. Thus, we think, that the Polish banking sector at this stage of development and with a relatively small concentration is more similar to the banking sectors of developed economies as they were two-three decades ago.

In this respect, application of the theory and the method of the analysis to the Polish banking sector is more justified than it would be for more developed banking sectors. Nevertheless, the major privatisation in the Polish banking sector in the second half of the 1990s should contribute to increased concentration and convergence of strategies among banks, which would lead to less pronounced distinctions between the groups in the future.

Although most researchers have identified strategic groups in the researched sectors, some of them questioned the existence of any significant breakdowns within industries and claim that strategic groups stem from using false detection methods or are the result of an ad hoc choice of a strategic variable (Thomas and Venkatraman, 1988; Barney and Hoskisson, 1990).

Leask (2004) criticises research on strategic groups. He claims that particular researchers select industry-specific variables, for which the differences may be significant in one industry but not necessarily in another. Similarly to Oster (1982), he criticizes the fact that there is no standard for selecting variables constituting strategy dimensions, which is why they are somewhat subjective. He proposes focusing on several predefined strategic variables, so that the results of research become comparable. Other criticism concerns the lack of a unified method used to classify companies into groups and errors in the use of techniques based on cluster analysis. Leask notes that the majority of researchers do not

use any test for consistency of results that would be alternative to cluster analysis per se. Another common error is including significantly correlated variables in analyses, which results in multiple use of the same information.

Leask's requirement that the same set of strategic variables be applied to identify strategic groups cannot be met in the case of the banking sector, due to different characteristics of the balance sheets of financial institutions when compared to those of manufacturing companies. Nevertheless, while selecting strategic variables we took into account most of the balance sheet structure variables analysed by Amel and Rhoades (1988) and Koller (2001). Thus, we attempted to make our research comparable with other research on strategic groups in the banking sector.

In spite of the criticism, the research seems to have achieved a certain level of analytical standard, which makes it possible to claim that it has become a recognised field of research (Heene and Houthoofd, 2002).

4 Data - strategy dimensions

The data analysed in this paper come from the banking statistics of the national Bank of Poland, which collects mandatory monthly financial reports from all commercial banks operating in Poland, including three banks associating cooperative banks, from the period between the first quarter of 1997 and the third quarter of 2004. The banks that went bankrupt during that time or were managed by a board of trustees were included, too. The data include the balance sheet items as at the end of March, June, September and December[3] or quarterly data for the profit and loss account items. The ratios related to the strategic variables were derived from yearly data. For balance sheet data, the arithmetic mean was calculated for particular items as at the end of each quarter. For profit and loss account items, the ratios were calculated using the values of particular items as at year-end. If a bank terminated its operations or was taken over by another bank during a year, it was included into the analysis until the end of the year preceding its liquidation or acquisition.

The measure of homogeneity (similarity) in the cluster analysis is the degree of diversity between particular strategic variables in subsequent periods. We have classified these variables into three categories:

Category I: variables describe the strategy of use of acquired resources.

They define the market segment or the product group in which a given bank focuses its activity. Some of the ratios also characterise major customer groups - on the asset side:

- total loans / total assets
- loans to individuals / total loans
- housing loans / loans to households
- corporate loans / total loans
- securities / total assets

[3] Data on Treasury bills are an exception - the average of their balances at the end of every month of a quarter was taken into account instead, due to the high volatility of this asset category.

- foreign currency loans / foreign currency liabilities.

Category II: variables describe the strategy of acquiring resources. The ratios below define the way a bank acquires resources to finance assets and measure its competitiveness in this area. Some of the variables characterise also customer groups - on the liabilities side.

- Net debt on the interbank market / total assets
- Debt in foreign financial institutions / total assets
- Deposits from individuals / total assets
- Corporate deposits / total assets
- Foreign currency deposits from non-financial sector / total assets.

Category III: variables describe the strategy in a bank's structure of costs and revenues. They are taken into account in order to differentiate between retail and wholesale banks.

- Total assets per employee (the lower the ratio, the more retail the bank is - more numerous customer service staff)
- Salaries / total assets
- Fee income / income from banking activity (indicates whether the bank focuses on the margin income or income from services)
- Personnel costs per employed.[4]

We used all the variables mentioned above jointly to identify strategic groups. In addition, separate clusters were identified for the three categories. Thus, we classified banks on the basis of a multidimensional analysis, i.e. analysis of clusters in three different dimensions defined by variables from particular categories, as well as on the basis of a one-dimensional analysis taking into account clusters identified using all variables jointly. Such an approach aims, among other things, at defining which of the categories of variables (which of the dimensions) help in explaining the banks' earnings the most. However, in the panel regression analysis we did not use a multidimensional analysis, since we needed only one breakdown to define dummy variables.

According to theoretical deliberations, potential variables that arc strategy dimensions should include such values as risk management quality, the ability to maintain the existing and win new customers, expenses for the development of a branch network and risk management models, or expenditure on advertising. Furthermore, some other variables, not necessarily linked to the ratios based on balance sheets or profit and loss accounts, such as marketplace, customer type, pricing strategy, marketing strategy, risk management quality, bank risk aversion, etc, may also have an influence on the classification of a bank into a strategic group. Although it is commonly assumed in the strategic group literature that the strategy linked to these variables should have already been reflected in the strategic dimensions, as measured by the balance sheet ratios, more research is needed to test whether this is actually the case. Nevertheless, this is beyond the scope of this paper,

[4] In the categories II and III we considered a few other ratios as well: however, they were excluded from further analysis due to their high correlation (over 0.6) with other variables from the set.

though it leaves some room for further research. Moreover, these variables are unavailable in the banking statistics or they are difficult to measure, which is why taking into account the measures of e.g. management quality could give rise to doubts as regards its definitions. However, apart from balance-sheet based relations we used also ratios based on other data to include some other strategy dimensions. For instance, we assume that expenses incurred in the development of a branch network or expenditure on advertisement should be reflected in the variables that we take into account.

5 Adopted research method

5.1 Grouping of banks

There are many methods of grouping of companies. According to Halkidi et al. (2001), the following clustering procedures can be differentiated:

- partitional clustering - consists in partitioning the population into a predetermined number of clusters. The number of clusters is determined on the basis of a predetermined optimisation criterion (e.g. minimisation of the loss of information),
- hierarchical clustering - groups are obtained recursively as a result of agglomerating smaller clusters into larger ones, and the adequate indicator of the cut-off level (e.g. the inconsistency ratio) is used as a criterion of stopping the procedure before obtaining only one group,
- density-based clustering - clusters are formed in such a way that the appropriately measured density of the elements in clusters is increased,
- grid-based clustering - groups are created as a result of dividing the element feature space into cubes. By this very simple method, clusters are created from single cubes that elements of the population fall into.

Of these four types of clustering methods only two - partitional and hierarchical - were able to be considered in the work for this article. The grid-based clustering method requires predefined partition of values of variables applied in the algorithm for grids, whereas by the density-based clustering method the choice of the tolerance parameters is usually tricky and algorithms might be very sensitive to the initial values of the parameters. Moreover, density-based procedures perform well if clusters are supposed to be convex sets in data space. Finally, hierarchical methods handle noisy observations and outliers in a better way than partitional clustering. For the above mentioned reasons, we decided to use the hierarchical clustering method. Nevertheless, consistency of results was tested by using different measures of distance applied in this clustering algorithm. Last but not least, the results of the hierarchical clustering analysis can be visualised in form of dendrograms, which is of undeniable importance when analysing consistency of results.

Cluster analysis does not end up with the mere classification of items to groups. The adequacy of the results has to be justified by carrying out significance tests in terms of selected analysis criteria or the purpose of building of clusters. These can be done by applying some statistical or econometric tests. In the case of the models that lack a defined probabilistic structure (e.g. when clusters are fuzzy sets) adequate validity indices may be used alternatively.

