

Efficiency and Competition in the Polish Banking Sector – Would Euro Adoption Change Them?*

Poziom efektywności i konkurencji polskiego sektora bankowego. Czy wejście do strefy euro wpłynie na jego zmianę?

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Abstract

The aim of this analysis is to assess the impact of the euro adoption on efficiency and competition of the Polish banking sector. Efficiency and competition of banks are the main factors important for the stability of the financial sector through their influence on banks' profitability, access to external funding and the country's economic development.

The results of the empirical analysis indicate that the main driver of the rise in efficiency and competition in the Polish banking sector was Poland's entry into the European Union. The degree of both efficiency and competition was higher in the segment of retail banking than in corporate banking.

The results of the analysis of efficiency and competition of the Polish banking sector also lead to the conclusion that Poland's entry into the euro area is not likely to significantly change the degree of competition in the banking sector as a whole, and may only impact the segment of corporate banking.

It seems that Poland's entry into the euro area will mainly result in an increase in competition and efficiency in the segment of corporate banking. Retail banks, on the other hand, will continue to be of a local character owing to the bank lending relationship with individual customers and SME. This conclusion is based on observations noted in the euro area banking sectors after the creation of EMU.

Keywords: Economic and Monetary Union, competition, concentration, market structure, Panzar-Rosse model, efficiency, DEA, SFA

JEL: F36, G2, G21, G34, L1

Streszczenie

Celem opracowania jest określenie wpływu przystąpienia do strefy euro na efektywność oraz poziom konkurencji polskiego sektora bankowego.

Z przeprowadzonej analizy empirycznej wynika, że głównym impulsem wzrostu efektywności i konkurencji w polskim sektorze bankowym było wejście Polski do Unii Europejskiej i ich obecny poziom jest zbliżony do poziomu występującego w krajach strefy euro. Poziom efektywności i konkurencji był wyższy w segmencie bankowości detalicznej niż korporacyjnej.

Wydaje się, że wejście Polski do strefy euro nie wpłynie na znaczną zmianę poziomu konkurencji w całym sektorze bankowym; może jedynie spowodować wzrost konkurencji w segmencie bankowości korporacyjnej. Wejście do strefy euro nie powinno mieć istotnego wpływu na poziom konkurencji w bankowości detalicznej, ponieważ nadal będzie ona miała charakter lokalny ze względu na tzw. relacje z bankami (*bank lending relationship*). Ten wniosek jest zbieżny z wynikami analiz dotyczących bankowości detalicznej w krajach strefy euro.

Słowa kluczowe: Unia Gospodarcza i Walutowa, konkurencja, koncentracja, efektywność, fuzje, DEA, SFA, model Panzara-Rosse'a

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1. Introduction

The Second Banking Directive and the establishment of the Economic and Monetary Union (EMU) have radically transformed institutional conditions of the European financial market. Those processes combined with IT developments have boosted competition, efficiency and profitability of banks. However, the integration of financial services has spurred greater competition in corporate banking, keeping retail sector still segmented and country oriented. Poland has participated in the third stage of the Economic and Monetary Union since its accession to the European Union (EU), when it acquired the status of a Member State with a derogation regarding the adoption of the euro, committing itself to introducing the euro and joining the euro area in the future.

The anticipated euro adoption in Poland will have an impact on the condition of the whole Polish banking market, including its retail and corporate segment. The analysis of the process of euro introduction in the first twelve countries indicates the existence of a multi-channel type of impact on the financial sector. The euro adoption accelerated unification of the European financial market and consolidation of credit institutions increasing the number of mergers and acquisitions. Particularly for banks, the euro adoption increased the volume of cash transactions and reduced profits from foreign exchange transactions. In the area of regulation, the euro centralized the system of conducting the monetary policy shifting it from the national central banks to the European Central Bank and relaxing the bank entry conditions (Yusov 2004, p. 17).

One of the main expectations of the creation of the euro area was the improvement in efficiency of commercial banks and competition conditions in the banking market. The most important channels of euro influence on the banking efficiency and competition were banking consolidation and financial deregulation. Higher concentration enabled banks to achieve economy of scale. At the same time, the reduction of banks entry requirements led to higher competition on the market, but it should be noted that the results of *ex post* research related to the changes in competition in euro area countries are ambiguous.

The same changes in the banking sector would be expected following Poland's entry into the euro area, but the same channels, i.e. consolidation and financial deregulation, that were observed in the EU during the adoption of the euro, have already influenced the banking efficiency and competition of Polish banking sector after Poland's accession to the EU. Therefore, when Poland enters into euro area the impact on efficiency and competition of the banking sector through these channels will probably be much weaker.

The availability of data for nearly ten years of EMU existence provides an opportunity to consider

the following question: what impact might the euro adoption have on the efficiency and competition and on the Polish banking sector as a whole, in particular, on the groups of retail and corporate banks? It should be noted, however, that empirical research on the impact of euro adoption on the efficiency and competitive conditions of the national and EU banking sectors is scarce. The literature on this subject focuses on the entire problem of the financial markets integration rather than on specific aspects.

In order to answer the above question, this study firstly assesses competition and efficiency in the Polish banking sector. In this paper two methods, i.e. Data Envelopment Analysis (DEA) for the assessment of technical efficiency and Stochastic Frontier Approach (SFA) for the assessment of cost efficiency, have been used to analyse efficiency in the Polish banking sector. For assessment of the quality of competition on the banking market the Panzar and Rosse model has been applied in this study. In order to evaluate differences between levels of efficiency and competition in individual banking segments the micro-panel data sample for Poland have been divided into three groups: the total banking sector, retail banks and corporate banks. The micro-panel data for the Polish banking sector has been obtained from statistics of the National Bank of Poland for the period 1997–2006.

Secondly, to assess the potential impact of the single currency adoption in Poland, a comparative analysis of market conditions has been made. For this part of research, the data for banking sectors in the Czech Republic, Hungary, Slovenia,¹ Slovakia, Poland (new EU members and non-EMU members), the UK, Denmark ("old" EU members and non-EMU members), Spain, Portugal, France and Germany (EMU members) has been obtained from BankScope (IBCA).

Efficiency for each country² and for each year separately has been estimated based on the paper by Casu and Girardone (2007). Competition, also for each country, has been estimated for the total period (1997–2006), and for three sub-periods: pre EMU, post EMU and the period following the EU accession of new member states, based on the paper by Utrero-Gonzalez and Callado-Muñoz (2007).

The empirical results indicate a slight increase in efficiency in the Polish banking sector. Furthermore, the Polish banking industry can be characterized as a market with monopolistic competition. This means that the level of competition among commercial banks operating in Poland does not significantly diverge from the level observed among credit institutions in the euro area, where monopolistic competition also prevails. However, competition in the retail market is slightly higher than

¹ Slovenia became EMU member in 2007.

² For France and Germany, the results of the research by Hollo and Nagy (2006) and Casu and Girardone (2007) are presented.

in the corporate market owing to the growth in loans granted by mortgage banks.

To sum up, it seems that Poland's entry into the euro area will mainly result in an increase in competition and efficiency in the segment of corporate banking. The retail banking, on the other hand, will continue to be of a local character owing to bank lending relationship with individual customers and SME. This conclusion is based on observations noted in the euro area banking sectors after the creation of EMU. Therefore, all banks in Poland will be able to successfully compete on the unified euro banking market and preserve their financial stability.

The remaining parts of the paper are structured in the following way. The first section presents literature review. The second describes changes in the banking system. The third section discusses the methodology of competition and efficiency measurement. The fourth and fifth sections describe the data from NBP and BankScope (IBCA)³ and the empirical results for Poland based on NBP data and results for the Czech Republic, Hungary, Slovenia, Slovakia, Poland, England, Denmark, Spain, Portugal, France and Germany based on BankScope data. Conclusions are presented in the summary.

2. The impact of joining euro area on efficiency and competition of the financial sector – review of literature

The euro has been a feature of the financial landscape since 1 January 1999, when the third stage of EMU began. On 1 January 1999, the exchange rates of the participating currencies were irrevocably set, euro area Member States began implementing a common monetary policy and the euro was introduced as a legal currency. The 11 currencies of the participating Member States became subdivisions of the euro. The creation of the euro area was preceded by a number of analyses on the expected impact of the single currency on competition and efficiency in the financial sector.

Participation in the euro area was expected to increase competition in the financial sector and impact bank's profitability leading to an increase in the efficiency of financial institutions (ECB 1999). It was noted that joining the euro area would change the position of a bank as the main financial intermediary, i.e. would lead to disintermediation, which could change the financial results and lead to increased competition pressures in capital markets (McCauley, White 1997).

In view of such challenges, banking systems of the euro area undertook appropriate strategic remedial measures to increase efficiency through, *inter alia*, service quality improvement, cost reduction, development of alternative revenue sources through geographical expansion (ECB 1999). Banks became involved in mergers and acquisitions, of a cross-border character in particular, and strategic alliances. In 2005, cross-border transactions accounted for 51% of all M&A transactions – as a result of the mergers of Unicredito and HypoVereinsbank, ABN Amro and Banca Antonveneta, Swedbank and Hansabank.

However, the most intense merger activity was observed in the period preceding the introduction of the euro; in subsequent months consolidation slowed down. The number of financial institutions in the euro area had been decreasing all the time (Yusov 2004). The results of the consolidation have been most visible in the largest banks. The share of 25 largest banks rose from 45% in 1997 to as much as 60% in 2003. However, despite a rise in concentration measured with CR₅⁴ and HHI⁵ indicators this did not lead to decreased competition. Net interest margins went down considerably even in countries with high concentration degrees, which reflected market contestability (ECB 2005, p. 83).

