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Competition, concentration and foreign
capital in the Polish banking sector
(prior and during the financial crisis)

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Abstract

The aim of the study is to estimate the level of competition and concentration in the Polish banking sector in 1997-2009 (prior the financial crisis and during the crisis). In this paper the Panzar and Rosse model (P-R) and the Lerner index (LI) have been used for the evaluation of competition. Concentration in the Polish banking industry was analysed by using concentration indices (k bank concentration ratios (CR5) and the Herfindahl-Hirschman indices (HHI)).

Empirical analysis shows that the degree of competition in the Polish banking market in the period between 1997-2007 followed a slight upward trend. Results demonstrated also a slight decrease in competition in 2008-2009, caused by financial crisis. This results are confirmed by the Panzar and Rosse model (P-R) and the Lerner index (LI).

The same channels (prior the financial and during the crisis) which had an impact on changes in the competition of banking sectors in the euro zone countries, had an impact on the Polish banking sector due to the involvement of the capital from the euro zone. It might also mean that that increase of foreign participation stimulated competitive pressures. Furthermore, foreign capital was positively correlated with concentration indices.

JEL classification: F36; G2; G21; G34; L1.

Keywords: Competition; Concentration; Foreign Capital; Mergers and Acquisitions; Market structure, Panzar-Rosse Model, Lerner Index.

Introduction

Competitiveness of banks is the subject of interest to bank management, financial markets, bank supervisions and academics. This interest is driven by increasing consolidation in the banking sector, changes in production technology and regulation. Furthermore, the recent crisis reignited the interest of policy makers and academics in assessing bank competition because the increases in competition and financial innovation in markets contributed to the recent financial turmoil.

The period of 1997-2009 was a period of rapid changes in the Polish banking sector when the ownership structure changed and consolidation processes intensified. However, it should be noted that consolidation processes in the Polish banking sector were to a great extent a natural consequence of the earlier privatisation of domestic banks and attracting strategic investors for those banks as well as the fact that an increased number of mergers took place in the euro zone countries. Due to the fact that foreign capital in banks operating in Poland comes largely from the euro zone countries, the factors that triggered changes in the competition in banking systems of the euro zone countries also had an indirect impact on the Polish banking sector.

Between 1997 and 2007 (prior the financial crisis), competition and concentration in the Polish banking system were the effect of numerous different determinants, such as globalisation, deregulation, progress in IT technologies, progress in European Integration, implementation of FSAP programme and the New Capital Accord (Basel II). Between 2008-2009, the main source of short and mid-term threats for banking sector were external factors, caused by "subprime crisis" which in 2008 transformed into global crisis of the financial system. In 2009 very strong disturbance in functioning of financial markets slowly started to transfer to the real sphere. Due to that fact, between 2008-2009, the financial crisis had the main impact on the competition between the Polish banks.

The aim of this analysis is to assess the changes of competition measures in the Polish banking sector in 1997-2009 (prior the financial and during the crisis) with the use of quantitative methods based on the theory of competition measurement in the banking sector (the Industrial Organisation Approach to Banking). The degree of competition in the Polish banking sector was estimated with the use following models: the Panzar and Rosse (P-R) model and the Lerner index (LI). Also, the changes in the concentration in the Polish banking industry was analyzed by using concentration indices (k bank concentration ratios (CR5) and the Herfindahl-Hirschman indices (HHI)).

Between 1997 and 2001 the process of consolidation was very intensive and was a natural consequence of an increasing number of global mergers caused by the establishment of the euro zone (in 1999). In order to determine the impact of M&A, caused by the

establishment of the euro zone (in 1999) and the financial crisis (between 2008-2009) on the changes in the level of competition in the Polish banking sector the Panzar and Rosse (P-R) model and Lerner indices (LI) were estimated for the following three sub-periods: (1) in 1997-2001, (2) in 2002-2007, (3) 2008-2009¹.

The study consists of four parts and the summary. The first part presents the broad scope of the research methods for the measurement of competition. The second part contains an overview of the literature concerning competition measurement in EU banking sectors. The third part describes structural and technological changes in the Polish banking sector in 1997-2009 leading to changes in the concentration and the competition. The fourth part presents results of the analysis of changes in the degree of competition of the Polish banking sector (based on data from balance sheets and profit and loss accounts of commercial banks) with the use of the Panzar and Rosse model (P-R) and the Lerner index (LI). The last part presents, a summary of empirical results and conclusions.

¹ (1) period - with the lower level of average of concentration indices in the banking sector but with increasing trends, (2) - period with the higher level of average of concentration but with decreasing trends in 2002-2007, (3) - period of the financial crisis. A detailed information about concentration in the Polish banking sector is presented in chapter 3.

1. Methods of competition measurement

Competition among banks is a broad concept, covering many aspects of banking environment and behaviour. According to the theory of perfect competition the market sets a price equally acceptable for the borrower and the depositor. This can be achieved through liberalisation of services offered by banks, which consists in removal of any obstacles hampering access to the domestic market of financial services.

Competition in the banking sector is analysed through the market power and effectiveness measure. Research on competition is currently conducted as part of the industrial organisation approach to banking. The literature on the measurement of competition among banks can be divided into two major streams: structural approach developed on the basis of economic theories investigating the Industrial Organisation (IO)² and non-structural approach on the basis of the New Empirical Industrial Organisation Theory (NEIO).

The traditional IO theory comprises the following structural models: structure-conduct-performance paradigm (SCP) describing the relationship between the market structure, company conduct and the performance, and a theory based on the efficient structure hypothesis (ESH). In structural models, concentration ratios (i.e. Herfindahl-Hirschman (HHI) indices³ and the k bank concentration ratios (CR_k)⁴) are often used to explain competitive performance in the banking industry as the result of market structure.⁵ The market structure and entry conditions are usually used as an exogenous variable.

The SCP model developed by Bain (1951) relates structure and conduct to performance. This theory states that in a market with a higher concentration, banks are more likely to show collusive behavior and their oligopoly rents increase performance (profitability). The efficiency structure hypothesis (ESH), developed by Demsetz (1973) and Peltzman (1977) offers a competing explanation of the relation between market structure and performance. This theory states that if banks enjoy a higher degree of efficiency than their competitors, they can: increase shareholder value or gain market share by reducing prices. According to the ESH, concentrated markets are markets where highly effective firms (banks) operate. However, higher profits of firms with high market shares do not result from their power (size) but from higher effectiveness which creates their power. An elaboration on the efficiency hypothesis is the model developed by Boone (2000). Of note, like many other

² In the above theory that deals with market organisation and competition, behaviour of firms is investigated under certain limitations imposed by consumers and competitors. The central issue of this theory was the expansion of the micro-economic analysis with imperfectly competitive markets and the main model discussed in this theory is the oligopoly model. Cf. Łyszkiewicz (2002).

³ The HHI is calculated as the sum of squared market shares of each firm in a market in the terms of assets. It ranges from 0 to 1.

⁴ This index is calculated as market share of the k largest banks in all banking assets.

⁵ See: Bikker (2004).

model-based measures, the Boone indicator approach focuses on one important relationship affected by competition, thereby disregarding other aspects (see also Bikker and Bos, 2005).

To assess competitive conditions in a market, the New Empirical Industrial Organization (NEIO) literature provides empirically applicable tests based on either aggregate industry data or individual firm data. These approaches are estimation techniques to identify static models of industry equilibrium which are compatible with the actual data and thereby indicate the type of competitive conduct on the part of the firms/banks. According to NEIO, concentration is an endogenous variable and depends on the behaviours of individual market players that are exogenous from the firm's perspective (Breshnahn (1988)). Methods based on NEIO do not take into account the direction of changes in the level of concentration and they presume that the degree of competition does not always depend on concentration measures because other market characteristics, such as dynamic barriers to entry and exit, are more important.

Methods based on NEIO include the Iwata method (1974), Bresnahan (1989) and Lau method (1982), and Panzar-Rosse (1987) model. The Panzar and Rosse provided a measure called the H statistic⁶. However the Panzar and Rosse approach (P-R) has some limitations (Bikker et al. (2007a) provided empirical evidence that the level of competition in the banking industry in the existing empirical P-R literature is systematically overestimated). However, despite these limitations, the P-R model has been extensively applied to the banking sector in a number of countries. An alternative indicator of the degree of competition in banking markets based on the NEIO theory is the estimation of the Lerner index (1934),⁷ widely used in the specific case of banks on the basis of the Monti-Klein oligopolistic model.⁸

1.1. The Panzar an Rosse Model - Theoretical framework

Panzar and Rosse (1977, 1987) developed a test for competitive market conditions based on the reduced form revenue equation of the firms. The test was based on empirical observation of the impact on firm-level revenues on variations in factor input prices.

This method was derived from a general banking market model,⁹ which determines the equilibrium output and the equilibrium number of banks, by maximizing profits at both the bank level and the industry level. This implies, first, that bank i maximizes its profits, where marginal revenue equals marginal cost:¹⁰

⁶ For more see chapter 1.1.

⁷ For more see chapter 1.2.

⁸ Freixas and Rochet (2008).

⁹ Cournot oligopoly model with profit maximization by collusive Cournot oligopolies.

¹⁰ Bikker (2004).

$$R_i'(y_i, n, z_i) = C_i'(y_i, w_i, t_i) \quad (1)$$

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

where: R_i – revenue function of bank i , C_i – cost of bank i , y_i – output of bank i , n – number of banks, w_i – vector of m factor input prices of bank i , z_i – vector of exogenous variables that shift the revenue function, z_i – vector of exogenous variables that shift the cost function, with the prime denoting marginal values, and the asterisk denoting equilibrium values.

Market power is measured by the extent to which a change in factor input prices (dw_{ki}) is reflected in equilibrium revenues (dR_i^*) earned by bank i . In order to identify the nature of the market structure (monopoly or oligopoly, perfect competition or monopolistic competition) the Panzar and Rosse model (P-R) provides a measure called the H statistic.

Panzar and Rosse showed that the sum of the elasticity of the total interest revenues, with respect to changes in banks' input prices (w_i), allows inference about the banks' competitive conduct¹¹ (see equation (3)):¹²

$$H = \sum_{k=1}^m \frac{\partial R_i^*}{\partial w_{ki}} * \frac{w_{ki}}{R_i^*} \quad (3)$$

where: R_i^* – revenue function in equilibrium of bank i , w_{ki} – vector of m factor of input prices of bank i .