While grouping the banks, we used Ward's algorithm. This allows the minimization of distances between variables within a group, i.e. maximization of the group's homogeneity. The advantage of this hierarchical method is that it makes illustrating interdependencies between groups possible. The so-called dendrograms that are created during the visualisation of the algorithm allow for the definition of distances between clusters and the isolation of elements that are most alike within a given group, as well as elements that fit less well into the cluster, in terms of the clustering criterion used. Ward (1963) pointed out that the purpose of his research was to find a breakdown of a population, which would minimise the loss of information about the population, resulting from the clustering process. In his search for optimal clustering, Ward limited himself to procedures that, in each step, decrease the number of groups by 1 and minimise the loss of information. Ward's (1963) approach was a compromise between the simplicity of the scheme and its optimality in the broadest meaning.

Ward's procedure comprises n subsequent steps, where n is a number of elements (in this paper, the elements are banks) of the starting set. Ward assumed that a structure where every two elements belong to two different groups contains the fullest information about the elements of the examined set. In step zero, one-element groups are created from all the elements of the examined population. In every following step of the algorithm, two groups remaining from the previous step of the procedure arc merged in a way that will minimise the increase in the cost of information loss, i.e. - as Ward assumed - the $d_i^2(G,H)$ value, where:

$$d_i^2(G,H) = n_G n_H \frac{\left\| \overline{x}_G - \overline{x}_H \right\|^2}{n_G + n_H} \tag{1}$$

where $\overline{x}_G$, $\overline{x}_H$, n_G and n_H are mean values of elements from sets G and H and their sizes, respectively, minimised after all breakdowns of GH obtained in step i-1 into sets G and H ($G \cup H = GH$ and $G \cap H = 0$). In other words, two groups are merged in a given step, if no other pair of groups with a smaller distance between them can be found. When two groups are merged, the procedure goes to the next step. Next, d_i^2 is a measure of distance - the groups are identified with their "mean" element (the average representative) and the Euclidean distance between them is calculated. In a given step only two groups are merged, whereas all the others remain unchanged.

Robustness of clustering results was tested by means of Ward algorithm with different distance measures: "mean" and "average" (Gordon, 1999). For each year, we reported the percentage of banks which were classified to the same group applying three different measures of distance.

As a result of applying the procedure mentioned above, all the elements of a population are clustered, i.e. the procedure does not leave any elements unclassified. The algorithm itself does not have any mechanism that would allow it to be stopped before the creation of one group of all the elements (banks), when m groups ($1 < m < n$), are created. However, when analysing the hierarchy of the groups created in subsequent steps, we can use some additional criteria to stop the algorithm. Such a criterion could, for instance, as-

sume what part of the variance should be explained. Nevertheless, since the larger the number of groups (clusters), the more variance is explained, the number of clusters should not be excessively large, either, as it would make identification of groups that remain stable over time more difficult. On the contrary, too small a number of clusters may lead to creating clusters comprised of banks of different activity or risk profiles, which will affect profitability in different ways.

However, the problem of selecting the cut-off level may be avoided through the use of an adequate variant of the method based on a group cohesion index, e.g. Celinski-Harabasz index, Dunn index, etc. (Halkidi et al., 2001). For a predetermined number of clusters, which are supposed to result from the use of a selected method of clustering, an index is calculated. Then the breakdown that gives the highest value of the index is the optimal one. Nevertheless, the choice of an index itself usually is an issue of controversy.

In the initial phase of our research, a cut-off rule was adopted, which was used to isolate more than one group. It is based on the so-called inconsistency ratios, which measure the weight of linkages created between elements comprising particular groups - the" closer" to each other the two elements are in terms of their isolated features (the more they are alike), the lower the inconsistency ratios. A number of groups proved to be sensitive to the level of criterion adopted. Slight changes in the cut-off level caused a two-fold increase in the number of groups.

However, a different criterion turned out to be better for stopping the procedure. We defined the distance level above which building of subsequent groups was stopped. The stopping level was defined as a percentage of the maximum distance between groups, which merging in the next step would result in the whole studied population becoming one single group. In other words, it represents the percentage of the distance between groups in the case where there is no stopping criterion and, as a result of using the algorithm, there are only 2 groups left. The percentage of the distance was determined at 70%. Therefore, the stopping level defines the depth down to which the merging of the population elements into groups takes place.

Alternatively, the balance between the number of clusters and explained variance may be defined with the use of "jack-knifing", i.e. through defining a boundary (acceptable) percentage of unclassified banks, e.g. at 10%, or with the use of discriminative analysis, i.e. finding a boundary (optimal) percentage of explained variance on the basis of the adopted optimisation criterion (target function).

5.2 Strategic groups and banks' performance

When comparing the classification of items into clusters in different years, a question arises about the stability of the allocation in time. Thus, before delving into banks' performance within and between groups we had to find out whether clusters obtained using Ward's algorithm form sustainable strategic groups. Clusters have been calculated on the basis of annual data from 1997 and 2005. To assess the stability of the groups we used the percentage of banks migrating between the clusters identified in different years.

The main aim of this paper is to verify whether allocating banks into strategic groups improves modelling of the financial result of the banking sector as a whole. This may be the case only if the performance differs significantly between the groups. Thus, we test the following hypothesis:

- *H0: The identified groups differ significantly in terms of their performance.*

Since the breakdown of banks into groups should help in defining different profitability levels, the return on assets - as one of the profitability measures - was used to test the diversity of groups.[5] Should two groups of identical distributions emerge, there would be no use in differentiating between them. Thus, Kolmogorov-Smirnov statistics was used (Gajek and Kaluszka, 2000) to test whether the distributions of the following ratios: *net income from banking activity / total assets and the pre-tax earnings / total assets* differ significantly between groups. This test is very sensitive to the shape of distribution around the mean due to the way of defining the distance of distributions as the maximum distance between the points of the cumulative distribution function. It also generates relatively high Type II errors, although it has a relatively high power for smaller samples (Capon, 1965; Smirnov, 1948). The null hypothesis for each pair of groups is the equality of profitability distributions in the groups. The hypothesis was tested on three significance levels - 0.01, 0.05 and 0.10.

To test the main hypothesis we run also panel regression models of three variables - pre-tax earnings over total assets (ROA), non-interest income over total assets (NII) and irregular loans over total loans (IRL). Let us denote them as variables of type *DEP,* i.e. dependent variables. Should ROA and NII be explained by different explanatory variables, it would support hypothesis H0 about performance differences among the identified groups. Moreover, if the parameters of the same explanatory variable differ significantly among the models for different groups, it would indicate that banks' reaction to external shocks - the value of the parameter - depends, among other things, on the banks' allocation to the groups. In this regard, the significant group variable would also support the view that banks behave differently between the groups and similarly within the group, since there exist a similar though unidentified commonality in banks' behaviour within the group. This would be in line with the strategic group theory, which claims that reactions to shocks are an important factor of groups' differentiation.

The IRL variable is not related to banks' earnings but reflects the quality of assets of banks and may, nevertheless, be important in banking sector stability analysis. Hence, we tested the following hypothesis H0':

- *H0': The identified groups differ significantly in terms of their loan portfolio quality.*[6]

Possible differentiation between the groups in terms of loan portfolio quality would suggest that banks' strategies may be related to the adopted risk profiles. Although in the strategic group literature this topic has so far hardly been given attention, we think this is an interesting issue which deserves testing. However, to put this hypothesis into context, it is worth noting, that although loan portfolio quality may be a result of many different parameters, such as credit market segment, type of customers, sector composition of the portfolio, quality of the lending practices, etc., or the market strategy of a company, it does

[5] In order to explain differences in profitability, other authors use also return on equity ratio.

[6] The literature casts doubts on the application of IRL as a measure of loan quality suggesting that rather a ratio of non-performing loans to total loans should be used instead. Nevertheless, we use a more common measure of the quality of loans since the differences between the two ratios are not big in the period we analyse.

not necessarily determine the profitability of a bank, since this also stems from the pricing policy, or pricing strategy, of a bank. The interaction of these two strategies results in the positioning of a bank in the space of performance distribution. Thus, even if the strategic groups differ in terms of profitability, it does not imply that they differ in terms of credit quality. The opposite statement is true, too.