It should be noted that the number of empirical studies related specifically to changes in competition and efficiency of the financial sector in EMU (ex post) basing on quantitative methods is insignificant, cross-country research is still in its initial phase and explicit conclusions have not been formulated. The majority of available papers relates to a broad problem of financial integration (see Danthine 2000; Cabral et al. 2002; Manna 2004; ECB, 2007c) and shows differences in financial integration between retail banking and corporate banking (e.g. for the whole euro area corporate banking lending margin narrowed from 1.67% to 1.34%, for retail banking – from 1.48% to 0.76%, in 1998 and 2001 respectively (Cabral et al. 2002, p. 7). Statistics on the magnitude of cross-border deposits also reflect differences in the degree of integration. In 2002, cross-border deposits stood at 25% for corporate banking while the corresponding share for retail banking stood at 5% only (Manna 2004, p. 7). Differences in the level of financial integration lead to different degrees of concentration in the segments of euro area retail and corporate banking. Studies of the European Central Bank show an increase in the degree of competition and efficiency in corporate banking while the retail banking has been displaying national characteristics (only 1% of customers are using cross-border services with 26% of them accessing services through the internet (ECB

³ The BankScope database was created by Bureau van Dijk-Electronic Publishing. It contains information on balance sheets and income statements of commercial banks around the world. Information in the database is the annual audited data. BankScope database provides information on individual countries on 90% of assets of domestic banking sectors in national currencies, EUR and the US dollar. Quantitative analysis carried out by international institutions such as IMF, OECD is based on information contained in the database. See: Bhat-tacharya (2003), pp. 1–2.

⁴ CR₅ – indicator showing market share of 5 largest banks.

⁵ Herfindahl-Hirschman Indicator (HHI) – calculated as the sum of the squares of the market shares of each individual commercial bank (e.g. gross credits, net assets, deposits).

2007a, p. 2). In a comment to Cappelletto (2006) paper, Vieves (2006) stated that retail banking in euro area countries showed national characteristics. This occurs owing to information asymmetry which makes access to information about credit capability of SME and households difficult for foreign banks. In their paper, Mongelli and Vega (2006) also showed that lending to the SME sector in euro area countries is of a local character.

One of the few empirical studies using cross-country statistics that relate specifically to the impact of joining EMU on increased competition in the financial sector was carried out by Utrero-Gonzalez and Callado-Muñoz (2007). The authors analysed changes in competition in the banking sectors of Spain and France (euro area countries) and the United Kingdom and Denmark (non-euro area countries) in the period 1996-2002. The euro has been a feature of the financial landscape since 1 January 1999, when the third stage of EMU began. Therefore, the periods analyzed are 1996-1998 and 1999-2002. To evaluate the degree of competition in these banking industries in the two periods, Utrero-Gonzalez and Callado-Muñoz applied a methodology proposed by Panzar and Rosse, the so called "H-statistic" (for more information see section 4.2.1). Using a comparative analysis of changes in the degree of competition of the banking sectors in euro and non-euro area countries the authors demonstrated a positive impact of the single currency on increased competition in the euro area banking sector.

Different research results were presented by Bikker and Spierdijk (2008), Bikker, Spierdijk and Finnie (2007), who were the first to analyse changes in cross-country competition in 101 countries in the period of the last 15 years. The authors found significant changes in the degree of competition in the analysed countries. In addition, they reported a decrease in competition in the banking sector of Western Europe (in particular, in the euro area) and an increase in competition in the banking sectors of Eastern Europe. According to Bikker and Spierdijk, a slump in the upward trend of competition measures in the years 2001-2002 followed by their decrease was caused by a delayed response to the introduction of the "virtual" euro in 1999. Also, Fillipaki and Staikouras (2004) have shown that commercial banks in the new EU countries (EU-10) operate under conditions of stronger competition than the old EU countries (EU-15). Stronger competition in the banking sectors of the new EU countries, among others in Poland, may stem from lower market entry barriers and the presence of foreign capital that displayed a rising tendency in the new EU countries (EU-10) in the analysed period.

The reason for the decrease in competition in the banking sector of Western economies was,

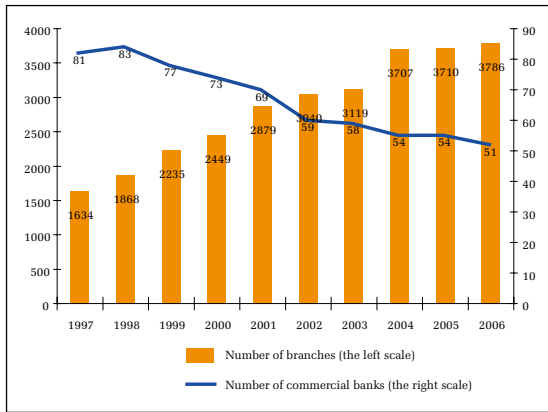
on the one hand, the establishment of very large banks with considerable market strength, and, on the other hand, the change of banks' role as the key financial intermediaries, owing to increasing significance of the capital market in lending to enterprises and the increase in banks' non-interest income. However, literature on this subject has not yet provided results of research on the relationship between the degree of competition and the rise in non-interest income in euro area banks (Bikker et al. 2007, p. 3).

However, the authors are of the opinion that the introduction of the euro led to increased competition in the financial market, among others through increased competition in the credit market as it modified the type of services offered by banks and led to a revival in the capital market. It should be noted that after the establishment of the single currency – the euro – there was a significant rise in corporate bonds issue: from EUR 30 billion in 1999 to EUR 170 billion three years later owing mainly to the rise in liquidity and increased competition in the sector of financial intermediaries (see EBC 2007, p. 20). Thus, the introduction of the euro changed the role of a bank as a financial intermediary that used to be the main service provider in the process of funding corporates in the euro area countries.

Increased competition in the credit market in euro area countries was also reported by Leuvensteijn et al. (2007). This paper is the first that applies a new measure of competition, the Boone indicator, in the credit market in euro area countries. This approach enables to measure competition of banking market segments, such as the loan market, whereas many well-known measures of competition can consider the entire banking market only. The paper points to differences in the degree of competition among euro area countries (the highest degree of competition in credit markets was found in Germany and Spain, the lowest – in France and Italy).

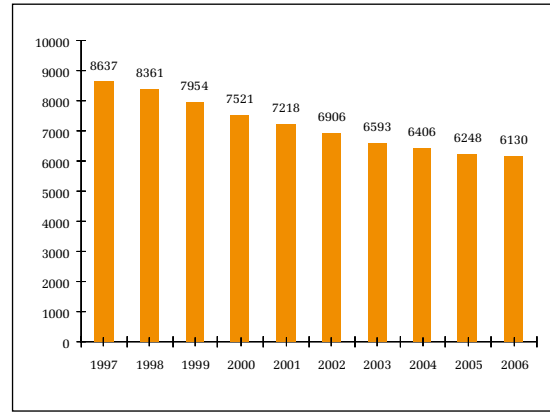
Research on the efficiency of the euro area countries utilising DEA and SFA methods (for more information see section 3.1.1) was carried out, among others, by Casu and Molyneux (2000), Bos and Schiedel (2003), Hollo and Nagy (2006), and Casu and Girardone (2007). The research results related to the efficiency of banking sectors indicate that there are differences in efficiency levels between individual euro area countries and there is no direct relationship between changes in competition and efficiency. The most interesting study was carried out by Hollo and Nagy (2006), who analysed profit efficiency of 25 EU countries. The results of their analysis show that the efficiency of EU-10 is close to the efficiency of EU-15 and that the so called "efficiency gap" between the "new" and the "old" EU countries is insignificant and is only 0.04%.

Figure 1. *The Number of Polish Commercial Banks and Branches in 1997–2006*



Source: NBP.

Figure 2. *The Number of Credit Institutions in MU-12 in 1997–2006*



Note: The number of credit institution includes commercial banks and cooperative banks.

Source: ECB.

3. Structural and technological changes in the Polish banking sector in 1997–2006

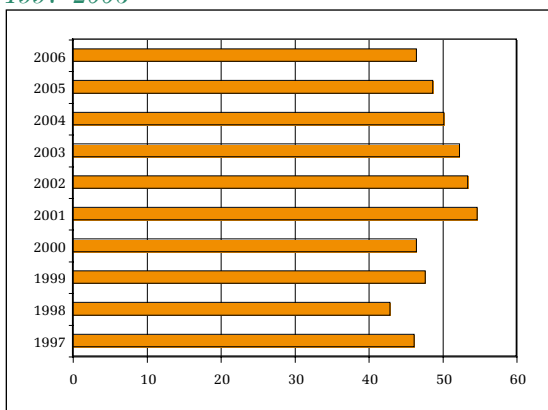
In Poland, the financial system is mainly based on commercial banks whose share in the financial system's assets amounts to around 70%. The role of other financial institutions has been increasing systematically but remains insignificant. The period of 1997–2006 was characterised by fast changes in the Polish banking sector. Banks attempted to formulate new development strategies to achieve the best possible financial results. One of the elements of commercial banks' strategy was the process of mergers and acquisitions, which was driven by a fast technological development. It should be noted, however, that the consolidation process in the Polish banking sector was to a great extent a natural consequence of the earlier privatisation of domestic banks and gaining strategic

investors, as well as intensified mergers in the euro area countries. As a result of the consolidation process in the Polish banking sector a decrease in the number of commercial banks was observed with a simultaneous growth in the number of bank branches. The decrease in the number of banks has also been observed in euro area countries (see: Figure 1 and 2).

The consolidation in the Polish banking sector (as in other euro area countries) resulted in changes in concentration (measured with HHI and CR₅ indices). Changes in concentration measured with HHI and CR₅ indices are shown in Figure 3 and 4.

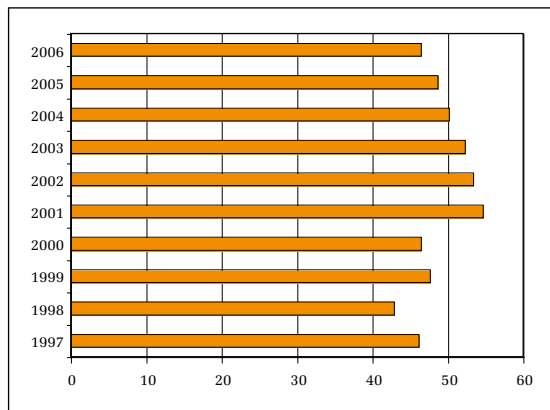
When studying the fluctuation of concentration indices in the Polish banking sector it should be noted that for part of the analysed period (1998–2001) the indices display a rising trend. The rise in concentration indices was driven by mergers and acquisitions carried

Figure 3. *Herfindahl - Hirschman Indices (HHI) for Polish Commercial Banks in 1997–2006*



Source: own analysis.

Figure 4. *CR₅ for Polish Commercial Banks for Assets in 1997–2006*



Source: own analysis.

out by large banks. On the other hand, in 2002–2006 concentration indices were going down despite a further fall in the number of commercial banks. The decline of concentration indices was caused by a slow-down in the consolidation process and a slower growth of large banks.