The estimated value of the H statistic ranges between $-\infty$ and 1. Moreover, Panzar and Rosse (1987) showed that in market equilibrium perfect competition is indicated by *the H statistic* equal to unity. Due to the fact that under perfect competition, an increase in input prices and thus in average costs should lead to a proportional price increase and (at the firm level) to a proportional rise in revenues. Under monopolistic conditions, an increase in input prices will increase marginal costs, reduce equilibrium output and consequently reduce total revenues and the H statistic is negative or equal to zero. If the market structure is characterised by monopolistic competition, the H statistics will lie between zero and unity¹³ (see Table 1).

Table 1 Interpretation of the Panzar-Rosse H Statistic

Values of H	Competitive Environment
$H \leq 0$	Monopoly or perfectly collusive oligopoly
$0 < H < 1$	Monopolistic competition
$H = 1$	Perfect competition, natural monopoly in a perfectly contestable market, or sales maximizing firm subject to a break-even constraint

Source: Hempell (2000, p. 8), Bikker (2004, p. 87).

¹¹For more formal specification see: Bikker (2004).

¹²The above methodology entails various assumptions, which are disused below. Also, for more information see: Gelos and Roldos (2002) and see: Bikker (2004).

¹³For more see Bikker (2004).

The first market model the Panzar and Rosse investigated described monopoly (Panzar and Rosse (1987), p. 445-446). Panzar and Rosse proved as well that the H statistic is equal to $e-1$ and yields an estimate of Lerner index of monopoly power $L = (e-1)/e = H/(H-1)$, where e is price elasticity.

The nature of the estimation of the H statistic means that one is especially interested in understanding how interest revenues react to variations in the cost figures. Also, the methodology requires assuming that banks use three inputs (i.e. funds - financial capital, labor, and physical capital), which is consistent with the intermediation approach views that a bank is a firm collecting deposits and other funds in order to transform them into loans and other assets (Sealey and Lindley (1977)). The other assumption is that higher input prices are not associated with higher quality services that may generate higher revenues, since such correlation may bias the computed H statistic. Finally, the test must be undertaken on observations that are in a long-run equilibrium.¹⁴ It means that price should equal marginal cost and free entry and exit conditions determine zero economic profit. A value of $H < 0$ would show non-equilibrium, whereas $H = 0$ would prove equilibrium (Shaffer 1982).

The Panzar and Rosse approach (P-R) also has some limitations: general limitations consist of the assumptions underlining its use as a measure of competition in banking industry as well as the resulting biases. Generally, the Panzar and Rosse approach was developed on the basis of static (oligopoly) models whereas for dynamic models there are no predictions on the value of H statistic (Corts (1999)). Furthermore, Bikker et al. (2007) provided empirical evidence that the level of competition in the banking industry in the existing empirical P-R literature is systematically overestimated. The reason for the misspecifications is that most studies use different definitions of the appropriate variable to represent banks' revenue (different definitions of the dependent variable in the P-R model). This issue will be discussed in detail in the next subsection. However, despite these limitations, the P-R model has been extensively applied to the banking sector in a number of countries.

Misspecification in the Panzar and Rosse (P-R) model

Bikker et al. (2007a) provided empirical evidence to show that the scaled P-R model is misspecified. The reason for this misspecification is that most studies use scaled versions of bank income as the dependent variable in the P-R model and work with revenues divided by total assets. However, scaling changes the nature of the model fundamentally, since it

¹⁴The empirical test for equilibrium is justified on the grounds that competitive capital markets will equalise the risk-adjusted rate of returns across banks to such an extent that equilibrium rates of return should not be statistically correlated with input prices.

transforms the revenue equation into a price equation. In order to see this fact, we must take into consideration the P-R model proposed by Bikker and Haff (2002):

$$\ln II = \alpha + a_1 \ln w_l + a_2 \ln w_f + a_3 \ln w_c + \sum_j \beta_j egz_j + \eta \ln(OI/II) + \varepsilon \quad (4)$$

where $\ln II$ denotes natural logarithm of interest income, w_l – the price of personal expenses, w_f – the price of funds, w_c – the price of capital, egz – bank-specific exogenous factors and OI/II – the ratio of other income to total assets.

H is calculated as the sum of the elasticity of a bank's total revenue with respect to the bank's input prices (w_l, w_c, w_f) and based on equation (4) $H = a_1 + a_2 + a_3$. However, equation (4) requires choosing a dependent variable and the value of H depends on this choice, although the choice of dependent and explanatory variables may vary.

In addition, the choice between relative and absolute measures of income (total income or interest income) in equation (4) is of crucial importance. Whereas many articles use the natural logarithm of the ratio of income and total assets, others take the natural logarithm of total or interest income. However, the natural logarithm of the ratio of income and total assets is 'the price', as the natural logarithm of interest income is 'the revenue' - the correct dependent variable.

The choice of the dependent variable explains why previous studies find that H-statistic increases with bank size (Bikker et al., 2006, pp. 17-18). To see this, let us consider equation (4) like as simple panel regression model:

$$y_{it} = \alpha_i + \mathbf{x}_{it}^T \boldsymbol{\beta} + \varepsilon_{it}, \quad i=1, \dots, N \quad t=1, \dots, T. \quad (5)$$

where: \mathbf{x}_{it} - is the it th observation on K explanatory variables appearing in equation (4) (all input prices and other bank-specific exogenous factors of bank i in time t), $\boldsymbol{\beta}$ - is a $K \times 1$ vector of coefficients.

Let us denote by $\hat{\beta}_p$ the OLS estimator of $\boldsymbol{\beta}$ with $y_{it} = \ln(II/TA)_{it}$ as the dependent variable and by $\hat{\beta}_r$ ¹⁵ the OLS estimator with $y_{it} = \ln(II_{it})$. It is easy to show that $\hat{\beta}_p = \hat{\beta}_r + \text{linear function of } \ln(TA_{it})$. Obviously, H-statistics calculated from $\hat{\beta}_p$ and $\hat{\beta}_r$ clearly differ and the "bias" of H_p with respect to H_r is the function of total assets.¹⁶ Bikker et. al. (2006) showed that the "bias" is virtually always nonnegative and must be an increasing function of the total assets. However, an uncalled revenue function generally requires additional information i.e. about market equilibrium, see Bikker et. al. (2011).

¹⁵ Where the subscripts 'p' and 'r' refer to dependent variable in the P-R model, being either 'the price' or 'the revenue'.

¹⁶ Note that the H-statistic is the sum of the OLS coefficient of the input prices; i.e. $H = \beta_1 + \beta_2 + \beta_3$.

Another very important issue is the specification of explanatory variables in the P-R model. All inputs are used to generate total income (TI), so that: $\ln(TI) = \ln(II + OI) \approx \ln(II) + OI/II$, where II is interest income and OI/II is the ratio of other income (commission and fee income) to interest income. Therefore, in the specification of the model, we should use as the explanatory variable the ratio of other income to interest income variable (OI/II), like in equation (4).

The standard procedure for estimation of the H-statistic involves the application of fixed effects (FE) regression to panel data for individual firms. However, Goddard and Wilson (2009) showed that FE estimator of H-statistic is severely biased towards zero and suggested using GMM estimator for the revenue equation. Also, Goddard and Wilson (2009) showed that dynamic panel estimation eliminates the need for a market equilibrium assumption.¹⁷

1.2. Lerner index - Theoretical framework

An alternative indicator of the degree of competition in banking markets is the estimation of the Lerner index (1934), widely used in the specific case of banks.

The Lerner index is the mark-up of price (average revenue) over marginal cost. The higher the mark-up, the greater the realized market power is. The values of the index range from 0 (perfect competition) to 1 (monopoly). Lerner index never exceeds 1 because marginal cost MC is never negative. Lerner index measures the monopolist's margin. According to the Lerner index, the market power of a monopolist depends on price elasticity of market demand.

Algebraically, the Lerner Index (LI) is presented as equation 6:

$$L = \frac{1}{|e|} = \frac{p - MC}{p} \quad (6)$$

where: p – price, MC – marginal cost, e – price elasticity of demand.

In the case of perfect competition, price p is equal to marginal cost MC , Lerner index $L = 0$ (firms under perfect competition have no market power). Positive values of Lerner index L indicate the existence of market power. The higher the value, the greater the market power of a company/bank and the lower the market competition. In the case of monopoly, Lerner index $L = 1/e$, where e is the value of the price elasticity of demand.

The measurement of Lerner index in the banking industry is based on the Monti-Klein model of oligopolistic competition on the deposit and credit market, pursuant to which the

¹⁷ See also: Pawłowska (2011).

sensitivity of interest rates on deposits and loans to changes in inter-bank rates (regulated by the central bank)¹⁸ depends on the number of banks. This model examines the behavior of a monopolistic bank faced with a deposit supply curve of positive slope $D(r_D)$ and a loan demand curve of negative slope $L(r_L)$. The bank's decision variables are L (the amount of loans) and D (the amount of deposits), and for simplicity's sake the level of capital is assumed to be given. The bank is assumed to be a price taker in the inter-bank market (r).

The function of bank profit with the use of the Monti-Klein model is as follows:

$$\pi(D, L) = (r_L(L) - r) * L + (r - r_D(D)) * D - C(D, L) \quad (7)$$

where r_L – interest rate on loans, L – loan size, r_D – interest rate on deposits, D – deposit size, r – interest rate on the inter-bank market, so that profit is the sum of intermediation margins on loans and deposit (the net interest income between deposits and loans), minus management costs $C(L, D)$.

The first order conditions with respect to deposits and loans are as follows:

$$\begin{aligned} \frac{\partial \pi}{\partial L} = \frac{\partial r_L}{\partial L} L + r_L - r - \frac{\partial C}{\partial L} = 0 &\rightarrow \frac{\left[r_L^* - r - \frac{\partial C}{\partial L} \right]}{r_L^*} = \frac{1}{\varepsilon_L} \\ \frac{\partial \pi}{\partial D} = -\frac{\partial r_D}{\partial D} D + r - r_D - \frac{\partial C}{\partial D} = 0 &\rightarrow \frac{\left[r - r_D^* - \frac{\partial C}{\partial D} \right]}{r_D^*} = \frac{1}{\varepsilon_D} \end{aligned} \quad (8, 9)$$

where ε_D i ε_L are elasticities for deposits and loans respectively.