Table 1: Variables used in panel regression

Variable	Type	Lags	Description
AEq	*BANK*		assets over tier1 capital
C2Income	*BANK*	1y	cost-income ratio
CLoans2T	*BANK*	1y	corporate loans over total loans
DepCorp2A	*BANK*		corporate deposits over total assets
DepMinLoans2A	*BANK*		deposits less loans over total assets
Foreign	*BANK*		0-1 variable: 1 indicates that a bank at a given point of time is foreign owned
FXLoans2A	*BANK*		foreign currency loans over total assets
Group*(k)*	*GROUP*		0-1 variable: 1 indicates that a given bank belongs to group number *k*
HipoL2HL	*BANK*	1y	mortgage loans to households over total loans to households
HipoL2T	*BANK*		mortgage loans to households over total loans
IrrLoans2T	*BANK*, *DEP*		(IRL) irregular loans to total loans
IrrMedian	*BANK*		dierence between IrrLoans2T and a median value of IrrLoans2T for all banks at the end of given quarter (IFRS led to signif. changes in ratios of irregular loans after Dec 31, 2005)
LoansA	*BANK*	1y	loans over total assets
LogA	*BANK*		log (assets)
NII2A	*BANK*, *DEP*		(NII) non-interest income over total assets
NII2AMedian	*BANK*, *DEP*		(NIIm) dierence between NII2A and a median value of NII2A for all banks for a given quarter (to compensate for changes in denition of non-interest income due to IFRS)
ROA	*BANK*, *DEP*	1y	return on assets (pretax earnings to total assets)
RecDepI	*BANK*		interbank loans received less placed in other banks over total assets
TBillsA	*BANK*		t-bills of Polish government over total assets
GDP	*MACRO*	1-8q	GDP y/y
HHI	*MACRO*		Herndahl-Hirschman Index of concentration of banks' assets
IFRS	*MACRO*		0-1: 1 for quarters after Dec 31, 2005, when banks were allowed to adopt IFRS (eg. classication of NII has changed)
PPI	*MACRO*	1y	purchasing power parity
Wibor3Mq	*MACRO*		3 month WIBOR rate
WIG20q	*MACRO*		quarterly change of WIG20 stock exchange index on Warsaw Stock Exchange

Source: authors' specification

Variables of type *DEP* were regressed on variables of type *GROUP* and on the controlling variables of two types, which may influence banks' financial results or be relevant for the risks to which a bank is exposed. Each variable Group$^{(k)}$, $k \in \{1, ..., 5\}$, from type *GROUP* indicates that a given bank belongs to group number k, i.e. has value 1 if the bank belongs to group k and 0 otherwise. The first type of controlling variables - the bank specific type (*BANK)* - encompasses banks' balance sheet and profit and loss account indicators, the second one - the macroeconomic type (*MACRO*) covers variables describing the macroeconomic environment, in which banks operate and indicating some changes in the financial accounting standards. In table 1 we presents detailed definitions of the variables. We control for many factors commonly used in the vast literature on the subject (see e.g. DeYoung and Rice (2004); Goddard et al. (2004); Stiroh (2002)), however, not for all variables used in the cluster analysis. This was impossible, as some of the series used for grouping were highly correlated and caused colinearity problems.

We eatimated the following equations:

$$\text{var}_{it}^{DEP} = \alpha_0 + Group_i^{(k)} + \text{var}_{it}^{BANK}\,\beta_1 + \text{var}_t^{MACRO}\,\beta_2 + u_{it} \qquad (2)$$

where var_{it}^{DEP} is one of the 4 dependent variables, var_{it}^{BANK} stands for the bank specific variables, var_t^{MACRO} are macroeconomic variables, which vary only in time and $u_{it} := \varepsilon_{it} + \mu_i$ is an error component with random individual effects μ_i.

Taking into account the goal of the paper, a key variable among the regressors is that describing adherence of banks to strategic group (Group$^{(k)}$). Each panel regression was performed on the whole sample of variables; however we used only one of the group variables in each model, i.e. we tested, whether an allocation of a bank to a given group provides additional information which improves the explanation of the independent variable. If the parameter at variable Group$^{(k)}$ is statistically significant in a given equation for a given dependent variable var^{DEP} it means that, controlling for bank specific variables, var^{DEP} differs on average in group k from other banks in financial system. Thus, H0 cannot be rejected. The significance of the parameter would also suggest that the group variable is important in modelling var^{DEP} in the Polish banking sector, which implies that strategic groups may improve the prediction of the banking sector results or risk taken. This is an important implication for financial stability analysis of the banking sector, since ignoring strategic group variables in a model of banks' profitability or loan portfolio quality could blur the assessment of banks' growth potential, asset quality or banks' credit risk, which all are crucial elements of the financial stability analysis.

Having identified the stable composition of groups after 2000, we assumed that group composition in 2005 applies to the entire 2000-2005 period. This is a strong assumption, however, it is sufficient for comparison purposes.

Since groups do not change in time, random effect estimation (General Least Square (GLS) procedure, Swamy-Arora method (SWAR)) had to be used. This allows both the cross-bank and the time-series variation included in the observations to be controlled while unobserved individual effects are simultaneously embedded. In the second theoretically possible type of model - a fixed effects one - only parameters of variables that change in

time can be estimated. As Baltagi (2001) suggests, SWAR gives asymptotically efficient general least square estimators, which are better - in this respect - then OLS and *within* estimators. Since there is no evidence which of the known GLS methods (eg. SWAR., Amemiya or Nerlove) provide more accurate estimates, we applied the most popular one.

Consistency of the random effect estimators was verified by means of the Hausman test. Hypothesis of no individual effects in the model (2) $\mathrm{cov}(u_{it}, u_{is}) = 0$ for $s \neq t$) was verified by the Breusch-Pagan Lagrange Multiplier test and *ANOVA F* test based on comparison of *within* and *pooling* estimation. In case of inconsistent estimators in the random effect model we used a Hausman-Taylor (HT) model as a remedy (Baltagi et al., 2003). We tested consistency of HT estimators (in other words strict exogeneity of instruments) by means of the Hausman test comparing *within* and HT estimators (HT vs FE test). The following instrumental variables were used in the regressions: C2Income, AEq, LogA, IrrMediana, HipoL2T, WIG20q in equations explaining ROA; ROA1yLag, C2Income1yLag, AEq, LogA, HipoL2T, WIG20q in equations explaining IRL; and C2Income, AEq, LogA, IrrMediana, HipoL2T, WIG20q in equations for NII. The reader can find more about the adopted procedures for testing hypothesis for panel regressions in Baltagi (2001).

The estimations were run on the period from 1st quarter 2000 to 4th quarter 2005. The maximum lag we used was 2 years (on GDP).

6 Results

6.1 Identified groups

Should the strategic groups exist, the allocation of banks to clusters should not differ much in time. Figure 1 presents an analysis of the stability of the clusters identified in one-dimensional analysis over time, i.e. an attempt to identify strategic groups in the Polish banking sector.

All banks, which until 2005 were independent organisations, are sorted on the basis of their assignment to the cluster in 2005. The one-dimensional clustering allowed identification of the following groups of banks, the names of which were determined on the basis of the dominant profile of bank business in particular clusters: *universal banks, corporate banks, car finance banks, mortgage banks, retail banks and regional banks* that associate cooperative banks. However, it is important to notice that naming of the identified groups is not necessary for further analysis, in particular, to run the panel regressions or to support our hypothesis. We could use the numbering of the groups instead. Nevertheless, to make our results more intuitive and related to the different banks' business profiles, which we think the identified groups adequately represent, we named the groups.