It should be noted that the privatisation process carried out in the Polish banking sector led to a significant decrease in the role of the state in the banking sector. The share of banks with majority foreign ownership amounted to 66.6% at the end of December 2006 while in 1997 it stood at 15.3%. The analysis of ownership transformation in the Polish banking sector in recent years also shows that since 2000 the share of foreign capital has stabilised (see Table 1 in Statistical Annex A).

During the period of 1997–2006 the financial performance of Polish banks was constantly improving (see Table 2 in Statistical Annex A). Profitability of assets and equity has raised and in the meantime the value of net interest margins has dropped to about 3.2% in 2006, in comparison with 5.4% in 1997. Some signs of the economic slow-down of 2000 followed by lower creditworthiness of businesses can be recognized by the temporary reduction of banks profits. However, starting from 2004 the performance of commercial banks has improved significantly, which is associated with Poland's accession to the EU. Better business environment resulted in lower value of non-performing loans (NPL) and improvement in profitability ratios. However, it must be emphasized that the outlook of the financial situation of the banking sector can be in some way distorted due to the implementation of the International Financial Reporting Standards (IFRS) which have been effective since the beginning of 2005.

The period of 1997–2006 is also marked by the development of electronic technologies in banking. Owing to the new technical solutions banks were able to improve the quality of their operations, improve settlement procedures and speed up the turnover of money. In the last decade, technical solutions, including the development of IT and the Internet, have become one of the key internal factors enabling banks to improve their management systems. In addition, they contributed to the development of banking products and their distribution channels. The customers, especially individuals and small enterprises, take a growing interest in telephone banking, which includes account services and the purchase of banking products through the phone, as well as in mobile banking, which combines telephone banking with Internet banking, with the use of access to the Internet via the WAP protocol.

An important factor (perhaps the most important) that had an influence on the competition in the banking sector in the analysed period was Poland's accession to the European Union. One of the results of the accession was the harmonisation of Polish financial law with EU regulations. It should be noted that on the day of Poland's accession to the EU one of the entry barriers for

EU banks was removed (Bikker, Bos 2005, p. 39) through the introduction of a single passport in Poland. According to the single passport principle, a credit institution licensed to conduct banking activities in any EU country may undertake activities in the territory of another Member State without the need to undergo another licensing procedure. The only obligation it has is to notify the banking supervisor of the host country of the intention to undertake activities in its territory (NBP 2004).

Another factor influencing the development of the banking sector in recent years has been the implementation of the New Basel Capital Accord (Basel II). The New Basel Capital Accord (NCA) sets standards for managing banks for the years ahead, among others, through the implementation of new systems of risk management. The aim of the NCA is to improve the quality of risk management in banks, in particular in the area of credit risk management. One of the most innovative aspects of the NCA is the possibility of using internal instruments of credit risk management in the capital adequacy assessment process, i.e. internal ratings-based (IRB) approach. In Poland, the New Capital Accord was introduced by law in 2007 while the possibility of using the IRB approach in banks was introduced on 1 January 2008 (thus it is not covered by the analysis).⁶ It should be noted that the introduction of the NCA will have an impact on the degree of competition in the banking sector as one of its goals is to change the way in which small banks compete with large banks. The introduction of the NCA may lead to further concentration of banking services. Smaller banks may also seek a chance of building bank lending relationships, which will enable them to improve the quality of risk management.

To sum up, it may be stated that today, Polish commercial banks are modern and have made a large progress towards implement new technologies and offer state-of-the-art banking products. It might mean that they have the power to compete in the European Single Market.

4. Methodology

4.1. Measuring bank efficiency

Efficiency is a broad concept that can be applied to many dimensions of a firm's activities and there are many definitions of efficiency. This paper will deal with the following definitions of efficiency: technical efficiency and cost efficiency.

Technical efficiency is related to the ability of a firm to produce outputs with given inputs: a production plan is technically efficient if there is no way to produce

⁶ In Poland draft laws regulating the new way of managing risk in banks were developed on the basis of UE draft directives (2006/48/EC and 2006/49/EC). This was related to the amendments to the Banking Act and drafts of new resolutions of the Commission for Banking Supervision (among others, Resolutions 1 – 9 of 13 March 2007).

the same output(s) with less input(s) or to produce more output(s) with the same inputs. Technical efficiency considers scale and scope economies.⁷

Cost efficiency is determined by calculating how close a bank's costs lie to the efficient cost frontier for a given technology. The efficient frontier is determined by two conditions, technical efficiency (minimum use of inputs) and allocative efficiency (optimal mix of inputs given relative factor prices) (see: Favero, Papi 1995, p. 38).

The definitions of efficiency call for different measurement methodologies. The most common efficiency estimation techniques are non-parametric and parametric. There are two main non-parametric approaches: Data Envelopment Analysis (DEA) and Free Disposal Hull (FDH). FDH is a special case of the DEA model but generates larger estimates of average efficiency than DEA.

There are three main parametric frontier approaches: Stochastic Frontier Approaches (SFA), Distribution-Free Approach (DFA) and Thick Frontier Approach (TFA). SFA and DFA allows for random error, but the main difference between these techniques is how they separate the measure of inefficiency from an individual bank from random errors. DFA assumes that the efficiency of each firm is stable over time, whereas random error tends to average out to zero over time. Also, TFA allows for random error and does not provide exact point of efficiency for individual firms but is intended to provide an estimate of the general level of overall efficiency. All non-parametric methods generally yield slightly lower mean efficiency estimates and seem to have a greater dispersion than the results of the parametric models (Berger, Humphrey 1997, pp. 175–212).

In this paper two methods, i.e. Data Envelopment Analysis (DEA) for the assessment of the technical efficiency and Stochastic Frontier Approach (SFA) for the assessment of the cost efficiency, were used to analyse the efficiency in the Polish banking sector.

4.1.1. Data Envelopment Analysis (DEA) – methodology

DEA is a non-parametric linear programming technique that computes a comparative ratio of outputs to inputs for each unit, which is reported as the relative technical efficiency score (Charnes et al. 1978, pp. 429–444). The technical efficiency score is usually expressed as a number between 0 and 1. This method assumes that there are decision-making units (DMUs) that are to be evaluated. Each DMU consumes varying amounts of m different inputs to produce s different outputs. A decision-making unit with a score less than 1 is deemed inefficient relative to other units. An efficient DMU depicts the efficient frontier that represents achieved

efficiency. The efficient frontier envelops all other data points, thus giving rise to the name of data envelopment analysis. The mathematical programming approach to the construction of production frontiers and the measure of efficiency relative to the constructed frontiers is frequently given the descriptive title of data envelopment analysis. For details see Pawłowska (2003, pp. 8–11).

Data Envelopment Analysis (DEA) is also a source of concepts and methodologies that have now been incorporated into several models. Among a number of DEA models, we would like to present the ones used most frequently (CCR-model and BCC-model and NIRS-model).

In this paper the technical efficiency has been investigated on the following assumptions: constant returns to scale (CRS), variable returns to scale (VRS) and non-increasing returns to scale (NIRS).

The following symbols have been applied in this paper:

e_{crs} – measure of technical efficiency under constant returns to scale assumption (CRS),

e_{vrs} – measure of technical efficiency under variable returns to scale assumption (VRS),

e_{nirs} – measure of technical efficiency under non-increasing returns to scale assumption (NIRS).

For the above three technical efficiency measures (e_{crs} , e_{nirs} , e_{vrs}), the following property also holds: $0 < e_{crs} \leq e_{nirs} \leq e_{vrs} \leq 1$. Based on scale efficiency measure (e_s) only, it is not possible to distinguish in which region the given DMU is operating: increasing or decreasing returns to scale, to make this distinction, these measures must be compared with e_{nirs} measure. If $e_{crs} = e_{nirs}$, DMU is not scale efficient and is operating with increasing returns to scale. If $e_{nirs} > e_{crs}$, DMU is operating with decreasing returns to scale. For details see Fare et al. (1994 p. 73).

4.1.2. Stochastic Frontier Approach (SFA) – methodology

The Stochastic Frontier Approach (SFA) specifies a functional form for the cost, profit, or production relationship among inputs, outputs, and environmental factors, and allows for a random error. The stochastic production function was suggested by Aigner et al. (1977) and applied to banks by Ferrier and Lovell (1990).

In estimating the cost function and measuring banks' efficiency a certain relationship between total cost, input prices and output quantities has to be assumed. The general form of the cost function is the following in a period t :

$$\ln TC_{it} = C(y_{it}, w_{it}; \beta) + \varepsilon_{it} \quad (1)$$

where

TC_{it} is the total cost of bank i ,

y_{it} is the natural logarithm of the output,

w_{it} is the natural logarithm of input prices,

β is the unknown parameter vector to be estimated.

⁷ In this paper we consider only the economy of scale, without taking into account prices.

Finally, ε_{it} is a two-components error term that for the i -th firm that can be written as follows: $\varepsilon_{it} = u_{it} + v_{it}$ where v_{it} is two sized error term capturing effects of statistical noise, assumed to be independently and identically normal distributed with zero mean and variance σ_v^2 and independent of the $u_{it} = \{u_{it} \exp[-n(t-T)]\}$ where u_{it} is a one-sided error term capturing the effects of inefficiency and assumed to be half normally distributed with mean zero and variance σ_u^2 , n is an unknown parameter to be estimated capturing the effect of inefficiency change over time.

Most studies of efficiency compute efficiency scores from translog cost equations. The translog functional form was first introduced by Cristensen et al. (1971). Many researchers prefer to apply the translog form, particularly with reference to the study of Berger and Udell (1997).

4.2. Measuring bank competition

The 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 the removal of any obstacles hampering access to the domestic market of financial services. The literature on the measurement of competition among banks can be divided into two major streams: structural approach and non-structural approach.

The structural approach is based on more conventional views on the relation between competition and market structure, and embraces the structure-conduct-performance paradigm (SCP) and the efficiency hypothesis (ES), as well as a number of formal approaches with roots in Industrial Organisation Theory. The model developed by Boone (2000) can be seen as an elaboration on the efficiency hypothesis. Boone's model is based on the notion, first, that more efficient firms (firms with lower marginal costs) gain higher market shares or profits and, second, that this effect is stronger the heavier the competition in that market.