Those equations are simply the adoption to the banking sector of Lerner Indices (price minus cost divided by price) and inverse elasticities. The Lerner index for expression (8, 9) represents the extent to which the monopolist's market power allows it to fix a price above marginal cost, expressed as proportional to the price. In the case of perfect competition, the value of the index is zero, there being no monopoly power. Starting from this extreme case, the lower the elasticity of demand, the greater the monopoly power to fix a price above the marginal cost. As Guevara et al (2004) show, relative margins, rather than absolute margins, are the most appropriate for evaluating the evolution of competition, for two reasons. First, oligopoly competition models determine a relation of equilibrium between the relative margin (price minus marginal cost divided by the price) and the structural and competitive conditions of the market. And second, the relative margin offers a proxy for the loss of social welfare that is due to the existence of market power. The extension of the model to the case of an oligopoly (N banks) provides the following expression of the first order conditions:

¹⁸ Freixas and Rochet (2008).

$$\frac{\left[r_L^* - r - \frac{\partial C}{\partial L} \right]}{r_L^*} = \frac{1}{N \varepsilon_L} \quad (10, 11)$$

$$\frac{\left[r - r_D^* - \frac{\partial C}{\partial D} \right]}{r_D^*} = \frac{1}{N \varepsilon_D}$$

which differs from the case of monopoly only in that elasticities are multiplied by the number of competitors (N). With this simple adaptation, the Monti-Klein model can be reinterpreted as a model of imperfect competition with two extreme cases: monopoly ($N=1$) and perfect competition ($N=\text{infinity}$).

2. Results of the measurement of competition in European banking sectors – overview of literature

In recent years, there are ongoing debate on the economic role of market competition in the banking industry. There are several related strands of literature concerning competition in the financial sector. The empirical literature investigates the relationship between structural and regulatory factors and performance, as well as access to financing and growth on the one hand and the competition in the banking sector on the other. Empirical cross-country investigation in this research area related primarily to the issue of the influence of competition in the financial sector on its stability, the access to external financing and the economic development.

The most common theoretical arguments used to identify positive and negative economic effects of bank competition found Pagano (1993). In a stylized model of economic growth, showed that market power generating a direct negative effect on the economy grow. Cetorelli (2001) found that more competition is likely to lead to a larger quantity of credit, more market power should increase banks incentives to produce information on prospective borrowers, thus leading to a higher *quality* of the applicant pool. Competition in the banking industry is necessarily welfare-enhancing, but there are possible channels through which bank competition may generate negative economic effects.

Specific to the financial sector, is the link between competition and stability, long recognized in theoretical and empirical research and, most importantly, in the actual conduct of prudential policy towards banks (Schaeck et al., (2006), Vives (2010)). Vives (2010) found that competition may increase instability by exacerbating depositors coordination problem on the liability side, and fostering runs, which may affect the system overall; and increasing the incentives to take risk (on either the liability or asset sides), thus increasing the probability of failure. However, Beck et al. (2011), documented significant cross-country heterogeneity in the competition-stability relationship. Furthermore, Beck et al. (2011) showed that an increase in competition will have a larger impact on banks' risk taking incentives in countries with stricter activity restrictions, more homogenous market structures, more generous deposit insurance and more effective systems of credit information sharing.

Another issue, is the link between competition and concentration (Claessens and Laeven, 2004). A number of analysts, who investigated the trade-off between competition and concentration, found that there is no evidence that banking sector concentration negatively relates to the level of competition. Gelos and Roldos (2002) using the P-R methodology and BankScope data in transition economies (1994-2000), found that banking markets in the Central European countries (including Poland), did not become less competitive, even though concentration increased. In their study, however, the authors pointed to the fact that the

process of consolidation, in particular in Central Europe, had not ended yet and therefore it was difficult to make definite conclusions. The above results were confirmed by Yildirim and Philippatoas (2007) and by Claessens and Laeven (2004) in a cross-country research (including Poland). Hempell (2002) reached a similar conclusion with respect to the German banking industry and Coccorese (2004) related to the Italian banking industry. Fillipaki and Staikouras (2006) showed that banks in the new EU countries, among others in Poland, operate under conditions of stronger competition than the old EU countries, due to lower market entry barriers and the presence of foreign capital. Furthermore, Claessens and Laeven (2004) found that the openness of the market determines effective competition especially by allowing (foreign) bank entry and reducing activity restrictions on banks.

A cross-country analysis for Central and Eastern European countries was also conducted by Philippatos and Yildirim (2003) between 1993 and 2000 and by Koutsomanoli-Fillipaki and Staikouras between 1998 and 2002. The results of their analyses indicated there existed monopolistic competition in most analysed banking sectors in Central and Eastern European countries. In addition, they concluded that between 1998 and 2002 only in EU-10 countries, due to lower barriers to entering the market and an increase in the share of foreign capital, the increase in concentration did not cause a decrease in the level of competition in the analysed period.

The establishment of the euro zone also posed a challenge to analysts conducting research on the degree of competition (ECB 1999). Particularly for banks, the euro adoption increased the volume of cash transactions and reduced profits of foreign exchange transactions. In the area of regulation the euro centralized the system of conducting the monetary policy moving it from the national central banks to the European Central Bank and relaxing the bank entry conditions (Yusov 2004, p. 17). Banks became involved in mergers and acquisitions, in particular cross-border transactions¹⁹. The greatest wave of mergers was recorded just before euro adoption and in subsequent years the pace of consolidation slowed down. However, mergers and acquisitions and the reduction in banking regulations have the largest impact on changes in the competition in the banking sector (Vives, 2010).

It should be stressed that the results concerning changes in competition in euro zone countries (prior the crisis) are ambiguous: on the one hand an increase in competition after the introduction of the single euro currency was detected (see Utrero-González and Callado-Munoz (2007)) and on the other hand, the results of Bikker and Spierdijk (2008) indicated a decrease in competition in euro zone countries. Bikker et al (2007) and Bikker and Spierdijk (2008) who were the first to perform a cross-country analysis of changes in competition in

¹⁹ In 2005 cross-border transactions accounted for 51% of total M&A transactions – due to the merger of Unicredito and HypoVerensbank, ABN Amro and Banca Antonveneta as well as Swedbank and Hansabank.

101 countries in the last fifteen years, demonstrated a downward trend in competition in major economies despite ongoing liberalisation, internationalisation, integration and IT developments. They also proved there had been a decrease in competition in banking sectors of Western economies (in particular in euro zone countries) and an increase in competition in Eastern European banking sectors²⁰.

A number of studies have used the Lerner index to try to determine the trend in competitive behaviour over time. Most studies based on the Lerner index (e.g. de Guevara and Maudos, 2004, 2007; de Guevara et al., 2007; Carbó and Rodríguez, 2007; Maudos et al., 2007) found a reduction of competition during the 90s and a higher Lerner index in MU countries. A similar result was found when the analysis was applied on a regional basis within a country (Carbo et al., 2003; Maudos and Perez, 2003). However, de Guevara et al (2004) demonstrated an increase in competition despite increased concentration (in Germany and the UK) and Angelini and Cetorelli (2003) demonstrated an increase in competition despite an increase in concentration in the Italian banking sector (between 1984 and 1997 the market power decreased). Similarly, de Guevara et al. (2004) demonstrated an increase in competition despite increased concentration (between 1992 and 1999 in Germany and UK), while Fischer and Hempell (2005) demonstrated an increase in competition in the German banking sector between 1993 and 2001. However, Maudos and de Guevara (2007) demonstrated for 1986-2002 a decrease in the market power in the Spanish banking sector since mid-1990s. Finally, Carbó et al. (2009) found using five measures of competition (the net interest margin (NIM), the Lerner index, the return on assets (ROA), the H-statistic and the HHI market concentration index) that various indicators of competition yield different conclusions on competitive behaviour due to that fact that those competition indicators measure different things.

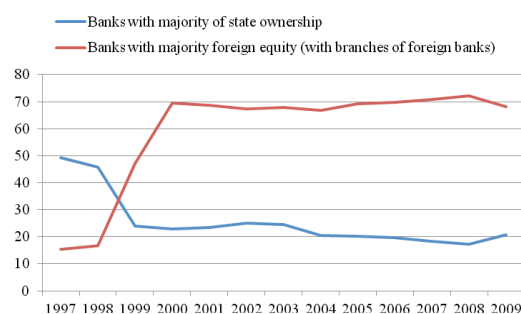
²⁰ It should be noted that the establishment of the common currency – the euro was followed by a rapid increase in corporate bond issues: from EUR 30 billion in 1999 to EUR 170 billion three years later (mainly due to an increase in liquidity and an increase in competition in the financial intermediaries sector). See ECB (2007).

3. Structural and technological changes in the Polish banking sector between 1997 and 2009

Deregulation of 1989 radically restructured the banking system in Poland²¹ and in the majority of the new EU countries. It started the process of privatization and consolidation of the banking industry, previously dominated by very few government-controlled banks. The period of 1997-2009 was a period of rapid changes in the Polish banking sector. Banks attempted to devise new development strategies in order to achieve the best financial results. Mergers and acquisitions, enhanced by a fast technological development constituted one of the components of commercial banks' strategy.

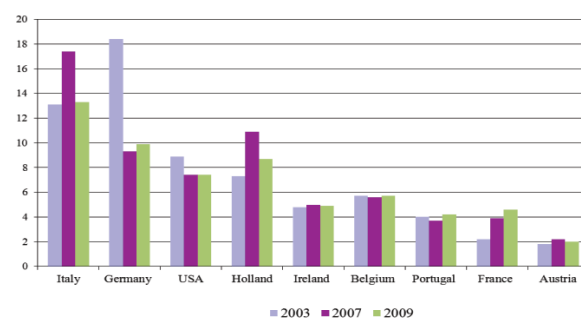
When analysing processes that took place in the Polish banking sector between 1997 and 2009 it should be noted that privatisation led to an increase in the share of foreign capital in the Polish banking sector. As of the end of 2009, the share of banks with predominantly foreign capital was approximately 70%, while as of the end of 1997 it was approximately 15%, see figure 1. When analysing ownership transformations in the Polish banking sector in recent years, the stabilisation of the share of foreign capital since 2000 should be emphasised. In 2009, foreign investors controlled 39 commercial banks and all branches of credit institutions. Their market share measured by assets amounted to 68.1% (the dominant role was played by Italian investors who control 13.3% of the sector assets, followed by German (9.9%), Dutch (8.7%), American (7.4%) and Belgian (5.7%)²², see figure 2). Due to the fact that foreign capital in banks operating in Poland comes largely from the euro zone countries, the factors that triggered changes in the competition in the banking systems of euro zone countries also had an indirect impact on the Polish banking sector.