To support our view on the accuracy of the allocation of banks to the groups in respect to their business profiles, consider the group of *universal banks*, which consist of all largest Polish commercial banks, which operate both on the consumer as well as on the corporate credit market. The *car finance* group consists of five banks that specialise only in car financing and have well known car brand names in the firm name (Daimler-Chrysler, GM, FORD, Volkswagen, Toyota). Moreover, the *retail banks* group is com-

posed of relatively new banks, whose strategy is based on relying on their own strong depository base, such as Bank Porztowy (Post bank), which has offices in most of the post offices across Poland or Lukas bank and Dominet bank, which started to build their own depository base in big consumer trade centres or stores.

Table 2: Clusters of banks - cumulative table

No.	1999	2000	2001	2002	2003	2004	2005	Bank name
1	1	5	1	1	1	*	1	LUKAS B. Swietok. SA
2						1	1	Polski Kred. B./HSBC Polska
3	1	5	5	1	1	1	1	B. Pocztowy SA
4	1	1	1	1	4	2	1	GE Cap. B. SA
5	1	1	1	1	4	2	1	AIG B. (Pol) SA
6	6	2	2		4	2	1	CC B. SA
7					1	5	1	B. SPOLEM SA
8	5	5	5	1	1	5	1	Dominet B. SA
9	6	6	6	2	5	2	2	Gosp. B. Wielk. SA
10				2	2	2	2	HYPO-B. (Pol) SA
11	6	6	6			2	2	B. Pol. Spoldz. SA
12	6	6	6	2	5	2	2	Maz. B. Reg. SA
13	6	2	2	2	2	2	2	Rheihyp-BRE Hip. SA
14				2	3	3	2	Danske B. (Pol) SA
15	2	2	2	2	3	3	2	Westd. Landesb. (Pol) SA
16	2	2	2	2	3	3	2	Rabob. (Pol) SA
17	2	2	2	2	5	5	2	BGK SA
18	2	3	3	5	3	3	3	ABN AMRO B. (Pol) SA
19				3	3	3	3	DZ B. (Pol) SA
20	5	3	3	3	3	3	3	Raffeisen-Centrob. SA
21	5	3	3	3	3	3	3	Cred. Lyonnais B. (Pol) SA
22	2	3	3	3	3	3	3	BNP-Dresdner B. (Pol) SA
23	5	3	3	3	3	3	3	Deutsche B. (Pol) SA
24					3	3	3	MHB B. (Pol) SA
25				3	3	3	3	B. of Tokyo-Mitsub. (Pol) SA
26	*	2	6	1	2	2	4	DaimlerChrysler Serv. B. SA
27	1	1	6	1	4	2	4	GMAC B. SA
28	1	1	6	1	4	2	4	FORD B. (Pol) SA
29	1	1	6	1	4	2	4	Volksw. B. (Pol) SA
30		2	6	1	4	2	4	Toyota B. (Pol) SA
31	5	3	3	3	3	3	5	BH SA (in Citigroup)
32	5	3	3	3		3	5	BW Euro SA
33	5	5	5	1	1	5	5	PKO BP SA
34	5	5	5	5	5	5	5	ING BSK SA
35	5	5	5	5	5	5	5	B. Przem.-Handl. SA
36	5	5	5	5	5	5	5	WBK SA
37	5	3	3	3	5	5	5	BRE Bank SA
38	6	6	5	5	5	5	5	B. Millenium SA
39	5	5	5	5	5	5	5	B. Pekao SA
40					5	5	5	BISE SA
41	5	5	5	5	5	5	5	Nordea B. Polska SA
42	5	5	5	5		5	5	Kredyt B. SA
43	5	5	5	5	5	5	5	BOS SA
44	5	5	5	1	1	5	5	GBG SA
45	5	3	5	5	5	5	5	Fortis B. SA
46	1	5	1	1	1	5	5	Invest B. SA
47	5	5	5	1	1	5	5	DB 24 SA
48	5	5	5	5	5	5	5	BGZ SA

Bank group number: 1 – retail; 2 – mortgage; 3 – corporate; 4 – car industry; 5 – universal; 6 – regional.

*Note: In this case, symbol * denotes banks that are not classied.*

Source: own calculations.

Table 3: Kolmogorov-Smirnov test for distributions of ROA measures in the groups of banks

Cutting level	0.6
Comparison of distributions of	pre-tax earnings

Percentage of rejected null hypotheses		Year								
Clusters by variables	**Significance level**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**Total**
All categories jointly	0.01	0.0	0.0	0.0	0.1	0.1	0.1	0.3	0.3	0.8
	0.05	0.2	0.2	0.1	0.2	0.3	0.1	0.6	0.8	2.6
	0.10	0.3	0.4	0.2	0.2	0.3	0.4	0.6	0.8	3.3
All categories jointly	Suma	0.6	0.6	0.3	0.5	0.7	0.6	1.5	2.0	6.7
Category I (assets)	0.01	0.0	0.2	0.0	0.0	0.0	0.0	0.3	0.0	0.5
	0.05	0.3	0.3	0.0	0.0	0.0	0.3	0.5	0.0	1.5
	0.10	0.3	0.3	0.0	0.3	0.0	0.7	0.5	0.0	2.2
Category I (assets)	Suma	0.7	0.8	0.0	0.3	0.0	1.0	1.3	0.0	4.2
Category II (liabilities)	0.01	0.0	0.0	0.2	0.0	0.1	0.0	0.0	0.0	0.3
	0.05	0.4	0.0	0.3	0.3	0.6	0.0	0.3	0.2	2.1
	0.10	0.5	0.5	0.5	0.6	0.7	0.0	0.3	0.3	3.5
Category II (liabilities)	Suma	0.9	0.5	1.0	0.9	1.4	0.0	0.7	0.5	5.9
Category III. (financial result)	0.01	1.0	0.3	0.0	0.0	0.0	0.0	0.0	0.0	1.3
	0.05	1.0	0.7	0.0	0.3	1.0	0.0	0.7	0.0	3.7
	0.10	1.0	0.7	0.0	0.3	1.0	0.7	0.7	1.0	5.3
Category III (financial result)	Suma	3.0	1.7	0.0	0.7	2.0	0.7	1.3	1.0	10.3
	Total	5.1	3.6	1.3	2.4	4.1	2.3	4.8	3.5	27.1

Cutting level	0.7
Comparison of distributions of	pre-tax earnings

Percentage of rejected null hypotheses		Year								
Clusters by variables	**Significance level**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**Total**
All categories jointly	0.01	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.3	0.5
	0.05	0.2	0.3	0.0	0.0	0.2	0.2	0.7	0.8	2.3
	0.10	0.2	0.3	0.0	0.5	0.5	0.5	0.7	0.8	3.5
All categories jointly	Suma	0.3	0.6	0.0	0.5	0.7	0.7	1.5	2.0	6.3
Category I (assets)	0.01	0.0	0.0	0.0	0.0	0.0	0.0	0.7	0.0	0.7
	0.05	0.3	0.3	0.0	0.0	0.0	1.0	0.7	0.0	2.3
	0.10	0.3	0.3	0.0	0.3	0.0	1.0	0.7	0.0	2.7
Category I (assets)	Suma	0.7	0.7	0.0	0.3	0.0	2.0	2.0	0.0	5.7
Category II (liabilities)	0.01	0.0	0.0	0.2	0.3	0.1	0.0	0.0	0.0	0.6
	0.05	0.0	0.0	0.3	0.7	0.6	0.0	0.3	0.0	1.9
	0.10	0.0	0.0	0.5	0.7	0.7	0.0	0.3	0.7	2.9
Category II (liabilities)	Suma	0.0	0.0	1.0	1.7	1.4	0.0	0.7	0.7	5.4
Category III (financial result)	0.01	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0
	0.05	1.0	0.0	0.0	0.3	1.0	0.0	0.7	0.0	3.0
	0.10	1.0	0.0	0.0	0.3	1.0	0.7	0.7	0.0	3.7
Category III (financial result)	Suma	3.0	0.0	0.0	0.7	2.0	0.7	1.3	0.0	7.7
	Total	4.0	1.3	1.0	3.2	4.1	3.3	5.5	2.7	25.0