Concentration ratios (Herfindahl-Hirschman (HHI)) indices and the k bank concentration ratios (CR_k) are often used in structural models explaining competitive performance in the banking industry as the result of market structure (Bikker 2004, pp. 63–64). Thus, the case of using concentration as proxy for competition can be seriously disputed. This is critical for the inference of policy implications since concentration does not necessarily imply the lack of competition, given that factors other than competition may drive concentration. For example, regulatory initiatives to increase capital may spark off a wave of mergers that considerably increase the degree of concentration in the industry.

Moreover, a banking system with high entry barriers, in which a small number of institutions dominate the industry, can nevertheless be characterised by competition (Schaeck et al. 2006, p. 6).

Bikker (2004) has reported that HHI indices and the CR_k tend to exaggerate the degree of competition in small countries and are increasingly unreliable when the number of banks is small.

In response to the theoretical and empirical deficiencies of structural models (Hempell (2002), p. 9), non-structural models of competitive behaviour have been developed: the Iwata model (1974), the Bresnahan model (1982), the Lau model (1982), and the Panzar and Rosse (1987) method (P-R). These New Empirical Industrial Organisation approaches (non-structural approaches) do not take into account the impact of concentration on competition. For details see Pawłowska (2005, p. 10). However, the *contestability theory* stresses that a concentrated banking industry may nevertheless behave competitively, if the hurdles to be surmounted by potential entrants to the market are low (Bikker 2004, p. 5).

4.2.1. The Panzar and Rosse Methodology

Panzar and Rosse (1987) developed a method for the identification of the degree of competition using bank level data. This method was derived from a general banking market model, Cournot oligopoly model with profit maximisation by collusive Cournot oligopolies, which determines the equilibrium output and the equilibrium number of banks, by maximizing profits at both the bank level and the industry level.

In order to identify the nature of the market structure (oligopoly, monopoly competition or perfect competition) the Panzar and Rosse model (P-R) provides a measure called the H-statistic.

Panzar and Rosse have shown that the sum of the elasticity of the total interest revenues, with respect to changes in banks' input prices (w_j), allows inference about the banks' competitive conduct (see equation (2)). For more formal specification see Bikker (2004, p. 85).

$$H = \sum_{k=1}^m \frac{\partial R_i^*}{\partial w_{ki}} \cdot \frac{w_{ki}}{R_i^*} \quad (2)$$

where:

R_i^* – revenue function in equilibrium of bank i ,

w_{ki} – factor k of input prices of bank i ,

m – number of factor input prices.

The estimated value of the H-statistic ranges between $-\infty$ and (1). Moreover, Panzar and Rosse (1987) have shown 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 monopoly, an

increase in input prices will increase marginal costs, reduce equilibrium output and, consequently, reduce total revenues with the H-statistic being negative or equal to zero. If the market structure is characterised by monopolistic competition, the H-statistic will lie between zero and unity. Furthermore, H increases with competitiveness of the banking industry.

It should be noted that model P-R entails various assumptions, for example, that banks are acting exclusively as financial intermediaries, or that higher input prices are not associated with higher quality services that generate higher revenues, and finally, given the volatile economic environment in the economies covered by this study, that banks need to be observed in a long-run equilibrium. A critical feature of the H-statistic is that the tests must be undertaken on observations that are in a long-run equilibrium. The empirical test for an equilibrium is justified on the grounds that competitive capital markets will equalize the risk-adjusted rate of returns across banks such that, in an equilibrium, return on assets (ROA) and return on equity (ROE) shall not be correlated statistically with input prices (see Panzar and Rosse (1987)). A value of $H < 0$ would show non-equilibrium, whereas $H = 0$ would prove an equilibrium. For details see Pawłowska (2005, p. 10).

The nature of the estimation of the H-statistic means that we are particularly interested in understanding how interest revenues react to variations in the cost Figures. We assume that banks use three inputs (i.e. funds, labour, and capital), which is consistent with the intermediation approach.

5. Efficiency analysis

5.1. Results of efficiency measurement in the Polish banking sector in 1997–2006 using DEA and SFA method

Changes in the environment (among others, the probable introduction of the single currency – euro) pose difficult challenges for banks forcing them to introduce solutions improving their efficiency which eventually leads to enhancing competition. Therefore, from the macroeconomic point of view scale effects, low unit costs and cheaper access to production factors are important elements of banks' competitiveness. Accordingly, from the strategic point of view, the analysis of a bank's efficiency is an important element of the bank's analysis. In this paper, the analysis was conducted using panel data from the NBP which contains commercial banks' balance sheets and income statements data of 1997–2006.

The analysis of banks' technical efficiency was made using a number of estimations of technical efficiency: e_{crs} method – efficiency measure assuming constant scale

effects, e_{vrs} – efficiency measure assuming variable scale effects, e_{nirs} – efficiency measure assuming non-rising scale effects and e_s – scale efficiency measure.⁸ The choice of input and output has been based on modified *value added approach* -VAA). The assumed input is: x_1 – number of the employed, x_2 – net fixed assets, x_3 – non-performing claims to the financial sector. The assumed output is: y_1 – net loans, y_2 – current deposits, y_3 – term deposits, y_4 – net charges. For details see: Kopczeński, Pawłowska (2000, pp. 17–18) The model chosen for estimation of efficiency measures of the Polish banking sector is the expanded BCC model that takes into account scale effects and is output-oriented (*output maximization*).

The results of the analysis indicate that in 1997–2001 there was a minor rise in commercial bank's efficiency. In 2002, technical efficiency measures dropped, but in 2003 an improvement in commercial banks' efficiency was observed. In 2004, e_{crs} and e_s efficiency measures decreased significantly.⁹ In 2005–2006, a slight improvement in technical and scale efficiency was recorded in the Polish sector of commercial banks (e_{crs} , e_s). It should be emphasised that there was a strong increase in scale efficiency (e_s), which means that in 2005–2006, commercial banks were operating efficiently in relation to the scale of the used production factors. Changes in technical efficiency in 1997–2006 are presented in Figure 5.¹⁰

The analysis of banks' cost efficiency was made using Stochastic Frontier Approach (SFA). Assuming that, a bank operates as a financial intermediary (*intermediation approach* – IA), we treat funds, labour and physical capital as input to this activity while loans and securities are treated as the final output. Efficiency assessment has been carried out in relation to bank's total cost. The price of input is defined as follows: w_1 – price of funds – relation of interest expenses to total liabilities; w_2 – personnel expenses – relation of pay costs and pay-related cost to net assets; w_3 – price of physical capital – relation of depreciation to fixed assets.

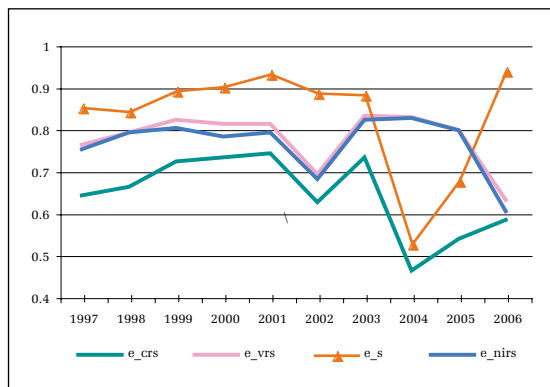
To ensure linear homogeneity of total costs and price of input factors they have been normalised with the personnel expenses by deducting cost curve of the personnel expenses logarithm from both sides of the equation 1. The analysis embraces the whole banking sector and has also been carried out for the break down into retail and corporate banks (breakdown into retail and corporate banks according to Hałaj and Żochowski 2007). The results of the efficiency analysis for the period 1997–2001 show that there was an increase in cost efficiency of both the banking sector as a whole

⁸ The program developed by Kopczeński (PhD) included in the Gauss 6.0.computer package has been used to calculate results-oriented DEA measures.

⁹ The decrease is the consequence of zloty appreciation in 2004 that led to a decrease in the volume of loans denominated in foreign currencies.

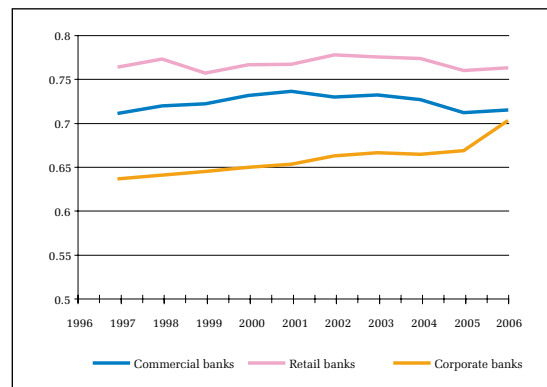
¹⁰ A detailed description of technical efficiency measures is presented in Table 1 in Appendix B.

Figure 5. Measures of technical and scale efficiency (e_{crs} , e_{vrs} , e_s , e_{nirs}) in 1997–2006, produced with DEA model



Source: own calculations. See Pawłowska (2005).

Figure 6. Measures of cost efficiency in 1997–2006 produced with SFA model



Source: own calculations.

and commercial banks, while retail banking efficiency is variable, which reflects the strong consolidation process carried out in this sector. Beginning from 2002, efficiency of the sector as a whole and efficiency in the group of retail banks started to decline slightly. The turning point for the change in the trend was the year 2005 when efficiency improved. It should be noted that in the whole analysed period retail banks were more efficient than corporate banks. Changes in cost efficiency measures in 1997–2006 are presented in Figure 6.

Efficiency analysis carried out according to both DEA and SFA method has shown an increase in efficiency measures in 1997–2001, which was driven by the consolidation process in the banking sector in this period. The reasons for the decline in efficiency

measures in 2002 (confirmed by both DEA and SFA method) can be primarily attributed to external factors relating to weaknesses in managing credit risk. The year 2005 was the turning point for the change in the downward trend when there was a strong impulse enhancing efficiency that resulted from a rise in banks' profitability and a decline in non-performing loans in banks' balance sheets (profitability ratios are presented in Table 1 in Appendix A). Poland's accession to the European Union contributed to the rise in banks' efficiency in the period of 2005–2006.