Figure 1. Share of foreign investors in assets of the Polish banking sector (1997-2009)



Source: NBP and KNF.

Figure 2. Share of foreign investors in assets of the Polish banking sector in 2003, 2007 and 2009 by country of origin



²¹ In 1989 a two-tier structure of Polish banking was established, with 9 regional commercial banks.

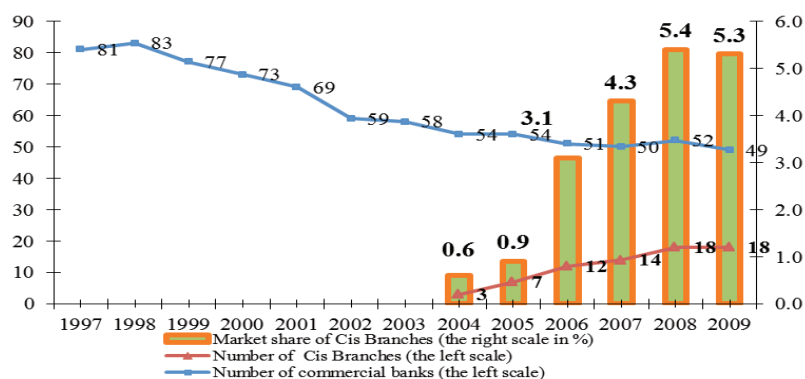
²² See: Polish Financial Supervision Authority, Report on the condition of Polish banks in 2009, pp. 42-44.

In the first half of 1990s, the main consolidation mechanism consisted in acquisitions by strong banks of other banks whose financial condition was poor. Mergers conducted between 1997 and 2001 were a natural consequence of the increasing number of global mergers caused by the establishment of the euro zone (in 1999). An analysis of the process of mergers and acquisitions between 1997 and 2001, the following main mergers took place: the merger of Citibank (Poland) SA with Bank Handlowy w Warszawie SA, both being entities directly controlled by Citibank Overseas Investment Corp, the merger of Bank Zachodni SA and Wielkopolski Bank Kredytowy SA, which were subsidiaries of Allied Irish Bank European Investments Ltd., merger of Pekao SA Group, the merger of PBK SA with BPH SA triggered by the merger of their owners, i.e. Bank Austria Creditanstalt and HypoVereinsbank, which resulted in the creation of the third largest bank in Poland.²³

Between 2002 and 2007, the pace of consolidation slowed down and since 2004 the main trend was to set up branches of foreign credit institutions. In the period 2008-2009 as a consequence of the crisis, due to of weakening of financial condition of the parent company, same changes of strategic investors of Polish banks had happened and the consolidation processes intensified (for example M&A between GE Money Bank and Bank BPH, Dominet Bank with Fortis Bank and Cetelem Bank of Sygma Bank branch in Poland).

Due to consolidation processes in the Polish banking sector the number of commercial banks has decreased. During this time, the number of branches foreign credit institutions increased from 3 in 2004 to 18 in 2009. In 2009 market share of foreign credit institutions was 5.1% (see figure 3).

Figure 3. Number of commercial banks and foreign Cis branches in Poland (1997-2009)



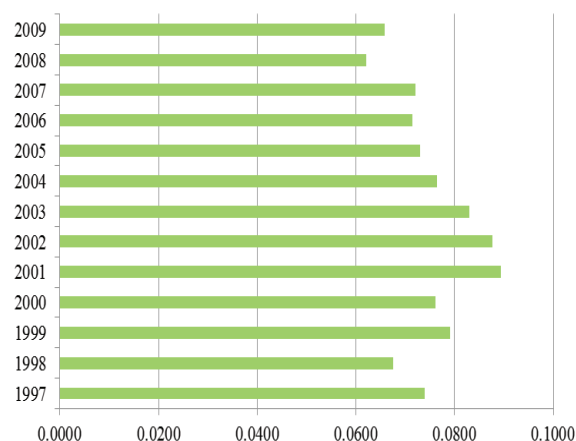
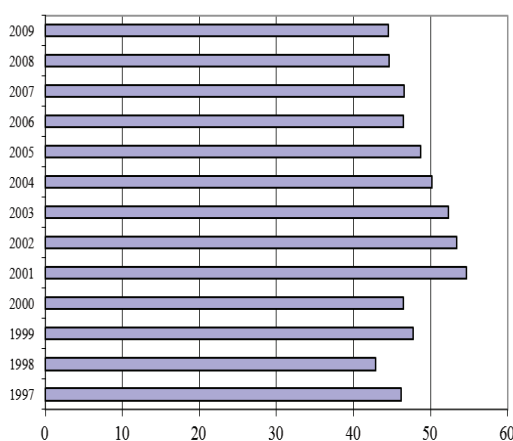
Source: NBP and KNF.

The consolidation in the Polish banking sector (similarly to euro zone countries) led to changes in concentration (measured with the HHI and CR5 ratios). The analysis of the

²³ Pawłowska (2003).

variability of concentration ratios in the Polish banking sector shows that in part of the analysed period (1998-2001) those ratios followed an upward trend. The increase in concentration ratios was enhanced by mergers and acquisitions conducted by large banks. In turn, between 2002 and 2007 and between 2008 and 2009 concentration measures were decreasing despite further decrease in the number of commercial banks. The decrease in concentration ratios was caused by a slowdown in the consolidation process and a slower development of large banks (see figure 4 and 5)²⁴.

Figure 4. CR₅ ratio in Polish commercial banks – measured by assets between 1997-2009 (%) **Figure 5. HHI index in Polish commercial banks – measured by assets between 1997-2009**



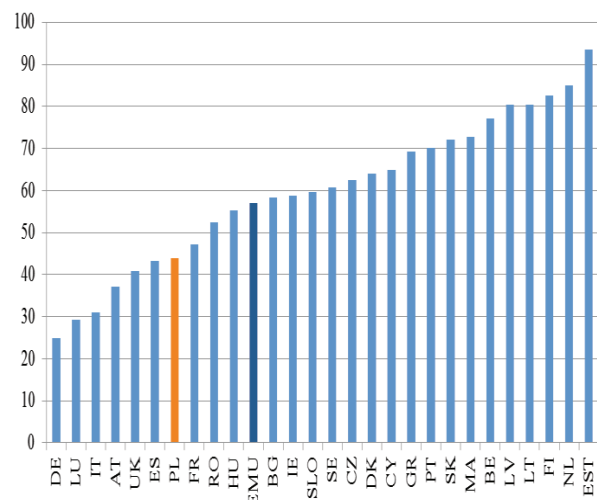
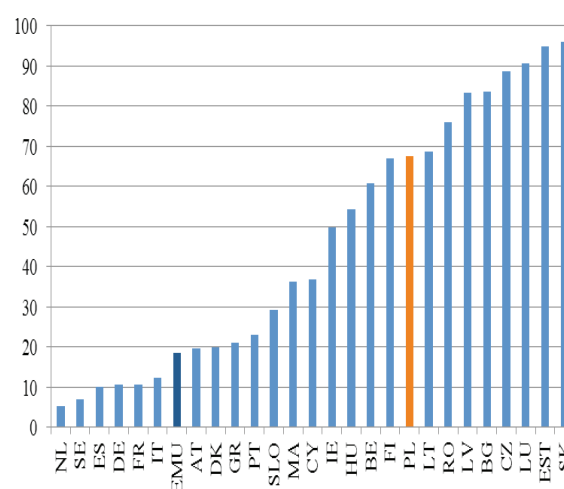
Source: NBP, PFA and own calculation.

Despite the dominant role of several large banks, the level of concentration of the Polish banking sector remains moderate in comparison with other EU countries (see figures 6). At the end of 2009, the share of the five largest banks in assets in the banking sector was 44%. At the same time, the CR5 concentration ratio was 72% in Slovakia, 93% in Estonia, and 62% in Czech Republic. In the Polish banking sector PKO BP and Pekao remain unquestionable leaders on the market, their total share in the banking market exceeds 25%²⁵.

It should be stressed that also the market share of foreign banks differs significantly between EU countries (see Figures 7). Figure 7 also shows that the highest percentage of foreign ownership in the banking sector is in Slovakia, Estonia rank second and Poland ninth.

²⁴ However it should be stressed that the average concentration for the period 1997-2001 was lower than for the period 2002-2007. The average CR5 for 1997-2001 and 2002-2007 amounted to respectively 47.6 and 49.6.

²⁵ See: Polish Financial Supervision Authority, Report on the condition of Polish banks in 2009, pp. 23-24.

Figure 6. CR5 in EU countries measured by assets in 2009 (%)**Figure 7. Share of Banking Sector Assets with Majority of Foreign Equity in EU in 2009 (%)**

Source: ECB, KNF, Schoemaker (2011), s. 4 and own calculation.

The profitability of commercial banks in Poland between 1997 and 2009 was influenced by a large number of internal and external factors: consolidation and technological processes, real economy, Poland's accession to the European Union. Due to changes in the banks' external environment, between 1997 and 2009 their profitability measured with return on assets (ROA) and return on equity (ROE) also changed. After a significant decrease in the profitability of commercial banks between 2001 and 2003 related to economic slowdown, between 2004 and 2007 a clear improvement in profitability was observed. It should be notice, the slight decrease in the profitability indicators in the period 2008 - 2009 caused by financial.

In 2008, banking operations can be divided into two periods. The first period, covering approximately three first quarters, was characterized by fast development thanks to relatively favorable macroeconomic conditions, as well as high optimism of enterprises and households. The second period covered Q4 and featured significant slowdown of lending activity and deterioration of banking performance due to the "second wave" of the financial crisis,

deteriorated financial situation of certain borrowers and write-offs related to currency derivative transactions²⁶.