Cutting level	0.6
Comparison of distributions of	net income from banking activity

Percentage of rejected null hypotheses		Year								
Clusters by variables	**Significance level**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**Total**
All categories jointly	0.01	0.0	0.1	0.0	0.5	0.3	0.2	0.2	0.0	1.2
	0.05	0.2	0.1	0.3	0.5	0.4	0.3	0.3	0.3	2.5
	0.10	0.3	0.2	0.3	0.5	0.5	0.5	0.3	0.5	3.3
All categories jointly	Suma	0.5	0.4	0.7	1.5	1.2	1.1	0.8	0.8	7.0
Category I. (assets)	0.01	0.0	0.2	0.0	0.0	0.3	0.7	0.5	0.3	2.0
	0.05	0.3	0.5	0.0	0.0	0.7	0.7	0.7	0.5	3.3
	0.10	0.6	0.5	0.0	0.3	0.7	0.7	0.7	0.5	3.9
Category I (assets)	Suma	0.9	1.2	0.0	0.3	1.7	2.0	1.8	1.3	9.2
Category II (liabilities)	0.01	0.0	0.0	0.3	0.0	0.3	0.0	0.0	0.2	0.8
	0.05	0.3	0.5	0.7	0.2	0.4	0.2	0.0	0.3	2.6
	0.10	0.6	0.7	0.8	0.4	0.4	0.2	0.0	0.7	3.7
Category II (liabilities)	Suma	0.9	1.2	1.8	0.6	1.1	0.3	0.0	1.2	7.1
Category III (financial result)	0.01	0.0	0.0	0.0	0.7	0.0	0.0	0.0	0.0	0.7
	0.05	0.0	0.0	1.0	0.7	0.0	0.3	0.0	0.0	2.0
	0.10	0.0	0.3	1.0	0.7	0.0	0.3	0.3	0.0	2.7
Category III (financial result)	Suma	0.0	0.3	2.0	2.0	0.0	0.7	0.3	0.0	5.3
	Total	2.3	3.1	4.5	4.4	4.0	4.1	3.0	3.3	28.7

Cutting level	0.7
Comparison of distributions of	net income from banking activity

Percentage of rejected null hypotheses		Year								
Clusters by variables	**Significance level**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**Total**
Sve kategorije zajedno	0.01	0.3	0.2	0.3	0.0	0.2	0.3	0.2	0.0	1.5
	0.05	0.5	0.5	0.5	0.0	0.5	0.5	0.3	0.3	3.2
	0.10	0.7	0.5	0.5	0.2	0.5	0.7	0.3	0.5	3.8
Sve kategorije zajedno	Suma	1.5	1.2	1.3	0.2	1.2	1.5	0.8	0.8	8.5
Category I (assets)	0.01	0.0	0.0	0.0	0.0	1.0	1.0	0.7	0.3	3.0
	0.05	0.0	0.0	0.0	0.0	1.0	1.0	0.7	0.7	3.3
	0.10	0.0	0.0	0.0	0.3	1.0	1.0	0.7	0.7	3.7
Category I (assets)	Suma	0.0	0.0	0.0	0.3	3.0	3.0	2.0	1.7	10.0
Category II (liabilities)	0.01	0.0	0.0	0.3	0.0	0.3	0.0	0.0	0.0	0.6
	0.05	0.0	0.0	0.7	0.0	0.4	0.2	0.0	0.7	1.9
	0.10	0.0	0.3	0.8	0.0	0.4	0.2	0.0	0.7	2.4
Category II (liabilities)	Suma	0.0	0.3	1.8	0.0	1.1	0.3	0.0	1.3	4.9
Category III (financial result)	0.01	0.0	0.0	0.0	0.7	0.0	0.0	0.0	0.0	0.7
	0.05	0.0	0.0	1.0	0.7	0.0	0.3	0.0	0.0	2.0
	0.10	0.0	0.0	1.0	0.7	0.0	0.3	0.3	0.0	2.3
Category III (financial result)	Suma	0.0	0.0	2.0	2.0	0.0	0.7	0.3	0.0	5.0
	Total	1.5	1.5	5.2	2.5	5.3	5.5	3.2	3.8	28.5

Note: Percentages of null hypothesis rejections reported.

Furthermore, the existence of all groups and the reliability of the allocation of banks to the groups in 2005 cluster could be supported by an expert assessment. Membership of banks in groups identified in 2005 overlaps to a large extent with the classification by the General Inspectorate of Banking Supervision (GINB), which is based on the inspection knowledge of the major business lines of Polish banks. Apart from this, there exists no other classification of Polish banks, so we could not further cross check the results of the allocation. Nevertheless, since the allocation overlaps to a large extent with the GINB classification and is in line with the banks' main business profiles, we adopt the naming of the groups and the allocation of banks identified in the 2005 cluster for further analysis.

The most stable over time are groups of *corporate* and *universal banks*. Less stable are groups of *retail* and *mortgage banks*. The least stable group is the *car finance* group, but it stems from a relatively small number of banks in this group. In the years 1997-2001 there was also a stable group of *regional banks*. Some banks tended to migrate between the groups, particularly prior to 2000, but there are also banks, which did not change their group membership over the whole period.

Robustness check, i.e. classification by means of different measures of distance, showed significant improvement in consistency of the clustering results over time. In 2000, only 56.6% of banks were classified to the same group irrespectively of the distance measure. In 2003, the ratio rose to 65% and further increased to 77.6% in 2005. Certainly, the differences in the composition of groups resulting either from different sets of descriptive variables and the clustering methods can impact the verification of the hypotheses. However, we chose the clustering algorithm which has a very intuitive interpretation in terms of the loss of information (see subsection 5.1). We also focused on the broad, expert-based range of variables exhibiting an economically meaningful relationship with the strategies of banks.

The analysis of dendrograms and the analysis of sustainability of clusters over time, measured as a percentage of banks migrating between clusters, allowed us to make a statement that groups stable over time can only be singled out starting from the year 2000. This may be related to significant changes of the ownership of banks in the years 1998-1999 followed by the extensive privatisation program. The further consequent stabilisation of groups may be an indication of converging strategies, whereby groups of banks follow similar strategies adopted from their major investors.

The percentages of rejected null hypotheses of the Kolmogorov-Smirnov test on the lack of a significant difference between the distributions of *the pre-tax earnings / total assets or net income from banking activity / total assets* ratios among the banks assigned to particular clusters are reported in Table 3 for three significance levels. The percentages are presented for clusters identified for particular categories (the multidimensional analysis) and for all the categories jointly (the one-dimensional analysis). For example "0.5" on Table 3 on the crossing of row "Category I (assets) 0.05" and column "2003" means that 50% of null hypothesis about equal distributions of ROA of Kolmogorov-Smirnov tests at the 5% significance level was rejected for all pairs of groups of banks found using Category I variables in year 2003. The higher the percentage of rejections the stronger the support of the thesis that groups differ in the distribution of profitability measured by

ROA. The aim of this exercise is to help in identifying the categories and years, in which significant differences in distributions of pre-tax earnings or net income from banking activity emerge.

It stems from Table 3 that significantly higher percentages of rejected null hypotheses of the Kolmogorov-Smirnov test are only for variables of *Category I* (from the multidimensional analysis) and for all the variables jointly (one-dimensional analysis). These results are consistent with those of Hackethal (2001), who identified differences in profitability between groups of European banks, but only using of market based variables (cf. Chapter 3). However, the percentages are higher only for the years 2000-2004, and in particular for the income from banking activity. No major differences have been observed in the distributions of profitability ratios: *pre-tax earnings / total assets and net income from banking activity / total assets* for other dimensions, i.e. for variables of *Categories II and III.* This means that the membership of a bank in a given group may be important for the explanation of differences in profitability after the year 2000, but only for groups identified of the basis of all variables jointly or on the basis of variables of *Category I*. In terms of the net income from banking activity, the percentage of rejected hypotheses is also higher between 1997 and 1999; however, the existence of strategic groups that would be meaningful for the explanation of differences in profitability in those years, cannot be confirmed when using *pre-tax earnings / total assets* instead.