Average efficiency of commercial banks in Poland stood at 0.72% in the analysed period, while the efficiency of corporate and retail banks stood at 0.66% and 0.76% respectively. Assuming however, that

Table 1. Efficiency measures of CEC5 countries – BankScope

		1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	Change between 1997–2006
		DEA	Czech Republic	0.59	0.65	0.50	0.81	0.98	0.67	0.88	0.94	0.88
Poland	0.60	0.76	0.63	0.80	0.86	0.80	0.86	0.77	0.81	0.86	0.26	
Slovakia	0.76	0.67	0.75	0.91	0.93	0.85	0.97	0.96	0.93	0.98	0.22	
Slovenia	0.76	0.67	0.75	0.54	0.95	0.85	0.97	0.96	0.93	0.94	0.17	
Hungary	0.62	0.66	0.74	0.52	0.72	0.64	0.52	0.67	0.76	0.82	0.20	
SFA		1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	Change between 1997–2006
Czech Republic	0.51	0.50	0.53	0.56	0.61	0.60	0.58	0.61	0.68	0.67	0.16	
Poland	0.54	0.56	0.59	0.62	0.64	0.56	0.60	0.64	0.64	0.68	0.14	
Slovakia	0.57	0.66	0.64	0.68	0.75	0.68	0.69	0.74	0.73	0.75	0.18	
Slovenia	0.71	0.72	0.71	0.71	0.71	0.76	0.78	0.77	0.79	0.78	0.06	
Hungary	0.68	0.68	0.66	0.65	0.60	0.67	0.66	0.67	0.67	0.66	-0.02	

Source: own calculations.

Table 2. Efficiency measures of CEC5 countries - BankScope

DEA		1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	Change between 1997-2006
	UK		0.76	0.67	0.75	0.91	0.93	0.67	0.85	0.97	0.96	0.93
Denmark		0.59	0.76	0.93	0.59	0.70	0.59	0.65	0.52	0.64	0.58	-0.01
SFA		1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	Change between 1997-2006
	UK		0.65	0.68	0.64	0.67	0.71	0.49	0.50	0.69	0.70	0.72
Denmark		0.67	0.70	0.72	0.69	0.63	0.48	0.48	0.57	0.61	0.62	-0.05

Source: own calculations.

following Poland's entry into the euro area banks will increase the volume of loans and will cut interest on deposits as a result of interest rates convergence they will achieve further improvements in their efficiency. Therefore, when Poland joins the euro area, average efficiency of Polish banks should be expected to be close to the efficiency of banks operating in the euro area.

5.2. Results of efficiency measurement in selected sectors in 1997-2006 (based on BankScope database)

In this section, in order to test how efficiency changed over the period 1997-2006 (pre EMU and post EMU period), the efficiency analysis using data from the BankScope database have been carried out for the banking sectors in the Czech Republic, Slovakia, Slovenia, Hungary, Spain, Portugal, the United Kingdom, Denmark as well as for Poland.¹¹

In the technical efficiency analysis according to DEA method we have applied the classification of input and output based on *value added approach* (VAA) proposed by Grigorian and Manole, (2002). The input taken from BankScope database for the needs of the

¹¹ Efficiency analysis and H-statistic based on BankScope database have only been used for commercial banks and savings banks.

analysis was: (x_1) – personnel expenses, (x_2) – total fixed assets, (x_3) – interest expense. The output has been assumed to be: (y_1) – total loans net, (y_2) – liquid assets, (y_3) – total deposits.

We have applied the classification of the intermediation approach (IA) in the cost efficiency analysis according to SFA method; input and output values are the same variables as the ones used in the analysis of the Polish banking sector. The results of the efficiency analysis according to DEA and SFA method in the period 1997-2006 and changes in efficiency are presented in Tables 1, 2 and 3.

The results of the analysis according to DEA and SFA method have revealed a marked increase in the efficiency of CEC5 banking sectors. An increase in efficiency (not so significant, though) was also shown for Spain and Portugal (euro area countries). The efficiency of banking sectors in non-euro area countries (UK and Denmark) varies – the efficiency of the British banking sector has slightly increased while that of the Danish sector has gone down. The results of the analysis have confirmed that the introduction of the euro and CEC5 countries accession to the EU have boosted the efficiency of commercial banks in the analysed banking sectors (see Table 2).

Table 3. Efficiency measures of banking sectors in Spain and Portugal (euro area countries) - BankScope

DEA		1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	Change between 1997-2006
	Spain		0.83	0.91	0.87	0.91	0.89	0.73	0.82	0.72	0.85	0.85
Portugal		0.93	0.82	0.78	0.65	0.67	0.87	0.71	0.76	0.98	0.97	0.04
SFA		1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	Change between 1997-2006
	Spain		0.51	0.50	0.53	0.56	0.61	0.60	0.58	0.61	0.68	0.67
Portugal		0.72	0.80	0.83	0.84	0.83	0.82	0.88	0.73	0.75	0.78	0.07

Source: own calculations.

Table 4. Efficiency measures of banking sectors in Germany and France (euro area countries) – BankScope

DEA ²		1999	2000	2001	2002	2003	2004	2005	Change between 1999–2005
	Germany	-	0.72	0.73	0.69	0.68	0.70	0.74	0.02
France	-	0.69	0.67	0.65	0.65	-	0.62	-0.07	
SFA ¹		1999	2000	2001	2002	2003	2004	2005	Change between 1999–2005
	Germany	0.75	0.73	0.75	0.71	0.73	0.71	0.75	0.00
France	0.70	0.69	0.66	0.65	0.70	0.70	0.70	0.00	

Source: ¹Hollo and Nagy (2006, p. 25), ²Casu and Girardone (2007, p. 30).

Measures for EU-25, Hollo and Nagy (2006) based on profit efficiency have shown that Poland ranks 9th in terms of efficiency and the most efficient banking sector is the German sector, while the French banking sector ranks 15th. For Germany and France, the results of efficiency measured with DEA and SFA are presented in Table 4.

The results of the analysis show that the most significant increase in efficiency was recorded by CEC5

countries. A slight increase in efficiency was observed in Spain and Portugal and the level of banking sector efficiency in Germany and France has somewhat stabilised (see Table 4). It should be noted that the level of efficiency of Polish commercial banks (measured with DEA and SFA methods both for the data sets from NBP and BankScope database information) is close to the efficiency of the euro area banking sectors.

Table 5. Value of H-statistic for commercial banks operating in Poland

		Commercial banks	Retail banks	Corporate banks
1997–2006	H	0.64¹	0.67¹	0.60¹
	Hausman test	24.63	31.45	53.1
	p(value)	(0.038)	(0.000)	(0.000)
	number of banks	83	36	21
	number of observations	528	238	165
1997–1998	H₁	0.58¹	0.63¹	0.52¹
	Hausman test	41.24	31.45	6.63
	p(value)	(0.000)	(0.000)	(0.249)
	number of banks	68	30	28
	number of observations	130	58	54
1999–2003	H₂	0.75¹	0.56¹	0.74¹
	Hausman test	56.05	69.94	49.58
	p(value)	(0.000)	(0.000)	(0.000)
	number of banks	75	26	39
	number of observations	320	91	92
2004–2006	H₃	0.67¹	0.69¹	0.49¹
	Hausman test	11.56	28.91	3.99
	p(value)	(0.021)	(0.001)	(0.551)
	number of banks	55	26	29
	number of observations	144	68	63

Note: we consider Wald tests for monopoly the value of H: H₀: H = 0 versus H₁: H ≠ 0, and for perfect competition: H₀: H = 1 versus H₁: H ≠ 0.

¹ Null hypothesis H = 0 and H = 1 has been rejected at 1% significance level.

Source: own calculations.

6. Analysis of the degree of competition

6.1. Results of competition measurement using Panzar and Rosse's H-statistic in the Polish banking sector in 1997–2006

In this chapter, in order to evaluate competition in the Polish commercial bank's based on equation (2) the panel data was used for the period 1997–2006. We use three input prices: unit price of labour (w_1), unit price of funds (w_2), unit price of capital (w_3).

In order to estimate the H-statistic for the Polish banking sector the following reduced form revenue equation has been estimated. For details see also Gelos and Roldos (2002, p. 14):

$$\ln(IR_{it}) = c_i + a_1 \cdot \ln w_{lit} + a_2 \cdot \ln w_{pit} + a_3 \cdot \ln w_{kit} + d \cdot oth_{it} + e_{it} \quad (3)$$

Where dependent variable (interest revenue function) is defined as follows: IR_{it} as relation of interest revenue to total assets for each bank i in period t . The price of input is defined as follows: w_{lit} – price of funds – relation of interest expenses to total liabilities for each bank i in period t ; w_{pit} – personnel expenses – relation of pay costs and pay-related cost to net assets for each bank i in period t ; w_{kit} – price of physical capital – relation of depreciation to fixed assets for each bank i in period t , oth_{it} – the size of nonperforming loans (NPL) for each bank i in period t , c_i – constant and e_{it} – error component. The sum of the factor prices of the reduced-form of revenues (see equation (3)) constitutes the value of the H-statistic for the Polish banking industry (Pawłowska 2005, p. 11).

The panel data for this analysis comprises all Polish commercial banks 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 2006. The sample of Polish banks has been divided into groups, depending on the type of business: retail banks and corporate banks, and the H-statistic has been calculated for all Polish commercial banks and for each particular group separately. To select the estimator for panel regression techniques (*random effects* or *fixed effects*) we use Hausman test (Baltagi 2001, p. 65).

The complex character of banking activities makes competition in the financial services market a complicated phenomenon which requires a break down of the market into segments specialising in different banking operations servicing different customers. Therefore, the measurement of the competition degree has been carried out for the whole sector of commercial banks and for retail and corporate banks separately (as in efficiency measurement according to SFA method). To analyse changes in the degree of competition in the Polish banking sector we have calculated the value of H-statistic for the whole analysed period (1997–1998) and for three sub-periods: 1997–1998 (H_1), 1999–2003 (H_2), and 2004–

2006 (H_3). Three values of H-statistic have been calculated: for all commercial banks, for retail banks and for corporate banks. We have applied the model of panel data analysis depending on the value of Hausman test to estimate the flexibility of the profit function. Table 5 presents the value of H-statistic, that determines the degree of competition for individual banking groups in 1997–2006, and for the periods: 1997–1998, 1999–2003, 2004–2006.

The relation between the value of H and market structure provides a direct way to test the degree of competition in banking sector. We consider Wald tests for monopoly: $H_0: H = 0$ versus $H_1: H \neq 0$, and for perfect competition: $H_0: H = 1$ versus $H_1: H \neq 0$. Null hypothesis of monopoly and for perfect competition were rejected for Polish commercial banks.