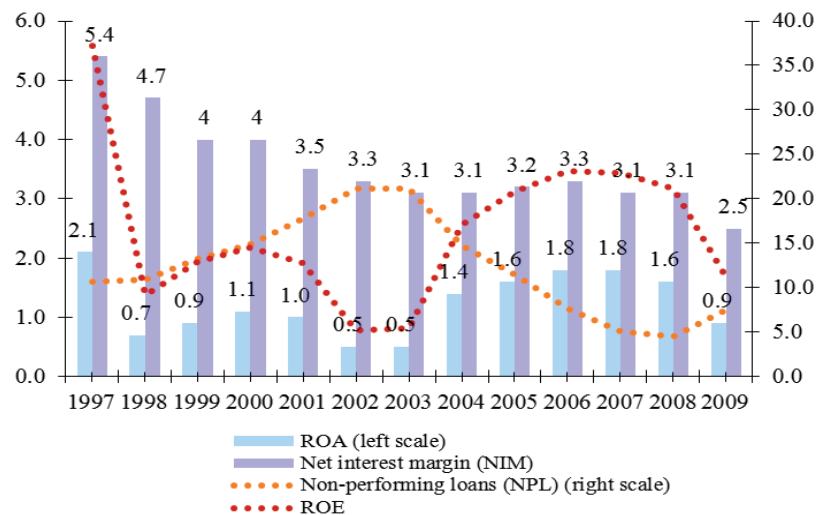
During the analysed period a downward trend of the net interest margin (NIM) was also observed,²⁷ but it was still twice as high as the average in EU-25. However, the decrease in net interest margin was also caused by a decrease in nominal interest rates resulting from a lower inflation rate.

²⁶ See: Polish Financial Supervision Authority, Report on the condition of Polish banks in 2008, p. 16, 38.

²⁷ Net interest margin is calculated as the quotient of net interest income and average assets in a particular year.

The improvement in banks' profitability was facilitated by, among others, a decrease in the share of non-performing loans²⁸ in assets, in particular loans granted to companies crisis (see figure 8).

Figure 8. Commercial Banking Sector's Efficiency Indicators in Poland 1997-2009 (%)



Source: NBP. Note: Net interest margin (NIM) = net interest income (interest income minus interest expenses) over average assets. Non-performing loans (NPL) = the share of loans which are classified as: substandard, doubtful and loss, in total assets.

An important (possibly the most important) factor which influenced the shape of the banking sector in the analysed period was Poland's accession to the European Union. Owing to this fact, the Polish financial law was harmonised with European Union regulations. It should be noted that as of the date of Poland's accession to EU, one of the entry barriers²⁹ for EU banks was removed as a result of introducing a single passport law in Poland.³⁰ Another factor driving recent changes in the banking sector has been the introduction of the New Capital Accord (NCA)³¹ implementing new risk management systems.

The period of 1997-2009 was also a period of the development of electronic technology in banking. Owing to new technical solutions banks were able to improve the

²⁸ Since Poland's accession to the EU the classification of non-performing loans changed to a less restrictive classification, for instance for sub-standard receivables from 1 to 3 months into from 3 to 6 months, for doubtful receivables from 3 to 6 months into from 6 to 12 months, for lost receivables from above 6 months to above 12 months. See NBP (2004).

²⁹ Bikker and Bos (2005).

³⁰ Pursuant to the single passport rule, a credit institution which obtained a banking licence in one EU country may undertake and conduct the activity in the territory of another UE country, without having to undergo another licence procedure. The credit institution is only required to notify the banking supervisor of the host country of its intention to undertake the activity in its territory. See: NBP (2004).

³¹ On 14 July 2004, the European Commission published the Capital Requirement Directive (CRD). On 28 September 2005, the text of CRD was adopted by the European Parliament and after consultations with EU countries in June 2006 two directives were adopted: Directive 2006/48/EC and Directive 2006/49/EC.

quality of their operations, streamline settlement procedures and accelerate cash turnover. In the last decade, technical solutions (including the development of IT technologies and the Internet) became an important internal factor enabling banks to improve their management systems and contributed to the development of modern banking products and their distribution channels. It should be stressed that Internet banking was one of the fastest growing commercial applications of the Internet.

In 2008, the turbulences on the global financial market, which was reflected at the Polish level as lower confidence between financial institutions, lead to obstacles in the liquidity management and risk hedging, as well as emphasises the need to focus on obtaining long-term and stable sources of financing. As a result of the crisis escalation a sharp increase in rates occurred on the interbank market, transactions' deadlines was reduced and limits for exposure for each entity were decreased; all of this led to the increase of financing costs and difficulties in managing current liquidity and securing the risk. Decline of mutual trust among market participants created a situation where banks, uncertain of contractors' financial situation, preferred to invest available funds in central banks. However, situation on Polish interbank market can be considered quite good in comparison to disturbance occurring in other countries. WIBOR 3M rate, which is a reference rate for majority of domestic currency loans, increased from 5.7% at the end of 2007 to 5.9% at the end of 2008. Also, the "deposit war" took place among Polish commercial banks in the fourth quarter of 2008³².

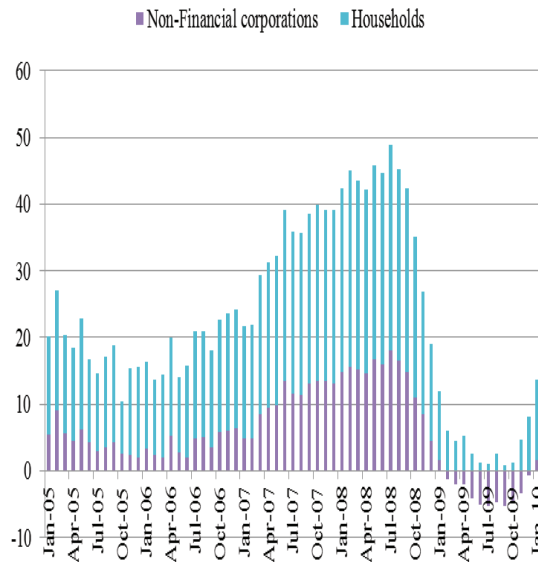
It is necessary to note that a decrease of mutual trust among market participants occurred also in Poland. In order to stabilize and improve situation on financial market the National Bank of Poland developed a so-called "Confidence Package" which enabled banks to expand the possibilities for banks to obtain liquidity in zloty. In order to counteract the crisis also the Polish Government took the Legislative activity³³. In 2009, despite the strong deterioration in financial performance, the situation of the banking sector was quite stable, also in terms of liquidity. The main source of risks was inadequate lending procedures both for customers, individual institutions and for the whole sector. In response to the identified phenomena of loosening credit policy standards for retail loans, the PFSA adopted Recommendations that were quickly implemented into the banking practice. Finally, the financial crisis has also put back into the spotlight the importance of financial sector infrastructure (such as credit information systems, payment and securities settlement system, and collateral registries) for well-functioning and sustainable financial sectors.

³² The average interest rate on deposits made in December 2009 was 3.2% against 5.9% in December 2008, see: Polish Financial Supervision Authority, Report on the condition of Polish banks in 2009, p. 16.

³³ See: Polish Financial Supervision Authority, Report on the condition of Polish banks in 2008, p. 32.

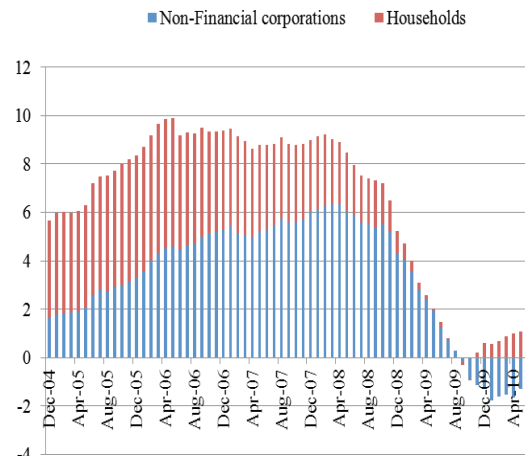
In the lending activity of Polish banks, similar to the lending activity of the euro zone banks, the growth of lending for the non-financial sector which was observed in 2006-2008, was stopped in 2009 (see figure 9 and 10).

Figure 9. Growth of Bank Loans for Non-Financial Sector (y/y) in Poland (%)



Source: NBP, ECB.

Figure 10. Growth of Bank Loans for Non-Financial Sector (y/y) in the Euro zone (%)



4. Analysis of the level of competition of the Polish banking sector between 1997 and 2009 – empirical results

4.1. Results of competition measurement with the Panzar and Rosse method

In order to estimate the level of competition in the Polish banking sector, a panel study was conducted on annual data from balance sheets and profit and loss accounts of commercial banks for 1997-2009. *H statistic* for the Polish banking sector (the value of the elasticity of the revenue function) was estimated on the basis of the following equation:

$$IR_{it} = \alpha + a_1 * \ln w_{lit} + a_2 * \ln w_{pit} + a_3 * \ln w_{cit} + \eta * (OI/II)_{it} + \sum_{j=1}^N b_j * oth_{it} + \varepsilon_{it} \quad (12)$$

where the dependent variable IR_{it} is the natural logarithm of interest income $\ln(II)_{it}$ or the natural logarithm of interest income divided by total assets $\ln(II/TA)_{it}$ of bank i in time t , and the independent variables include:

the price of input, i.e.

w_{lit} – the *price of labour* is the ratio of personnel expenses to total assets of bank i in time t ;

w_{pit} – the *price of funds* is the ratio of interest expenses to total deposits of bank i in time t ;

w_{cit} – the *price of capital* is the ratio of other operating and administrative expenses to fixed assets of bank i in time t ,

as well as other bank specific variables:

OI/II_{it} – other income/interest income of bank i in time t ,³⁴

$\sum_{j=1}^N oth_{it}$ – other bank-specific variables that affect long-run equilibrium bank revenues: the

share of loans which are classified as: substandard, doubtful and loss in total assets (*npl*), and the ratio of total deposit to total assets (*dep*), of bank i in time t , α – is a constant term, ε_{it} – error, a_1, a_2, a_3, η, b_j – regression coefficients³⁵.

In order to check the assumptions of the P-R method on a long-run equilibrium in the Polish banking sector, a test was performed by inserting ROA for 1997-2009 in place of the dependent variable in equation (12).³⁶ Based on the Wald test performed, the hypothesis on a long-run equilibrium in the banking sector at a conventional significance level cannot be rejected, which means that the condition for applying the Panzar and Rosse method is satisfied (results of the above tests are presented in statistical annex table A2).

In order to analyse changes in the level of competition in the Polish banking sector the value of H statistic function was calculated for the entire analysed period (1997-2009) and for three sub-periods: in 1997-2001 (H_1), in 2002-2007 (H_2) and in 2008-2009 (H_3).³⁷ In order to capture the impact of misspecification, two variants of equation 12 were estimated. The first

³⁴ With the aim to capture the increasing role of non-interest revenue in banks' income.