The results of the analysis seem to suggest that strategic groups in the Polish banking sector can be identified only after the year 2000. Therefore, we have obtained a preliminary confirmation of the hypothesis that the strategy adopted by a bank leads to differences in performance, but only for the second half of the analysed period. The next subsection elaborates on the issue of the usefulness of the classification of banks into groups in modeling basic variables that characterize bank performance.

6.2 Hypothesis testing

For further analysis we have adopted the clusters identified for 2005 as the composition of strategic groups in the Polish banking sector between 2000 and 2005 and used them to define the groups' dummy variables. The Celinski-Harabasz index, calculated for the 2005 data, proves that the adopted cut-off level adequately characterised the number of clusters.[7]

Tables 4, 5 and 6 (see Appendix) present estimates of panel regression with random individual effects of ROA, NIl and IRL, respectively. For each group three different models were reported. The first model includes all explanatory variables but the null hypotheses of the Hausman test were rejected in all these models. This means that the random effects estimators are biased. For other models usually the null hypothesis of the Hausman test cannot be rejected, which means that random effects estimators are more effective than the fixed effects estimators. However, in this case, there is a risk of model misspecification, since too narrow a set of dependent variables may result in inconsistent estimates of parameters in the models. That is why we conducted HT method of estimation on a wide set of *DEP* variables. Table 7 (see Appendix) shows results of application of

[7] The highest value of the index that we have obtained corresponds to 5 clusters

Hausman-Taylor estimators to the models with the same set of explanatory variables as in the first model presented in Tables 1, 4, 5 and 6 for corresponding *GROUP* and *DEP* variables. Using the Hausman test we compared *within* and HT estimators and did not reject null hypothesis of consistency of HT estimates for every model.

Neither of the models for ROA with the *retail* group as explanatory *GROUP* variable passed the Hausman test. The Hausman-Taylor estimator confirmed the insignificance of retail and pointed to the insignificance of corporate group. However, other groups proved to be important in explaining ROA in models with random individual effects. Controlling for leverage, cost effectiveness, risk taken and share of non interest income in total assets as well as including market concentration, business cycle and stock exchange performance into the regressions, we found dummy group variables to be statistically significant at the minimum 10% significance level. Thus, classifying banks into groups could improve the explanation and prediction of ROA at the individual bank level as well as at the banking sector level. Moreover, the parameters of the same explanatory variables differ significantly among the models for different groups.

The usefulness of the strategic groups in explaining the quality of loans as measured by irregular loans seems to be less promising when taking into account the very poor results of the Hausman test in case of models for IRL for most of the *GROUP* variables. In fact, the only group that was statistically significant was the group of *corporate banks*. However, we do not control for all effects in this model. HT estimators are significant only for *retail* and *universal* banks on 10% significance level. At the 5% level irregular loans in banks from the *universal* group are not statistically different than in other groups. Therefore, we conclude that the *mortgage*, *corporate* and *car industry* groups do not help in explaining the share of irregular loans.

The lack of explanatory power of groups in the IRL models may result from the fact that the existence of strategic groups that differ in terms of profitability does not imply that the groups differ in terms of loan portfolio quality. Moreover, the data set we used in panel regression did not cover the full business cycle when the full variability of credit quality should emerge. However, it may also stern from the problems with the explanatory variable we used in our panel regressions. There were many changes in the loan classification criteria during the analysed period, which created structural breaks. Furthermore, banks in Poland did not write off lost loans from their balance sheets for tax reasons, which may lead to the problems with stationarity of the variables. In fact, recently Głogowski (2008) has found evidence of the usefulness of our classification of banks into groups in modelling loan portfolio quality using another variable, namely, net flow of loan loss provisions, which is in Poland a more stable-over-time measure of loan quality.[8]

On the other hand, group variables were significant in explaining NIl in the case of *retail* and *mortgage* bank groups. Application of HT estimator has even broadened the set of groups that are, significant in explaining differences in non-interest income between banks. Only the group of car industry banks was not significant. Similarly as in the case

[8] Nevertheless, further research is needed to answer to the question about the relationship between irregular or nonperforming loans and business profile reflected into the strategic group classification. Perhaps, a more reliable and comparable set of data on loan portfolio quality, e.g. collected in line with recently introduced IFRS reporting standards, is needed.

of the models for ROE, parameters for the same variables differ significantly among the groups. Thus, our classification of banks to the groups could be very helpful in modelling the non-interest income, too.

7 Conclusions

The cluster analysis proved to be useful in identifying the strategic groups in the Polish banking sector. However, stable groups had formed only after the year 2000, which may be associated with the major ownership changes in the Polish banking sector that took place between 1998 and 1999.

Following the analysis the panel regression analysis and using the Kolmogorov-Smirnov test we can make a statement that the classification of banks into strategic groups improves modelling of the banking sector profitability in terms of return on assets and net interest income. Thus, it should also improve the forecasting performance of the banking sector earnings. Moreover, the significance of group variables and the significant differences among the parameters of the same explanatory variables across the models for different groups suggest that the identified groups differ both in performance and in the way the banks allocated to particular groups react to the shocks to keep earnings on predefined levels.

The breakdown of banks into groups did not help, however, in modelling the quality of loan portfolios as measured by the share of irregular loans in total loans but the issue should be investigated more deeply.

Making use of the theory of strategic groups in identifying the structure of the banking sector facilitates a more accurate ex ante assessment of the banks' potential and thus the stability of the financial system.

APPENDIX

Table 4: Estimation of regression for ROA

Variables	Group 1			Group 2			Group 3			Group 4			Group 5		
1 AEq	-0,074	-0,055	-0,055	-0,069	-0,049	-0,053	-0,07	-0,054	-0,054	-0,071		-0,049	-0,067	-0,057	-0,054
	***	***	***	***	***	***	***	***	***	***		***	***	***	***
2 C2Income	-0.016	-0.008	-0.009	-0.017		-0.007	-0.018	-0.008	-0.008	-0.015	0.013		-0.017	-0.016	-0.01
	***	*	**	***		*	***	*	*	***	***		***	***	**
3 CLoans2T	0.002			0.007			0.007			0.005			0.007		0.006
				**			**			*			**		**
4 CLoans2T1yLag															
5 DepCorp2A	0.001	-0.008	-0.008	0.001		-0.003	-0.004	-0.009	-0.008	0.003			-0.005		
		*	*					.	.						
6 DepMinLoans2A	-0.014			-0.012			-0.012			-0.012			-0.009		
	***			**			***			***			*		
7 Foreign		0.005	0.005										0.005	0.004	0.003
		***	***										***	***	**
8 FXLoans2A	0.003			0.003			0.003			0.008			0.002		
										.					
9 Group 1	-0.009	-0.008	-0.009												
	***	***	***												
10 Group 2				0.002	0.004	0.003									
					.	.									
11 Group 3							0.003	0.004	0.004						
							*	.	.						
12 Group 4										0.015	0.009	0.011			
										***	*	**			
13 Group 5													-0.004	-0.005	-0.003
													*	*	.
14 HipoL2T	0.009	0.004		0.011			0.013			0.011		0.006	0.013		0.008
	.			*			**			*			**		*
15 IrrLoans2T															
16 IrrMediana	-0.004	-0.004	-0.004	-0.004	-0.005	-0.004	-0.004	-0.005	-0.005	-0.004	-0.005	-0.005	-0.004	-0.004	-0.004