It can be said, basing on the value of H-statistic presented in Table 5 and results of hypothesis testing, that the degree of competition in individual market segments confirms the existence of monopolistic competition and that competition is stronger in the segment of retail banking. In the whole banking sector banks also operate in monopolistic competition conditions. In 1999–2003, the degree of competition in the whole sector of commercial banks was higher than in 1997–1998. In subsequent periods, the degree of competition in individual market segments began to level off. In 2004–2006, the degree of competition in retail banking was distinctly higher than in corporate banking. One of the main reasons for the increase in the degree of competition in the segment of retail banking seems to be a significant increase in demand for mortgage loans and a fast growth of this segment in the analysed period.

The increase in competition in the whole banking sector was caused by Poland's accession to the EU: financial deregulation (the single passport principle has facilitated new banks' entry into the territory of Poland (Bikker, Bos 2005, p. 39) and the M&A process (Pawłowska 2005), which was strictly connected to the process of privatization, based mostly on foreign capital from euro area. Therefore, the same channels, consolidation and financial deregulation, that were observed in EU during the adoption of the euro, influenced the banking efficiency and competition of Polish banking sector during Poland's accession to the EU.

The rising competition across the Polish banking sector is also reflected in the falling net interest margin.¹² In the Polish banking system, as in other EU countries, the net interest margin displays a downward trend, but in Poland it still remains twice as high as the UE-25 average.¹³ In the analysed period another factor contributing to the decrease in net interest margin was

¹² The ratio of net interest margin is calculated as the quotient of net interest income and average assets in a given year: relation of net interest income and assets.

¹³ In 2001 average net interest margin for EU countries stood at 1.51%. See: "EU Banking Sector Stability" European Central Bank, February 2003. In 2004 average net interest margin for Germany was 0.89%, for Spain – 0.95% and for Italy – 2.48%, see Banque de France (2005).

Table 6. Value of H-statistic for banking sectors in CEC5 countries (BankScope)

Country	H value 1997–1998	H value 1999–2003	H value 2004–2006	H value 1997–2006
Czech Republic	0.69 ¹	0.77 ¹	0.81 ¹	0.78 ¹
Hungary	0.95 ¹	0.78 ¹	0.34 ¹	0.44 ¹
Slovakia	0.18 ¹	0.61 ¹	0.84 ¹	0.45 ¹
Slovenia	0.65 ¹	0.75 ¹	0.79 ¹	0.76 ¹
Poland	0.26 ¹	0.82 ¹	0.82 ¹	0.64 ¹

Note: we consider Wald tests for monopoly the value of H: $H_0: H = 0$ versus $H_1: H \neq 0$, and for perfect competition: $H_0: H = 1$ versus $H_1: H \neq 0$.

¹ Null hypothesis $H = 0$ and $H = 1$ has been rejected at 1% significance level.

Source: own calculations.

Table 7. Value of H-statistic for banking sectors in Spain, Portugal, Germany and France – euro area countries (BankScope)

Country	H value 1997–1998	H value 1999–2003	H value 2004–2006	H value 1997–2006
Spain	0.70 ¹	0.50 ¹	0.62 ¹	0.67 ¹
Portugal	0.49 ¹	0.45 ¹	0.56 ¹	0.54 ¹
Germany	0.60 ¹	0.77 ¹	0.77 ¹	0.73 ¹
France	0.68 ¹	0.71 ¹	0.57 ¹	0.69 ¹

Note: we consider Wald tests for monopoly the value of H: $H_0: H = 0$ versus $H_1: H \neq 0$, and for perfect competition: $H_0: H = 1$ versus $H_1: H \neq 0$.

¹ Null hypothesis $H = 0$ and $H = 1$ has been rejected at 1% significance level.

Source: own calculations.

Table 8. Value of H-statistic for banking sectors in Denmark and United Kingdom – non-euro area countries (BankScope)

Country	H value 1997–1998	H value 1999–2003	H value 2004–2006	H value 1997–2006
Denmark	0.74 ¹	0.58 ¹	0.57 ¹	0.59 ¹
United Kingdom	0.71 ¹	0.69 ¹	0.74 ¹	0.72 ¹

Note: we consider Wald tests for monopoly the value of H: $H_0: H = 0$ versus $H_1: H \neq 0$, and for perfect competition: $H_0: H = 1$ versus $H_1: H \neq 0$.

¹ Null hypothesis $H = 0$ and $H = 1$ has been rejected at 1% significance level.

Source: own calculations.

the fall in nominal interest rates resulting from the decrease in the inflation rate.

6.2. Results of competition measurement in selected European banking sectors in 1997–2006 (based on BankScope database)

Using the Panzar and Rosse method (basing on equation 3), we have measured competition in the banking sectors of CEC5 countries (the Czech Republic, Hungary, Poland, Slovakia and Slovenia),

euro area countries (Spain, Portugal, France, Germany) and non-euro countries (Denmark, UK). The analysis was carried out on panel data consisting of the basis of statistics provided in BankScope database (as in the case of efficiency measurement according to DEA and SFA method). The panel data covered the years 1997–2006 (pre EMU, post EMU and the period following the EU accession of new member states). The results of the empirical analysis enable us to state that in 1997–2006 the organisation and production structure

Table 9. Value of H-statistic for the Polish banking sector

	Year	H value
Claessens and Laeven (2004)	1994–2001	0.82
Gelos and Roldos (2002)	1994	0.54
Gelos and Roldos (2002)	1999	0.53

Source: Gelos, Roldos (2002, p. 47), Claessens, Laeven (2004, p. 573).

Table 10. Results of H-statistic estimation for EU-15 and EU-10

Year	EU-15	EU-10
1998–2002 ¹	H = 0.54	H = 0.78
1994 ²	H = 0.87	H = 0.61
2004 ²	H = 0.55	H = 0.55

Source: ¹ Koutsomanoli-Fillipaki, Staikouras (2004, p. 39), ² Bikker, Spierdijk (2008, p. 26).

of banking sectors in the Czech Republic, Hungary, Slovakia, Slovenia, Spain, Portugal, Denmark and the United Kingdom was of a monopolistic competition nature (see Tables 6, 7, 8). A detailed description of H-statistics are presented in Table 1–4 in Appendix C.

The analysis of the degree of competition in the selected banking sectors showed similar tendencies as in the case of efficiency analysis. In 2004–2006, there was a marked rise in competition in the banking sectors of CEC5 countries measured with H-statistic (with the exception of the Hungarian banking sector). The analysis of H-statistic levels in the banking sectors of euro area countries after the introduction of the euro showed only a slight rise in competition in Portugal and Germany. In Denmark's banking sector there was a decline in the degree of competition and in the United Kingdom competition slightly increased in the banking sector. Similar results for the banking sectors in France, Denmark and UK were obtained by Utrero-González and Callado-Muñoz (2007).

The results of the panel analysis for Poland (see Table 6), confirm the earlier results obtained by other authors who analysed the degree of competition in European banking sectors on the basis of statistics from the BankScope database (among others: Koutsomanoli-Fillipaki and Staikouras (2004), Gelos and Roldos (2002), Claessens and Laeven (2004), Utrero-González and Callado-Muñoz (2007)). The results of the panel analysis for the Polish banking sector obtained by the above-mentioned authors are presented in Table 9.

In addition, the analysis of the degree of competition carried out by other authors based on H-statistic show that the degree of competition of the Polish banking sector is close to that in euro area countries (see Claessens, Laeven 2004, p. 573).

Bikker and Spierdijk (2008) analysed competition in European banking sectors in 1994–2004 and showed that in 2004 the degree of competition between banking sectors of the „old” and the „new” EU levelled off. Fillipaki and Staikouras (2004) have shown that commercial banks in the new EU countries (EU-10) operate under conditions of stronger competition than the old EU countries (EU-15), see Table 10.

The transformation taking place in European banking in recent years is driven by a number of diverse factors (not only the introduction of the single currency). Such factors can be mentioned as globalisation, liberalisation, deregulation, progress in the field of IT, changes in

demand for banking services, progress in European integration, implementation of the Financial Sector Assessment (FSAP) program and the introduction of the New Basel Capital Accord (Basel II). It is, therefore, difficult to explicitly state which factor has had the strongest impact on the efficiency and competition of financial institutions.

In addition, it should be noted that the results related to the changes in competition in euro area countries are ambiguous – on the one hand, an increase in competition has been found after the introduction of the euro (see Utrero-González, Callado-Muñoz 2007) and on the other hand, the results obtained by Bikker and Spierdijk (2008) indicate to a decrease in competition in the euro area countries. Also, the empirical results, which have been presented in this paper, based on Bankscope database, do not provide an explicit answer to the question, whether the introduction of the euro has led to a rise in competitiveness in the banking sectors of the euro area. It may, however, be explicitly stated that there has been a strong rise in competition in the group of CEC5 countries (including Poland) which was a consequence of EU accession. In 2004–2006, there was a marked rise in competition in the banking sectors of CEC5 countries measured with H-statistic (see Table 6).

On the basis of the analysis of the degree of competition of the euro area countries carried out by other bank analysts, as well as basing on our own analyses of the degree of competition of the Polish banking sector, it seems that Poland's entry into the euro area should not led to any major changes in the degree of competition since such changes have already taken place upon entering into the European Union. What may be expected, however, is a possible increase in competition in corporate banks while retail banks will continue to be of a local (national) character owing to bank lending relationship with individual customers and the SME sector, as it was the case in the euro area banking sectors.

6.3. Robustness check

Sample

All the panel data sets (the micro-panel data which have been obtained from statistics of the National Bank of Poland and micro-panel data from BankScope

(IBCA)) were unbalanced and spanning the years 1997–2006. Balanced samples were much smaller and limited the number of banks in our analysis. The data set from BankScope covers private and public banks with standardized reporting data that facilitate comparison across different accounting systems. One of the reasons for our focus on data from commercial and saving banks and removal of all observations pertaining to other types of financial institutions, such as securities houses, specialized governmental credit institutions, mortgagee banks, etc. was that we favour a more homogeneous sample. All regressions were checked for autocorrelation, heteroscedasticity, structural breaks and stationarity.

Equilibrium tests

It should be noted that, one of the key assumptions underlying the P-R model is that the banks analyzed are in a state of long-run competitive equilibrium. To test equilibrium, we can calculate the Panzar and Rosse H-statistic using the return on assets (ROA) ratio as the dependent variable in place of the interest revenue function in the regression equation (3) for the years 1997–2006. A value of $H < 0$ would show non-equilibrium, whereas $H = 0$ would prove an equilibrium. We apply the usual statistical framework to test the value of H. 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 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 has been met (the results of the test are presented in Table 2 in Appendix C).