³⁵ The sum of regression ratios ($a_1+a_2+a_3$) determines the value of H statistic for the sector of commercial banks.

³⁶ After replacing the dependent variable with ROA or ROE, the value of H statistic = 0 means that the banking system is in a long-run equilibrium. This test can be easily performed with the use of the above ratios because in the long-run equilibrium profits are equal to zero and both in the case of ROA and ROE they do not depend on input prices.

³⁷ In order to estimate panel analysis coefficients on non-balanced data panel, the STATA 9.2 package was used.

variant explains the natural logarithm of interest income divided by total assets $\ln(II/TA)$ as the dependent variable, whereas the second model was based on the natural logarithm of interest income $\ln(II)$. Finally, following Delis et al. (2008) and Goddard and Wilson (2009) dynamic panel versions of models (using GMM estimator) for two dependent variables of equation 12 were estimated. The panel data for this analysis comprises all Polish commercial banks and foreign credit institution branches for each year (see figure 3) covered by the National Bank of Poland's balance sheet and income statement. These statistics consist of annual data from all banks reporting to the National Bank of Poland and cover the period from 1997 to 2009. Values of estimations of H statistics for 1997-2009 for two dependent variables and for three type of estimators (FE,³⁸ pooled OLS,³⁹ GMM) are presented in table 2. For detailed of estimation see statistical annex table A1).

Table 2. Value of H statistic for commercial banks operating in Poland

Estimations results with time interaction terms for overall sample:		FE		pooled OLS		GMM	
		$\ln(II/TA)$	$\ln(II)$	$\ln(II/TA)$	$\ln(II)$	$\ln(II/TA)$	$\ln(II)$
H₁	1997 – 2001	0.55¹	-0.05²	0.49¹	-0.597²	0.60¹	-0.087²
	p(F-test)	(0.000)	(0.408)	(0.000)	(0.031)	(0.000)	(0.064)
H₂	2002 – 2007	0.78¹	0.281¹	0.79¹	-0.393²	0.84¹	0.175²
	p(F-test)	(0.000)	(0.000)	(0.000)	(0.537)	(0.000)	(0.045)
H₃	2008-2009	0.82¹	0.196²	0.88¹	-0.769²	0.82¹	-0.035²
	p(F-test)	(0.000)	(0.000)	(0.000)	(0.635)	(0.000)	(0.045)
p(F-test)	H₀ : H₁ = H₂	(0.000)	(0.000)	(0.000)	(0.094)	(0.000)	(0.000)
p(F-test)	H₀ : H₃ = H₂	(0.271)	(0.456)	(0.054)	(0.133)	(0.574)	(0.470)
p(F-test)	H₀ : H₃ = H₁	(0.000)	(0.037)	(0.000)	(0.405)	(0.000)	(0.009)
Estimations results for overall sample:		FE		pooled OLS		GMM	
		$\ln(II/TA)$	$\ln(II)$	$\ln(II/TA)$	$\ln(II)$	$\ln(II/TA)$	$\ln(II)$
H*	1997 – 2007	0.76¹	0.015²	0.73¹	0.006²	0.67¹	-0.011²
	p(F-test)	(0.000)	(0.854)	(0.000)	(0.393)	(0.000)	(0.053)
H	1997 – 2009	0.77¹	0.126²	0.74¹	-0.688²	0.67¹	-0.21²
	p(F-test)	(0.000)	(0.0685)	(0.000)	(0.395)	(0.000)	(0.054)

Source: own calculations. Note: to test the value of H the Wald tests were used: for monopoly: $H_0 : H \leq 0$ versus $H_1 : H > 0$, and for perfect competition: $H_0 : H = 1$ versus $H_1 : H \neq 1$. ¹Hypothesis of $H \leq 0$ and $H = 1$ was rejected at the significance level of 1%.²Hypothesis of $H \leq 0$ was not rejected at the significance level of 1%.*(see: Pawłowska 2011, p. 21).

The empirical results with respect to the H-statistic in the period 1997-2009, have shown that the values of H statistics were higher when the dependent variable was scaled by assets (see Bikker et al (2006), p. 17). By estimating the different regression equations with interaction terms for two periods, significant changes over time were found for the two sub-

³⁸ Fixed-effects panel data estimations.

³⁹ A large part of P-R literature applies pooled OLS estimations (see Bikker et al. (2011)).

periods in the overall sample, which was confirmed by the test for significance of the differences between the two periods ($H_1 = H_2$, $H_1 = H_3$, $H_3 = H_2$; see table 2).

The empirical results have shown a monopolistic competition as a characteristic of the analyzed banks' behavior when the dependent variable was scaled by assets ($\ln(II/TA)$), see table 2.⁴⁰ But for the natural logarithm of interest income ($\ln(II)$) as the dependent variable, the results for the whole period and for the subsample covering the period 1997-2001 was not rejected the hypothesis of $H \leq 0$ (corresponding to a neoclassical monopolist or collusive oligopolist). Furthermore, only for the period 2002-2007 and for *FE* estimator the values of H statistic indicate a monopolistic competition (neither perfect collusion nor perfect competition) for the natural logarithm of interest income ($\ln(II)$). The above results are consistent with Bikker and Spierdijk (2008), Bikker et al. (2011) for the Polish banking sector, see table 3.

In the period 2008 - 2009 we can notice the slight decrease in competition caused by financial crisis. For the natural logarithm of interest income ($\ln(II)$) as the dependent variable, and for the subsample covering the period 2008-2009 the hypothesis of $H \leq 0$ was not rejected (corresponding to a neoclassical monopolist or collusive oligopolist).

Results of the panel analysis for the Polish banking sector on the basis of data from the BankScope database obtained by Gelos and Roldos (2002), Koutsomanoli-Fillipaki and Staikouras (2004), Claessens and Laeven (2004), Bikker and Spierdijk (2008, 2011) with the use of the P-R method are presented in table 3.⁴¹

Table 3. Values of the H statistic for the Polish banking sector

	Year	Value of H-statistic	The dependent variable	Number of banks	Market Structure
Claessens and Laeven (2004)	1994 - 2001	0.77¹	$\ln(II/TA)$	40	Monopolistic competition
Gelos and Roldos (2002)	1994	0.54¹	$\ln(II/TA)$	55	Monopolistic competition
Gelos and Roldos (2002)	1999	0.53¹	$\ln(II/TA)$	55	Monopolistic competition
Yildirim and Philippatoas (2007)	1993 - 2000	0.50¹	$\ln(II/TA)$	53	Monopolistic competition
Bikker and Spierdijk (2008)	1992	0.45¹	$\ln(II)$	50	Monopolistic competition
Bikker and Spierdijk (2008)	2004	0.08	$\ln(II)$	50	-
Bikker and Spierdijk (2011)	1994-2004	0.83	$\ln(II/TA)$	-	-
Bikker and Spierdijk (2011)		-0.19	$\ln(II)$	-	-

Source: Gelos and Roldos (2002), p. 47, Claessens and Laeven (2004), p. 573, Yildirim and Philippatoas (2007), p. 203, Bikker and Spierdijk (2008), p. 26, Bikker and Spierdijk (2011), p. 49.¹ $H=0$ and $H=1$ rejected (level of confidence 99.9 per cent).

⁴⁰The values are in the range of above zero and below unity and The Wald tests reveal that H differs significantly from both 0 and 1, and therefore rejects the hypotheses of both monopoly and perfect competition for Polish banking sector at the 1% significance level. The monopolistic competition comprises the features typical of both perfect competition and monopoly, the market is provided with heterogeneous products and, consequently, each company is a monopolist given the product it manufactures, but the companies manufacturing similar products can also be freely accessed.

⁴¹ Only Bikker and Spierdijk (2008) demonstrated a lower level of concentration for the Polish banking sector. It should be noted that the level of competition in the Polish banking industry was measured on the different sample of commercial banks.

Fillipaki and Staikouras (2006) demonstrated with the P-R method that commercial banks in new European Union countries (EU-10) operate in conditions of a higher competition than countries of the old Union (EU-15) (the H measure when the dependent variable was the ratio of interest income to assets ($\ln(\text{II}/\text{TA})$) is higher for EU-10 countries). Sources of higher competition in banking sectors of new EU countries, including Poland, are deemed to be lower barriers to entry into the market and the presence of foreign capital which showed an upward trend in the new EU countries (EU-10) in the analysed period. When analysing the competition in European banking sectors between 1994 and 2004, Bikker and Spierdijk (2008) demonstrated that in 2004 the degree of competition between banking sectors of the „old” and the „new” EU levelled off (see table 4).

Table 4. Results of the calculation of the H statistic for EU-15 and EU-10

Years:	Dependent variable	EU-15	EU-10
1998-2002 ¹	$\ln(\text{II}/\text{TA})$	H = 0.54	H = 0.78
1998-2002 ¹	$\ln(\text{TI}/\text{TA})$	H = 0.61	H = 0.46
1994 ²	$\ln(\text{II})$	H = 0.87	H = 0.61
2004 ²	$\ln(\text{II})$	H = 0.55	H = 0.55

Source: ¹Koutsomanoli-Fillipaki and Staikouras (2006), p. 39, ²Bikker and Spierdijk (2008), p. 26.

Bikker et al (2007) and Bikker and Spierdijk (2008) demonstrated that in the last period the level of competition in banking sectors of the old European Union countries (both from the euro zone and from outside the euro zone) decreased. The decrease in competition in the analysed countries was caused on the one hand by the creation of very large banks with a large market power and on the other hand by a change in the role of the bank as the main financial intermediary through an increase of the importance of the capital market in corporate financing and an increase of non-interest income in banks.

4.2. Results of competition measurement with the application of the Lerner index

The calculation of the Lerner index in the Polish banking sector used equation (6) as well as a panel of annual data from balance sheets and profit and loss accounts of Polish banks for 1997-2009, as in the case of the P-R method.