	*	**	**	*	**	**	**	***	**	*	**	***	**	**	**
17 LoansA	-0.019			-0.017			-0.018			-0.024			-0.016		
	***			***			***			***			***		
18 LogA	-0.001	-0.002	-0.002	-0.001	-0.001	-0.001	-0.001	-0.001	-0.001	-0.001		-0.001	-0.001	0	-0.001
	*	**	**												
19 NII2A															
20 NII2AMedian	0.788	0.489	0.488	0.649	0.421	0.321	0.618	0.284	0.283	0.694	0.59	0.361	0.523	0.192	0.362
	***	***	***	***	**	*	***	*	*	***	***	**	***		*
21 RecDepI	0.009			0.007			0.007			0.008			0.006		
	***			**			**			***			**		
22 TBillsA	-0.006			-0.005			-0.005			-0.005	0.011				
	.										***				
23 GDP7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	*	***	***	*	***	***	**	***	***	*	*	***	**	*	***
24 HHIa	0.188	0.027	0.021	0.184	0.011	0.036	0.177		0.023	0.187			0.179	0.062	0.054
	*			*			.			*			*		
25 PPI1	0			0			0			0			0		
26 Wibor3Mq	0			0			0			0			0	0	
	**			**			**			**			**	***	
27 WIG20q	0.002	0.001	0.001	0.002		0.001	0.002	0.001	0.001	0.003			0.003		
28 No. observ.	984	984	984	984	984	984	984	984	984	984	984	984	984	984	984
29 R2	0.27	0.24	0.24	0.26	0.2	0.21	0.26	0.21	0.21	0.27	0.06	0.21	0.28	0.24	0.23
30 Hausman	92.9	24	25.5	157.8	11.7	12.3	134.7	10.6	10.6	81.2	6.1	8.7	83.6	20.1	14.7
	***	*	**	***	.		***			***			***	*	
31 Breusch-Pagan	97.1	61.6	65.2	121.1	434.9	417.3	101.5	421.5	421.2	137.5	398.7	319.6	72.9	203.3	118.2
	***	***	***	***	***	***	***	***	***	***	***	***	***	***	***
32 F-test	6.3	3.6	3.7	7	7.7	7.6	6.7	7.6	7.6	6.4	7.1	6.5	5.4	5.6	4.4
	***	***	***	***	***	***	***	***	***	***	***	***	***	***	***

*Note: *** detotes 0.001 signicance level, ** -0.01, * -0.05 and . -0.1.*

Source: own calculations.

Table 5: Estimation of regression for IRL

Variables	Group 1			Group 2			Group 3			Group 4			Group 5		
1 AEq	-0.098			-0.148			-0.151			-0.148			-0.152		-0.214
	*			**			**			**			**		***
2 C2Income		0.216	0.215										0.168	0.179	
		***	***										***	***	
3 C2Income1yLag	0.002			0.01	0.035	0.205	0.008	0.088	0.199	0.01	0.035	0.203			
						***		***	***			***			
4 CLoans2T	0.28			0.264	0.247		0.252	0.26		0.265	0.243				
	***			***	***		***	***		***	***				
5 DepCorp2A	-0.14			-0.183	-0.05		-0.191			-0.182			0.12		
	**			***			***			***			*		
6 DepMinLoans2A													-0.212		
													***		
7 FXLoans2A	-0.026			-0.016			-0.024			-0.027			-0.012		
8 Group 1	0.106	-0.033	-0.013												
	**														
9 Group 2				-0.039	-0.06	-0.018									
					.										
10 Group 3							0.056	-0.007	0.074						
									*						
11 Group 4										-0.099	-0.117	-0.042			
											*				
12 Group 5													0.006	0.007	0.001
13 HipoL2HL1yLag														0.048	
														**	
14 HipoL2T	-0.106		-0.209	-0.101			-0.101			-0.104			-0.177		-0.255
	*		***	.			.			*			***		***
15 LoansA	0.095			0.087			0.096			0.104			-0.082		
	*			*			**			**					
16 LogA	0.011			0.005		0.012	0.007			0.004			0.018		

		.				*							**		
17	NII2AMedian	-4.82		-4.648	-4.218			-3.988			-4.191			-5.088	-4.697	
		**		**	**			*			**			**	**	
18	RecDepI	0.139	0.112	0.108	0.159			0.167		0.076	0.162		0.072	0.222		0.118
		***	***	***	***			***		***	***		***	***		***
19	ROA1yLag				-1.082		-0.709	-1.082			-1.048					
					***		*	***			***					
20	TBillsA			-0.054												
				.												
21	GDP7	-0.011	-0.018	-0.024	-0.011	-0.011	-0.015	-0.011	-0.017	-0.015	-0.011	-0.011	-0.015	-0.015	-0.015	-0.025
		***	***	***	***	***	***	***	***	***	***	***	***	***	***	***
22	HHIa	5.33	4.851		5.259	6.178		5.306			5.259	6.392		6.126	5.11	
		***	***		***	***		***			***	***		***	***	
23	PPI		-0.006	-0.011										-0.005		-0.013
			***	***										**		***
24	PPI1	-0.004			-0.004			-0.004	-0.009		-0.004				-0.005	
		.			.			.	***		.				***	
25	Wibor3Mq	-0.002			-0.002			-0.002			-0.003			-0.001		0.003
		.			.			.			.					***
26	WIG20q	-0.04			-0.038	-0.018	-0.05	-0.037	-0.06	-0.047	-0.038		-0.046	-0.012		
		.			.		*		**	.	.		.			
27	No. observ.	984	984	984	984	984	984	984	984	984	984	984	984	984	984	984
28	R2	0.3	0.23	0.22	0.31	0.24	0.13	0.31	0.22	0.13	0.31	0.24	0.13	0.29	0.22	0.19
29	Hausman	43.9	0	2.3	32.7	26.1	5	32.9	31.5	0.7	31.1	17.6	0.1	38	2.6	1.4
		***			**	***		**	***		*	**		***		
30	Breusch-Pagan	1,431.5	1,811	1,717.9	1,376.3	1,514	1,581.9	1,374.2	1,548.8	1,359.5	1,417.3	1,663.7	1,581.1	1,348.2	1,836.8	1,921.5
		***	***	***	***	***	***	***	***	***	***	***	***	***	***	***
31	F-test	19.3	17.7	17.5	19.1	18.4	16.6	18.7	18.9	14.4	19.2	18.4	16	18.6	18.4	18.9
		***	***	***	***	***	***	***	***	***	***	***	***	***	***	***

*Note: *** detotes 0.001 signicance level, ** -0.01, * -0.05 and . -0.1.*

Source: own calculations.

Table 6: Estimation of regression for NII

Variables	Group 1			Group 2			Group 3			Group 4			Group 5		
1 AEq	0.001	0		0			0			0			0.001		
	.														
2 C2Income	-0.003		-0.003	-0.002	-0.003	-0.002	-0.002	-0.003	-0.002	-0.002	-0.003	-0.002	-0.002	-0.003	-0.003
	**		***	*	***	***	*	***	***	**	***	***	**	***	***
3 CLoans2T	-0.002	-0.003	-0.001	-0.003	-0.003	-0.002	-0.003	-0.003	-0.002	-0.003	-0.003	-0.002	-0.003		
	.	***		***	***	**	***	***	*	***	***	*	***		
4 DepCorp2A	0			-0.001			-0.001			-0.001			-0.001	0	0
5 DepMinLoans2A	0			0			0			0			0		
6 FXLoans2A	-0.003			-0.003		0.001	-0.003			-0.003			-0.003		
	*			*		.	*			**			*		
7 Group 1	0.004	0.005	0.005												
	***	***	***												
8 Group 2				-0.002	-0.003	-0.003									
				**	**	**									
9 Group 3							-0.001	-0.001	-0.001						
10 Group 4										-0.003	-0.001	-0.001			
										*					
11 Group 5													-0.001	-0.002	-0.001
12 HipoL2T	-0.002	-0.001	-0.002	-0.003			-0.003			-0.003			-0.003		
				*			*			*			*		
13 IrrLoans2T		-0.002	-0.002		-0.002	-0.002		-0.002	-0.002		-0.002	-0.002		-0.002	-0.002
		**	*		*	.		.	*		*	*		**	**
14 IrrMediana	-0.001			-0.001			-0.001			-0.001			-0.001		
	*			.			.			.			.		