In addition, based on the data obtained from BankScope for the Czech Republic, Hungary, Slovenia, Poland, the UK, Denmark, Spain, Portugal, France and Germany we confirm the assumption on long-term equilibrium based on the Wald test. However, we reject the null hypothesis of long-run equilibrium at 5% significance level for Slovakia (the results of the tests are presented in Table 6 in Appendix C).

7. Conclusions

In general, the creation of the European Economic and Monetary Union has led to increased competition in the financial market. In view of such challenges, euro area banking sectors applied strategic measures aimed at improving the systems of providing services to increase efficiency. The number of mergers and acquisition has increased, in particular those of a cross-

border character, and the banks' product offer has been broadened. Recent analyses emphasise that the rise in competition in the financial market of euro area countries was mainly characteristic for the credit market exposed to strong competition from the fast developing market for corporate debt securities. It has also been ascertained that among euro area countries the increase in competition and efficiency took place primarily in corporate banking, while retail banking has continued to focus on national markets and has depended on cultural, economic and fiscal conditions in individual countries.

The results of the empirical analysis of the Polish banking sector have shown that in 1997–2006, commercial banks operated in the conditions of monopolistic competition. The degree of competition in the Polish banking sector is close to that in euro area banking sectors (which is reflected in the values of Panzar and Rosse measures). The above assessment refers both to corporate banking and retail banking. In the analysed period the retail banking market displayed stronger competition than the corporate banking market.

Analogous results have been obtained from the efficiency analysis of the Polish banking sector (according to DEA and SFA methods). In the analysed period, the efficiency of Polish commercial banks increased. The average efficiency of Polish commercial banks was close to the efficiency of euro area banking sectors. In addition, retail banks were more efficient than corporate banks.

Comparative analysis carried out on the basis of statistics provided by the BankScope database indicates that after joining the euro area there was a slight increase in efficiency and competition in the banking sectors in Portugal and Germany, and a marked increase in efficiency and competition among the new Member States (the Czech Republic, Poland, Slovakia) in 1997–2006.

The empirical analysis shows that efficiency and competition in the Polish banking sector is close to the efficiency and competition in the euro area. The efficiency level and the degree of competition in the Polish banking sector is higher in the segment of retail banking than in corporate banking. The main impulse for the increase in efficiency and competition in the Polish banking sector was the entry into the European Union (the same channels, i.e. consolidation and financial deregulation, that were observed in EU during the adoption of the euro, influenced the banking efficiency and competition of Polish banking sector during Poland's accession to the EU, mainly due to the consolidation process which was strictly connected to the process of privatization of Polish banks, based mostly on foreign capital from euro area).

It seems that Poland's entry into the euro area will result in an increase in competition and efficiency mainly in the segment of corporate banking. The retail

banking, on the other hand, will continue to be of a local character owing to bank lending relationship with individual customers and SME. This conclusion is based on observations noted in euro area banking sectors after the creation of EMU.

It should be noted that in recent years, the transformation taking place in the Polish financial system as well as changes taking place in other European financial systems result from a number of diverse factors, among others, globalisation, liberalisation, deregulation, progress in the area of IT,

progress in European integration, implementation of the FSAP program and the introduction of the New Basel Capital Accord (Basel II). It is, therefore, difficult to explicitly state which factor has had the strongest impact on the efficiency and competition of financial institutions, and efficiency and competition in the Polish banking sector.

It should be added that the financial crisis will affect competition and efficiency in the Polish banking industry although currently the effect of this crisis seems to be difficult to predict.

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Statistical Annex A

Table A.1. Ownership Structure of the Polish Banking Sector in 1997- 2006 (%)

Efficiency Ratios	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
1. Commercial banks	95.5	95.7	95.8	95.8	95.4	95.0	94.8	94.7	94.2	93.8
1.1. Banks with majority of state ownership	49.3	45.9	23.9	22.9	23.5	25.1	24.4	20.6	20.3	19.7
1.2. Private sector banks of which :	46.2	49.8	71.8	72.9	71.9	69.9	70.4	73.5	73.1	71.0
1.2.1. Banks with majority Polish equity	30.9	33.2	24.6	3.4	3.2	2.5	2.6	6.6	4.0	4.4
1.2.2. Banks with majority foreign equity	15.3	16.6	47.2	69.5	68.7	67.4	67.8	66.9	69.1	66.6
2. Cooperative banks	4.5	4.3	4.2	4.2	4.6	5.0	5.2	5.3	5.8	6.2

Source: NBP.

Table A.2. Commercial Banking Sector's Efficiency Indicators in Poland 1997-2006 (%)

Efficiency Ratios	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
Profit before tax over average assets (ROA)	2.1	0.7	0.9	1.1	1.0	0.5	0.5	1.4	1.6	1.8
Profit before tax over tier 1 equity (ROE)	37.2	9.2	12.9	14.5	12.8	5.2	5.4	17.1	20.8	23.0
Net interest margin (NIM) ¹	5.4	4.7	4.0	4.0	3.5	3.3	3.1	3.1	3.2	3.2
Non-performing loans (NPL) ²	10.7	10.9	13.2	14.9	17.8	21.1	21.2	14.7	11.5	7.6

¹ Net interest margin (NIM) = net interest income (interest income minus interest expenses) over average assets.² The share of loans which are classified as: substandard, doubtful and loss, in total assets.

Source: NBP.

Statistical Annex B

Table B.1. *Average Technical Efficiency, Scale Efficiency, in Period 1997-2006*

Year	Statistic	e_crs	e_vrs	e_s	e_nirs
1997	Average	0.64	0.76	0.85	0.75
	standard deviation	0.30	0.30	0.18	0.30
	min value	0.10	0.10	0.44	0.10
	Number of efficient banks	13	22	13	22
1998	Average	0.66	0.79	0.84	0.79
	standard deviation	0.29	0.29	0.18	0.28
	min value	0.09	0.10	0.41	0.10
	Number of efficient banks	12	25	12	24
1999	Average	0.72	0.82	0.89	0.80
	standard deviation	0.27	0.26	0.14	0.27
	min value	0.16	0.18	0.53	0.18
	Number of efficient banks	18	28	17	25
2000	Average	0.73	0.81	0.90	0.78
	standard deviation	0.25	0.23	0.12	0.24
	min value	0.31	0.33	0.53	0.31
	Number of efficient banks	18	20	15	21
2001	Average	0.74	0.81	0.93	0.79
	standard deviation	0.25	0.25	0.10	0.26
	min value	0.13	0.19	0.67	0.13
	Number of efficient banks	16	21	16	21
2002	Average	0.69	0.75	0.92	0.75
	standard deviation	0.29	0.29	0.14	0.29
	min value	0.09	0.09	0.40	0.09
	Number of efficient banks	15	23	15	22
2003	Average	0.75	0.80	0.95	0.80
	standard deviation	0.25	0.26	0.10	0.26
	min value	0.19	0.20	0.62	0.20
	Number of efficient banks	21	28	22	27
2004	Average	0.40	0.81	0.47	0.81
	standard deviation	0.41	0.31	0.41	0.30
	min value	0.01	0.06	0.02	0.06
	Number of efficient banks	10	21	9	21
2005	Average	0.54	0.80	0.67	0.79
	standard deviation	0.31	0.29	0.27	0.29
	min value	0.03	0.06	0.24	0.06
	Number of efficient banks	10	27	9	27
2006	Average	0.58	0.62	0.94	0.60
	standard deviation	0.26	0.28	0.08	0.26
	min value	0.25	0.25	0.63	0.25
	Number of efficient banks	8	11	15	9

Source: own analysis. See Pawłowska (2005, p. 32).

Statistical Annex C. H–statistic for Polish Banking Industry

Table C.1. Estimation Results of the H–statistic for Polish Banking Industry (1997–2006)

Dependent Variable: LOG(IR)				
Commercial Banks				
Sample	1997–1998	1999–2003	2004–2006	1997–2006
LOG(WLAB)	0.381 (0.000)***	0.416 (0.000)***	0.666 (0.045)**	0.465 (0.000)***
LOG(WFUN)	0.187 (0.000)***	0.207 (0.000)***	0.006 (0.009)***	0.211 (0.000)***
LOG(WCAP)	0.002 (0.525)	0.004 (0.609)	0 (0.559)	-0.037 (0.086)*
H-statistic	0.57	0.63	0.67	0.64
Hausman test (p value)	27.0 (0.000)	56.05 (0.000)	11.56 (0.021)	24.63 (0.038)
Number of obs.	184	200	144	528
Number of groups	70	62	55	83
Retail Banks				
LOG(WLAB)	0.409 (0.000)***	0.406 (0.000)***	0.407 (0.000)***	0.383 (0.000)***
LOG(WFUN)	0.304 (0.000)***	0.063 (0.122)	0.118 (0.039)**	0.156 (0.000)***
LOG(WCAP)	-0.078 (0.276)	0.088 (0.121)	0.174 (0.006)***	0.132 (0.001)***
H-statistic	0.64	0.56	0.70	0.67
Hausman test (p value)	31.45 (0.000)	69.94 (0.000)	28.91 (0.001)	31.45 (0.000)
Number of obs.	58	91	68	238
Number of groups	30	26	26	36
Corporate Banks				
LOG(WLAB)	0.311 (0.000)***	0.28 (0.040)**	0.418 (0.001)***	0.326 (0.000)***
LOG(WFUN)	0.136 (0.000)***	0.264 (0.000)***	0.114 (0.002)***	0.182 (0.000)***
LOG(WCAP)	0.075 (0.046)**	0.204 (0.006)***	-0.042 (0.454)	0.093 (0.039)**
H-statistic	0.52	0.74	0.49	0.60
Hausman test (p value)	6.63 (0.249)	49.58 (0.000)	3.99 (0.551)	6.63 (0.249)
Number of obs.	54	48	63	165
Number of groups	28	20	29	21

Note: Dependent variable: interest income/total assets is sign as „IR”.

Unit factor prices: w_l – unit price of labor is sign as “WLAB”, w_p – unit price of funds is sign as “WFUN”, w_k – unit price of capital is sign as “WCAP”. H-statistic is the sum of elasticity of interest rate revenues.

Source: own analysis.