The marginal cost was estimated on the basis of translog cost function (Berger and Mester (1997)) with one output (total assets) and three input prices. Symmetry and linear restrictions in input prices are imposed. The cost function was specified as follows (see Fungacova and Weill (2009)):

$$\ln TC = \beta_0 + \beta_1 \ln y + 1/2 * \beta_2 |\ln y|^2 + \sum_{j=1}^3 \beta_j \ln W_j + \sum_{j=1}^3 \sum_{k=1}^3 \beta_{jk} \ln W_j \ln W_k + \sum_{j=1}^3 \gamma_j \ln y \ln W_j + v_{it} + z_i \quad (13)$$

where TC denotes the firm's total costs including financial costs and operating costs, y total assets, W_i – input prices estimated in the same way as in the P-R model (see equation 12); W_1 - the price of labour (w_l), W_2 - the price of capital (w_c), W_3 - the price of funds (w_f).

The estimation of the costs function (and hence of the marginal costs) was done for all panel data. Fixed effects are also introduced, in order to capture the influence of variables specific to each firm. Finally, as usual, the estimation is done under the imposition of restrictions of symmetry and of grade one homogeneity in input prices (for descriptive statistics of the main variables of estimation, see statistical annex table A3).

Next, the marginal cost (*MC*) was calculated as a derivative of the cost function against *y*:

$$MC = \frac{TC}{y} \left(\beta_1 + \beta_2 (\ln y_{it}) + \sum_{j=1}^3 \gamma_j \ln W_j \right) \quad (14)$$

The Lerner index is calculated as the quotient of the difference between the input price and marginal cost to the input price (see equation 6). The input price in the banking sector is assumed to be interest revenue divided by assets for each bank *i* in the period *t* (Angelini and Cetorelli (2003), Geuvara et. al. (2007)).

The calculated values of the Lerner index and the marginal cost for the Polish banking sector are presented in table 5. Results of the measurement of the marginal cost indicate its decrease between 1997 and 2009. In 2008 we can notice the slight decrease in competition in 2008 caused by financial crisis.

Table 5. Results of the calculation of the Lerner index for each year for the Polish banking sector between 1997 and 2009 (average)

Year	Std. Dev.	Lerner index	Std. Dev.	MC	Number of obs.
1997	0.425254	0.3802458	0.09015	0.07307695	83
1998	0.386123	0.3816084	0.08732	0.07155848	81
1999	0.340915	0.2866669	0.09159	0.06980097	73
2000	0.306847	0.4192944	0.08604	0.06887544	72
2001	0.684271	0.3019527	0.08770	0.06913474	70
2002	0.416789	0.0973307	0.08439	0.06642440	67
2003	1.695749	0.1360234	0.08662	0.06589605	59
2004	1.596667	0.1892985	0.08575	0.06461746	59
2005	0.862366	0.2846030	0.08973	0.06457389	58
2006	0.531301	0.2788467	0.08505	0.06336119	59
2007	1.031755	0.2591705	0.08568	0.06254121	60
2008	0.3700726	0.3700726	0.086041	0.06174030	64
2009	0.9603999	0.4222222	0.0220195	0.02212918	62

Source: own calculations.

In order to test the changes in competition between the three periods: with increasing and decreasing concentration,⁴² and time of financial crisis, the average values of the Lerner

⁴² See chapter 3: figure 4 and 5.

index were estimated for the following three sub-periods: L_1 : in 1997-2001, L_2 : in 2002-2007, L_3 : in 2008-2009.

The estimated values of the Lerner index for each period are presented in table 6. The Lerner index is an inverse measure of competition, i.e. a greater Lerner index means lower competition.

Table 6. Results of the calculation of the Lerner index for the Polish banking sector for 1997-2001, 2002-2007, 2008-2009 and 1997-2009

Years	Lerner index	Std. Dev.
(1) L_1 : 1997-2001*	0.3556355	0.0229866
number of observations	372	
(2) L_2 : 2002-2007*	0.207891	0.0600689
number of observations	351	
(3) L_3 : 2008-2009	0.2839089	0.7528025
number of observations	126	
$H_0: L_1 = L_2$	p(F-test)	(0.0096)
$H_0: L_3 = L_2$	p(F-test)	(0.0014)
$H_0: L_3 = L_1$	p(F-test)	(0.2351)
L: 1997-2009	0.3005048	0.8357595
number of observations	849	

Source: own calculations. *see: Pawłowska 2011, p. 25.

The estimation results of the average values of the Lerner index demonstrate a decreasing trend. Between 2002-2007 the level of competition in the entire sector of commercial banks was higher than in 1997-2001, as demonstrated by a decrease in the market power and higher level of competition. As confirmed by the test for significance of the differences between the two periods for all commercial banks: $L_1 = L_2$, $L_1 = L_3$, $L_3 = L_2$. Between 2008-2009 we can notice the slight decrease in competition caused by financial crisis.

4.3. Correlation between competition, concentration and foreign capital

In table 7 was presented the Spearman's rank correlation coefficient matrix between Lerner indices and the share of banks with majority foreign equity for Polish banks, the share of banks with majority of state ownership, bank concentration ratios (CR5), the Herfindahl-Hirschman indices (HHI), for the period 1997-2009. In table 8 was presented the Spearman's rank correlation coefficient matrix between bank concentration ratios (CR5) and the Herfindahl-Hirschman indices (HHI) and the share of banks with majority foreign equity for Polish banks, the share of banks with majority of state ownership, for the period 1997-2009.

There are negative correlation between Lerner index and the share of banks with majority foreign equity (see table 7). Furthermore, there are negative correlation between

concentration ratios and the share of banks with majority foreign equity (see table 8). It may mean that foreign participation may have increased competitive pressures. Similar conclusion for new EU banking sectors, has been found by Gelos and Roldos (2002, p. 20) for the period 1994-2000 and by Koutsomanoli-Fillipaki and Staikouras (2004, p. 29-30) for the period 1998-2002.

Table 7. Spearman's rank correlation coefficients matrix for Polish Commercial Banks in 1997-2009

Correlation	Banks with majority foreign equity (with branches of foreign banks)	Banks with majority of state ownership	CR5	HHI
Lerner index	-0.0330	0.0879	-0.7345	-0.5055

Source: own calculations.

4

Table 8. Spearman's rank correlation coefficients matrix for Polish Commercial Banks in 1997-2009

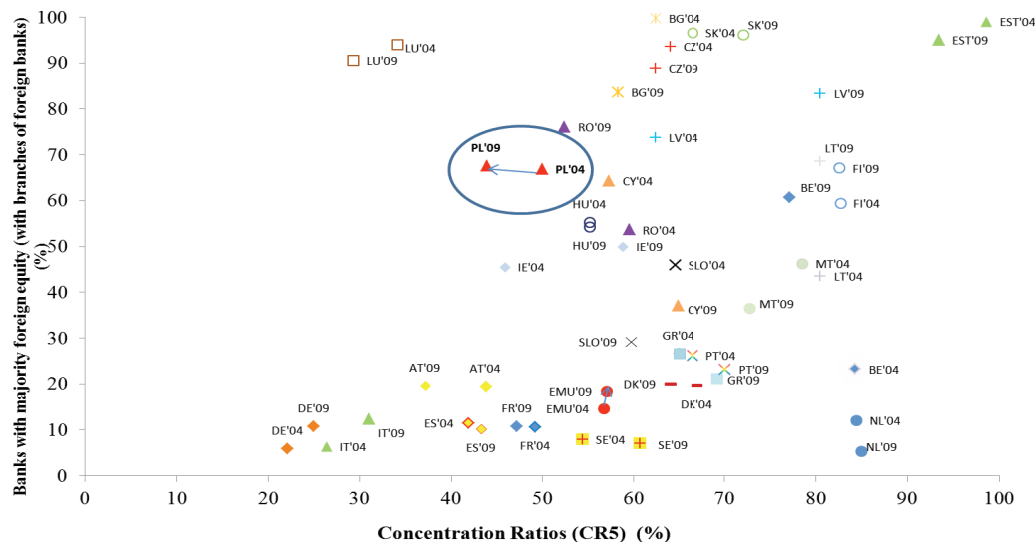
Correlation	Banks with majority foreign equity (with branches of foreign banks)	Banks with majority of state ownership
CR5	0.0825	-0.0193
HHI	0.4725	-0.3462

Source: own calculations.

However in Poland, we observed a decrease in the level of concentration and the share of foreign capital in the banking sector. By contrast, in the euro area due to massive consolidation process, the increase in concentration and in the share of foreign capital have been observed (see figure 10).

It should be stressed that the recent crisis rethinking the role of the state in shaping competition policies. The World Bank Report stressed that, the state has a very important role, especially improving supervision, ensuring healthy competition, and strengthening financial infrastructure (see: World Bank, 2012, p. 2).

Figure 10. Change of the Share of Banking Sector Assets with Majority of Foreign Equity and CR5 in EU (2004-2009)



Source: ECB, KNF, Schoenmaker (2011), s. 4 and own calculation.

4.4. Robustness check

Sample

The micro-panel data set which have been obtained from statistics of the National Bank of Poland was unbalanced and consist of 945 observation for the period 1997-2009 (data from all Polish commercial banks and foreign credit institution branches for each year). All regressions were checked for autocorrelation, heteroscedasticity and structural breaks.

Market structure tests

The relation between the H-statistic and the market structure provides a direct way for test the degree of competition in the banking sector. For this part of analysis, the usual statistical framework was applied: test for monopoly: $H : H_0 : H \leq 0$ against $H_1 : H > 0$, and test for perfect competition: $H_0 : H = 1$ against $H_1 : H \neq 1$. Above mention tests were applied for all estimated the H-statistics, for each period. The null hypothesis of monopoly and perfect competition was rejected at a 1% significance level only for the period 2002-2007.

Equilibrium tests

It should be noted that, one of the key assumptions underlying the P-R model is that the banks analysed are in a state of long-run competitive equilibrium. To test equilibrium, in this paper the Panzar and Rosse H-statistic was calculated, using the return on assets (ROA)

ratio as the dependent variable in place of the interest revenue function in the regression equation (12) for the period 1997-2009. A value of $H < 0$ would show non-equilibrium, whereas $H = 0$ would prove an equilibrium. Also, the usual statistical framework to test the value of H was applied. Testing for $H_0 : H = 0$ (equilibrium) against $H_1 : H < 0$ (disequilibrium) in the model with assets (ROA) ratio as the dependent variable provides a direct empirical way to test for long-run equilibrium. The idea behind this test is that, in equilibrium, returns on bank assets should not be related to input prices.

The null hypothesis of a long-term equilibrium in the Polish banking sector on a conventional level cannot be rejected on the basis of the Wald test, which means that the condition for using the Panzar and Rosse method was met (the result of the test is presented in table A.2 in Appendix).