15 LoansA	0.006			0.006			0.006			0.007			0.007		
	***			***			***			***			***		
16 LogA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	*	*	*					.			.			.	
17 RecDepI	-0.001			0			0			0			0		
18 TBillsA	0.001			0.001			0.001			0.001			0.001		
	*			.			.			.			*		
19 GDP4	0	-0.001	0	0		0	0			0			0		
	.			*			.			*			.		
20 HHIa	-0.002			-0.001			-0.001			-0.001			-0.002		
21 IFRS			-0.001			-0.001			-0.001			-0.001			-0.001
			*			.			.			.			
22 PPI1	-0.001			-0.001			-0.001			-0.001			-0.001		
	**			**			**			**			**		
23 Wibor3Mq	-0.001			-0.001			-0.001			-0.001			-0.001		
				*			.			*					
24 WIG20q	-0.001			-0.001	-0.001		-0.001	-0.001	-0.001	-0.001	-0.001	-0.001	-0.001	-0.001	-0.001
														.	.
25 No. observ.	984	984	984	984	984	984	984	984	984	984	984	984	984	984	984
26 R2	0.22	0.08	0.08	0.17	0.06	0.05	0.16	0.06	0.04	0.17	0.06	0.04	0.17	0.04	0.03
27 Hausman	197.5	4.7	7.5	4.9	8	17.7	47.4	90	5.3	54.6	25.8	16.6	51.2	18.4	21.1
	***					*	***	***		***	***	*	***	**	**
28 Breusch-Pagan	1,139.3	2,912.5	2,862.5	1,472	3,456.4	3,488	1,445.3	3,465.8	3,480	1,423.5	3,754.6	3,763.1	1,385.5	5,003.1	4,997.8
	***	***	***	***	***	***	***	***	***	***	***	***	***	***	***
29 F-test	18.5	28	28	24	36.7	38	24.4	39.7	41	23.8	41	42.2	23.8	60.4	61.1
	***	***	***	***	***	***	***	***	***	***	***	***	***	***	***

*Note: *** detotes 0.001 signicance level, ** -0.01, * -0.05 and . -0.1.*

Source: own calculations.

Table 7: Estimation by Hausman-Taylor method

	Variables	ROAgr1	ROAgr2	ROAgr3	ROAgr4	ROAgr5	IRLgr1	IRLgr2	IRLgr3	IRLgr4	IRLgr5	NIIgr1	NIIgr2	NIIgr3	NIIgr4	NIIgr5
1	AEq	-0.0588	-0.0588	-0.06	-0.0578	-0.0589	-0.0965	-0.0954	-0.1137	-0.0974	-0.1032	-0.0022	-0.003	-0.0029	-0.0028	-0.0033
		***	***	***	***	***	*	*	**	*	**		.	.	.	*
2	C2Income	-0.0144	-0.0152	-0.0146	-0.0146	-0.0157						-6e-04	-2e-04	-3e-04	-6e-04	-4e-04
		***	***	***	***	***										
3	C2Income1yLag						0.0156	0.0133	0.0148	0.0139	0.0126					
4	CLoans2T	0.0024	0.0014	0.0017	0.0026	0.0023	0.2609	0.2544	0.2562	0.2541	0.2494	1e-04	4e-04	3e-04	-1e-04	0
							***	***	***	***	***					
5	DepCorp2A	-0.001	-0.0021	-0.0025	-0.001		-0.1787	-0.1805	-0.1825	-0.1806	-0.1849	0.0049	0.0053	0.0056	0.0047	0.005
							***	***	***	***	***	**	**	**	**	**
6	DepMinLoans2A	-0.0038	-0.0026	-0.0033	-0.0031	-0.0032						-0.0037	-0.0043	-0.0044	-0.0037	-0.004
												**	**	**	**	**
7	Foreign					0.0024										
						.										
8	FXLoans2A	-0.0016	-0.0027	-0.0019	-0.0014	-8e-04	-9e-04	-0.0074	-0.0074	-0.0073	-0.012	-0.0038	-0.0034	-0.0036	-0.004	-0.0039
												*	*	*	*	*
9	Group 1	0.0073					0.1333					0.0052				
							*					*				
10	Group 2		0.0205					0.0754					-0.0142			
			.										*			
11	Group 3			0.0079					-0.063					-0.011		
														*		
12	Group 4				0.0389					0.2017					-4e-04	
					**											
13	Group 5					-0.0123					-0.0926					0.0036
						**					.					.
14	HipoL2T	0.012	0.0113	0.0117	0.0124	0.0128	-0.0549	-0.0587	-0.0644	-0.0566	-0.0533	6e-04	5e-04	3e-04	4e-04	2e-04
		**	*	**	**	**										
15	IrrMediana	-0.002	-0.0019	-0.002	-0.002	-0.0018						-0.0011	-0.0012	-0.0012	-0.0011	-0.0011
		.	.	.	.							**	**	**	**	**

16	LoansA	-0.0111	-0.0092	-0.0095	-0.0114	-0.0122	-0.014	-0.0078	-0.0045	-0.0097	-0.0072	0.0022	0.0015	0.0015	0.0025	0.0023
		*	.	*	*	**									.	
17	LoansA1yLag															
18	LogA	0.0013	0.0017	0.001	0.0016	0.0016	0.0181	0.0203	0.0144	0.0201	0.0201	-3e-04	-7e-04	-6e-04	-5e-04	-6e-04
		*	**	.	**	**	**	***	**	***	***		**	**	*	**
19	NII2AMedian	0.2443	0.2734	0.252	0.2467	0.289	-0.6219	-0.4645	-0.6113	-0.4898	-0.4436					
		**	**	**	**	**										
20	RecDepI	0.0095	0.0096	0.01	0.009	0.0088	0.127	0.1311	0.1321	0.131	0.1339	3e-04	4e-04	4e-04	4e-04	6e-04
		***	***	***	***	***	***	***	***	***	***					
21	ROA1yLag						-1.2434	-1.2335	-1.2427	-1.246	-1.2563					
							***	***	***	***	***					
22	TBillsA	0.0021	0.0024	0.0016	0.0025							-5e-04	-9e-04	-8e-04	-7e-04	-9e-04
23	GDP7	4e-04	5e-04	4e-04	5e-04	5e-04	-0.0151	-0.015	-0.0152	-0.015	-0.015	0	0	0	0	0
		**	**	**	**	**	***	***	***	***	***					
24	HHIa	0.1872	0.1964	0.1769	0.1938	0.2241	4.3474	4.4381	4.254	4.4365	4.4703	0.0273	0.0191	0.0221	0.0245	0.0208
		*	*	*	*	**	***	***	***	***	***					
25	PPI1	1e-04	1e-04	1e-04	1e-04	2e-04	-0.0054	-0.0054	-0.0055	-0.0054	-0.0054	0	0	0	0	0
							***	***	***	***	***					
26	Wibor3Mq	3e-04	3e-04	3e-04	3e-04	3e-04	2e-04	3e-04	0	3e-04	3e-04	-1e-04	-1e-04	-1e-04	-1e-04	-1e-04
		***	***	***	***	***							.			.
27	WIG20q	0.0033	0.0034	0.0032	0.0034	0.0036	-0.0413	-0.0402	-0.0425	-0.0402	-0.0399	-5e-04	-6e-04	-5e-04	-5e-04	-5e-04
							.	.	.	.	.					
28	No. observ.	1148	1148	1148	1148	1148	1148	1148	1148	1148	1148	1148	1148	1148	1148	1148
29	R2	0.248	0.249	0.248	0.248	0.25	0.328	0.33	0.321	0.327	0.326	0.069	0.041	0.047	0.058	0.056
30	H-T ili FE	8.5499	3.8546	12.5821	4.469	4.3425	4.7023	3.1324	10.3706	4.1842	6.2905	15.3297	2.3699	4.6275	17.4567	12.0731

*Note: *** detotes 0.001 signicance level, ** -0.01, * -0.05 and . -0.1.*

Source: own calculations.

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