Conclusions

Competition between banks is the crucial issue for the EU countries in general as well as for Poland in particular. This interest is driven by increasing consolidation in the banking sector, changes in production technology and regulation.

The results of the empirical analysis concerning the results of the competition measurement with the Panzar and Rosse model (P-R) and the Lerner index (LI) demonstrated a slight increase in competition between 1997 and 2009. On the base of tests, a significant difference was found when comparing the competitive behaviour of Polish banks between the three sub-periods (1997-2001, 2002-2007 and 2008-2009). It means that the process of consolidation in the Polish banking system which resulted in a slight increase in concentration measures, was not translated into a decline in the degree of competition. Between 2008 and 2009 Polish banking system was the effect mainly the financial crisis and the level of competition decreased⁴³.

Finally, this result showed that there was no trade-off between competition and concentration, as confirmed by negative correlation between the Lerner index and measures of concentration indices, and also with measures of foreign bank participation. It might also mean that that increase of foreign participation stimulated competitive pressures. Furthermore, foreign capital was positively correlated with concentration indices.

Liberalisation had an impact on the increase in the competition of the financial intermediaries and also on the financial crisis. It should be stressed that (prior the financial and during the crisis), the same divergently acting channels i.e. increase in mergers and acquisitions on the one hand and deregulation on the other; and during the crisis - increase in mergers and acquisitions as well and new regulations, which affected changes in the competition of banking sectors in the euro zone countries, affected the Polish banking sector due to the involvement of capital from the euro zone.

The evidence points out that liberalisation increased banking crises, while strong institutional environment and adequate regulation reduce them. Most importantly, underlines the importance of and market structure and competition for stability. This suggests that coordinating regulation and competition policy is necessary (see: Vives, 2010). With good regulation and supervision, bank competition can help improve efficiency and enhance access to financial services, without necessarily undermining systemic stability (see: World Bank, 2012, p. 2).

⁴³ However, in the fourth quarter of 2008 due to “deposit war” the different situation was observed on the loans market then on the deposit market.

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Statistical Annex

Table A.1 Estimation Results of the H–statistic for Polish Banking Industry (1997-2009)

Sample :	1997-2001	2002-2007	2008-2009	1997-2009	1997-2001	2002-2007	2008-2009	1997-2009
FE	<i>ln(II/TA)</i>			<i>ln(II/TA)</i>	<i>ln(II)</i>			<i>ln(II)</i>
w _l	0.3385977 (0.000)***	0.2973663 (0.000)***	0.1325161 (0.000)***	0.4699699 (0.000)***	-0.5633037 (0.000)***	-0.786627 (0.000)***	-1.030127 (0.000)***	-0.65549 (0.000)***
w _p	0.1469896 (0.000)***	0.4623772 (0.000)***	0.6624803 (0.000)***	0.3243236 (0.000)***	0.2944964 (0.000)***	0.9503728 (0.000)***	1.234301 (0.000)***	0.3110293 (0.000)***
w _c	0.0655363 (0.011)*	0.197463 (0.021)*	0.027023 (0.225)	-0.0354428 (0.000)***	0.2228699 (0.000)***	0.1173252 (0.000)***	-0.00801 (0.000)***	0.3049273 (0.000)***
OI/II	0.0217714 (0.903)	0.8819037 (0.001)*	0.027023 (0.000)***	0.0214903 (0.119)	-0.0102331 (0.004)	0.2448715 (0.000)***	0.473387 (0.000)***	-0.004407 (0.087)
npl	-0.0379284 (0.012)	-0.0033266 (0.881)	-0.0046967 (0.790)	-0.0151498 (0.000)***	0.0091651 (0.232)	-0.0050223 (0.585)	-0.0326835 (0.232)	0.0044661 (0.129)
dep	0.4606447 (0.000)***	0.3963901 (0.000)***	.6151743 (0.000)***	0.2375799 (0.000)***	0.0259846 (0.000)***	0.0951231 (0.000)***	1.22997 (0.000)***	0.0336342 (0.000)***
H-statistic	0.55 ¹	0.78 ¹	0.82 ¹	0.76 ¹	-0.05 ²	0.281 ²	-0.05 ²	-0.0395 ²
Number of obs.	815							
Number of groups	109							
Sample :	1997-2001	2002-2007	2008-2009	1997-2009	1997-2001	2002-2007	2008-2009	1997-2009
OLS	<i>ln(II/TA)</i>			<i>ln(II/TA)</i>	<i>ln(II)</i>			<i>ln(II)</i>
w _l	0.2429977 (0.000)***	0.2132084 (0.000)***	-1.030127 (0.000)***	0.408431 (0.000)***	-1.01704 (0.000)***	-0.92752 (0.000)***	-1.00227 (0.000)***	-0.711059 (0.000)***
w _p	0.1501346 (0.000)***	0.5352585 (0.000)***	1.234301 (0.000)***	0.2985082 (0.000)***	0.578269 (0.000)***	1.03477 (0.000)***	0.91655 (0.000)***	0.582441 (0.000)***
w _c	0.0921373 (0.011)*	0.0332863 (0.005)*	-0.0080078 (0.893)	0.0249312 (0.000)***	-0.1582566 (0.000)***	-0.50073 (0.000)***	-0.68329 (0.000)***	-0.3146118 (0.000)***
OI/II	0.1390757 (0.000)***	2.475149 (0.001)*	3.473387 (0.000)***	0.1612835 (0.119)	-0.0531391 (0.004)	0.2678179 (0.000)***	-0.0699425 (0.000)***	0.002182 (0.087)
npl	-0.022216 (0.000)	0.0066188 (0.527)	-0.0326835 (0.490)	0.0314765 (0.000)***	0.0100632 (0.232)	-0.0166045 (0.585)	-0.0699425 (0.475)	0.0035321 (0.129)
dep	0.1432135 (0.000)***	0.5169243 (0.000)***	1.22997 (0.000)***	0.2655795 (0.000)***	0.0684027 (0.000)***	0.1313395 (0.000)***	1.270842 (0.000)***	0.0464149 (0.000)***
H-statistic	0.49 ¹	0.78 ¹	0.88 ¹	0.73 ¹	-0.59 ²	-0.39 ²	-0.76 ²	-0.44 ²
Number of obs.	815							
Sample :	1997-2001	2002-2007	2008-2009	1997-2009	1997-2001	2002-2007	2008-2009	1997-2009
GMM	<i>ln(II/TA)</i>			<i>ln(II/TA)</i>	<i>ln(II)</i>			<i>ln(II)</i>
L1.IR	0.1320017 (0.000)***			0.2469129 (0.000)***	-0.2750194 (0.000)***			-0.2192471 (0.000)***
w _l	0.446558 (0.000)***	0.276489 (0.000)***	0.214519 (0.000)***	0.34732 (0.000)***	-0.0414117 (0.000)***	0.0020913 (0.000)***	-0.510041 (0.000)***	-0.5891199 (0.000)***
w _p	0.120238 (0.000)***	0.5859286 (0.000)***	.6073803 (0.000)***	0.3279865 (0.000)***	0.0206041 (0.000)***	-0.0558953 (0.000)***	0.521202 (0.000)***	0.295078 (0.000)***
w _c	0.0194073 (0.011)*	0.0355586 (0.011)*	-0.0029541 (0.000)***	-0.0046261 (0.014)*	0.0068127 (0.000)***	0.0615963 (0.000)***	-0.045974 (0.000)***	0.079663 (0.000)***
OI/II	0.0557849 (0.903)	1.055714 (0.001)	.8282976 (0.000)***	0.0745944 (0.020)	0.0012872 (0.000)***	0.1069595 (0.000)***	0.9611457 (0.000)***	0.0059927 (0.367)
npl	0.007264 (0.012)	-0.0290707 (0.000)***	-0.0163221 (0.000)***	-0.0211732 (0.020)	0.0076215 (0.336)	0.0003042 (0.655)	-0.076764 (0.000)***	0.0013953 (0.544)
dep	-0.1374791 (0.000)***	-0.5376006 (0.000)***	0.555588 (0.000)***	0.3373724 (0.000)***	0.0211597 (0.000)***	0.001659 (0.000)***	.5451412 (0.000)***	0.3665749 (0.000)***
H-statistic	0.60 ¹	0.84 ¹	0.82 ¹	0.67 ¹	-0.014 ²	0.011 ²	-0.0359 ²	-0.21 ²
Saragan test (p value)	(0.000)			(0.000)	(0.000)			(0.000)
Number of obs.	615							
Number of groups	94							

Source: own analysis. Note: Dependent variable: interest income/total assets - is marked as „II/A”, interest income - is marked as „II”. Unit factor prices: w_l – the price of labor, w_p – the price of funds, w_c - the price of capital, p values in brackets, * significant at 10%; ** significant at 5%; *** significant at 1%. ¹Hypothesis of H ≤ 0 and H = 1 was rejected at the significance level of 1%. ²Hypothesis of H = 0 was not rejected at the significance level of 1%.

Table A.2. Equilibrium Test for Polish Banking Industry (1997-2009)

ROA	Null Hypothesis Summary: Wald test for H=0	
Normalized Restriction (=0)	Value	Probab .
H-statistic	0.03271893	0.5681

Source: own analysis. Note: In linear regression on equation (10) a dependent variable has been used ROA. $H < 0$ is disequilibrium while $H = 0$ is equilibrium. Equilibrium is confirmed for the Polish banking sector (significant at 1 per cent).

Table A.3. Descriptive Statistic for the Main Variables

Variables	Obs	Mean	Std. Dev.
<i>II</i>	945	0.1058084	0.3534969
<i>III/TA</i>	930	0.11307	0.3838534
<i>OI</i>	945	229640.9	560882.8
<i>npl</i>	945	0.144561	0.682205
<i>dep</i>	945	0.408773	0.4482802
<i>w_l</i>	942	0.023842	0.0301337
<i>w_p</i>	856	6.398926	88.97036
<i>w_c</i>	921	7.65222	121.1115
<i>OI/II</i>	945	0.4861223	2.473912
<i>TC</i>	945	392482.2	863810.4
<i>ROA</i>	945	0.0144974	1.216489
<i>y</i>	945	13.96595	2.113375
<i>y2</i>	945	99.75427	28.45166
<i>s</i>	945	0.0140429	0.0297471

Source: own analysis.