Table C.2. Equilibrium Test for Polish Banking Industry (1997–2006)

ROA	Wald test for H = 0	
	Chi-square	Probab.
	0.81	0.36677
Null Hypothesis Summary:		
Normalized Restriction (= 0)	Value	Std. Err.
H-statistic	0.157719	0.30189

Note: In linear regression on equation (3) a dependent variable has been used ROA. $H < 0$ is disequilibrium while $H = 0$ is equilibrium. Equilibrium is confirmed for the Polish banking sector (1% significance level).

Source: own analysis.

Table C.3 Estimation Results of the H-statistic for CEC5: 1997-1998, 1999-2003, 2004-2006, 1997-2006

Dependent Variable: LOG(IR)				
Sample	1997-1998	1999-2003	2004-2006	1997-2006
Czech Republic				
LOG(WLAB)	0.351 (0.000)***	0.353 (0.000)***	0.527 (0.000)***	0.275 (0.000)***
LOG(WFUN)	0.246 (0.000)***	0.437 (0.000)***	0.204 (0.001)***	0.335 (0.000)***
LOG(WCAP)	0.097 (0.326)	-0.012 (0.895)	0.075 (0.397)	0.177 (0.000)***
H-statistic	0.69	0.78	0.81	0.79
Hausman test	27.22	9.77	38.57	54.63
(p value)	(0.000)	(0.082)	(0.000)	(0.000)
Number of obs.	41	69	65	191
Number of groups	24	27	25	36
Hungary				
LOG(WLAB)	0.231 (0.000)***	0.159 (0.001)***	-0.155 (0.594)	0.109 (0.017)**
LOG(WFUN)	0.729 (0.000)***	0.519 (0.000)***	0.026 (0.295)	0.271 (0.000)***
LOG(WCAP)	-0.009 (0.835)	0.106 (0.050)*	0.372 (0.105)	0.056 (0.287)
H-statistic	0.95	0.78	0.24	0.44
Hausman test	31.72	32.51	3.08	30.20
(p value)	(0.000)	(0.082)	(0.687)	(0.000)
Number of obs.	32	95	68	195
Number of groups	19	30	28	37
Slovakia				
LOG(WLAB)	0.063 (0.799)	0.262 (0.000)***	0.052 (0.844)	0.149 (0.147)
LOG(WFUN)	0.187 (0.000)***	0.501 (0.000)***	0.393 (0.001)***	0.236 (0.000)***
LOG(WCAP)	-0.066 (0.750)	-0.209 (0.000)***	0.413 (0.226)	0.161 (0.040)**
H-statistic	0.18	0.55	0.86	0.55
Hausman test	14.60	10.89	52.53	-333.5
(p value)	(0.012)	(0.0536)	(0.000)	(0.000)
Number of obs.	26	49	42	117
Number of groups	17	16	16	25
Slovenia				
LOG(WLAB)	0.684 (0.233)	0.105 (0.341)	0.206 (0.050)*	0.112 (0.101)
LOG(WFUN)	0.392 (0.260)	0.632 (0.000)***	0.654 (0.000)***	0.676 (0.000)***
LOG(WCAP)	-0.22 (0.606)	0.009 (0.921)	-0.076 (0.288)	-0.028 (0.609)
H-statistic	0.86	0.75	0.78	0.76
Hausman test	7.57	30.26	280.77	5.92
(p value)	(0.182)	(0.000)	(0.000)	(0.314)
Number of obs.	26	64	46	136
Number of groups	16	22	18	26
Poland				
LOG(WLAB)	0.086 (0.061)*	0.278 (0.001)***	0.373 (0.000)***	0.077 (0.237)
LOG(WFUN)	0.252 (0.000)***	0.532 (0.000)***	0.506 (0.000)***	0.5 (0.000)***
LOG(WCAP)	-0.078 (0.087)*	0.080 (0.120)	-0.063 (0.459)	0.067 (0.282)
H-statistic	0.26	0.82	0.81	0.64
Hausman test	13.46	123.90	138.68	54.63
(p value)	(0.182)	(0.000)	(0.000)	(0.000)
Number of obs.	66	100	99	302
Number of groups	39	53	42	66

Note: Dependent variable: interest income/total assets is sign as „IR”.

Unit factor prices: w_l – unit price of labor is sign as “WLAB”, w_p – unit price of funds is sign as “WFUN”, w_k – unit price of capital is sign as “WCAP”.

H-statistic is the sum of elasticity of interest rate revenues, p values in brackets.

* significant at 10%, ** significant at 5%, *** significant at 1%.

Source: own analysis.

Table C.4 Estimation Results of the H-statistic for EMU members

Dependent Variable: LOG(IR)				
Sample	1997–1998	1999–2003	2004–2006	1997–2006
Spain				
LOG(WLAB)	0.209 (0.000)***	0.223 (0.000)***	0.505 (0.000)***	0.251 (0.000)***
LOG(WFUN)	0.476 (0.000)***	0.48 (0.000)***	0.359 (0.000)***	0.524 (0.000)***
LOG(WCAP)	0.019 -0.495	-0.199 (0.000)***	-0.249 (0.009)***	-0.107 (0.017)**
H-statistic	0.70	0.50	0.62	0.67
Hausman test	40.96	35.71	30.55	121.28
(p value)	(0.000)	(0.000)	(0.000)	(0.000)
Number of obs.	279	624	296	1192
Number of groups	146	158	124	179
Portugal				
LOG(WLAB)	0.186 (4.12)***	0.15 (3.50)***	0.129 (0.221)**	0.104 (0.026)**
LOG(WFUN)	0.401 (8.09)***	0.405 (9.93)***	0.42 (0.000)***	0.443 (0.000)***
LOG(WCAP)	-0.102 (2.41)**	-0.101 (1.96)**	0.006 (0.956)	-0.007 (0.913)
H-statistic	0.49	0.45	0.56	0.54
Hausman test	19.44	5.45	18.43	82.11
(p value)	(0.002)	(0.3669)	(0.006)	(0.000)
Number of obs.	64	64	34	162
Number of groups	35	31	13	38
France				
LOG(WLAB)	0.17 (0.000)***	0.12 (0.000)***	0.187 (0.003)***	0.199 (0.000)***
LOG(WFUN)	0.49 (0.000)***	0.46 (0.000)***	0.327 (0.004)***	0.411 (0.000)***
LOG(WCAP)	0.02 (0.245)	0.13 (0.000)***	0.052 (0.399)	0.072 (0.009)***
H-statistic	0.68	0.71	0.57	0.69
Housman test	39.90	45.71	31.50	120.20
(p value)	(0.000)	(0.000)	(0.000)	(0.000)
Number of obs.	434	434	337	1100
Number of groups	227	227	131	253
Germany				
LOG(WLAB)	0.032 (0.319)	0.159 (0.001)***	0.25 (0.004)***	0.119 (0.000)***
LOG(WFUN)	0.449 (0.000)***	0.594 (0.000)***	0.635 (0.000)***	0.655 (0.000)***
LOG(WCAP)	0.123 (0.000)***	0.017 (0.653)	-0.111 (0.193)	-0.046 (0.000)***
H-statistic	0.60	0.77	0.77	0.73
Housman test	29.44	4.45	10.43	80.11
(p value)	(0.002)	(0.3669)	(0.006)	(0.000)
Number of obs.	1589	1933	1218	3619
Number of groups	826	778	427	851

Note: Dependent variable: interest income/total assets is sign as „IR”. Unit factor prices: w_l – unit price of labour is sign as “WLAB”, w_p – unit price of funds is sign as “WFUN”, w_k – unit price of capital is sign as “WCAP”. H-statistic is the sum of elasticity of interest rate revenues, p values in brackets.

* significant at 10%; ** significant at 5%; *** significant at 1%.

Source: own analysis.

Table C.5. Estimation Results of the H-statistic for non-EMU: 1997-1998, 1999-2003, 2004-2006 oraz 1997-2006

Sample	Dependent Variable: LOG(IR)			
	1997-1998	1999-2003	2004-2006	1997-2006
Denmark				
LOG(WLAB)	0.232 (0.000)***	0.057 (0.201)	-0.36 (0.001)***	0.131 (0.000)***
LOG(WFUN)	0.222 (0.000)***	0.192 (0.000)***	0.489 (0.000)***	0.322 (0.000)***
LOG(WCAP)	0.286 (0.000)***	0.335 (0.000)***	0.44 (0.000)***	0.132 (0.000)***
H-statistic	0.74	0.58	0.57	0.59
Hausman test	27.22	44.11	25.24	79.05
(p value)	(0.000)	(0.000)	(0.000)	(0.000)
Number of obs.	176	353	239	744
Number of groups	91	96	88	99
England				
LOG(WLAB)	0.12 (0.004)***	0.361 (0.000)***	0.193 (0.006)***	0.143 (0.000)***
LOG(WFUN)	0.428 (0.000)***	0.366 (0.000)***	0.352 (0.006)***	0.489 (0.000)***
LOG(WCAP)	0.16 (0.002)***	-0.034 (0.725)	-0.072 (0.488)	0.08 (0.021)**
H-statistic	0.71	0.69	0.47	0.71
Hausman test	72.54	92.34	5.81	86.02
(p value)	(0.000)	(0.000)	(0.3253)	(0.000)
Number of obs.	180	226	202	493
Number of groups	100	90	80	113

Note: Dependent variable: interest income/total assets is sign as „IR”.

Unit factor prices: w_l – unit price of labor is sign as “WLAB”, w_p – unit price of funds is sign as “WFUN”, w_k – unit price of capital is sign as “WCAP”. H-statistic is the sum of elasticity of interest rate revenues, p values in brackets.

* significant at 10%, ** significant at 5%, *** significant at 1%.

Source: own analysis.

Table C.6 Equilibrium Test for 1997-2006

ROA	Wald test for H = 0	
Czech Republic		
H-statistic = 0.45	Chi-square = 0.81	Probab.=0.0438
Hungary		
H-statistic = -0.06	Chi-square = 0.87	Probab.= 0.35505
Slovakia		
H-statistic = 0.68	Chi-square = 7.10	Probab.= 0.0077
Slovenia		
H-statistic = 0.37	Chi-square = 2.75	Probab.= 0.0970
Poland		
H-statistic = 0.2	Chi-square = 0.09	Probab.= 0.7671
Denmark		
H-statistic = -0.05	Chi-square = 0.08	Probab.= 0.9665
England		
H-statistic = 0.23	Chi-square = 0.68	Probab.= 0.4099
Spain		
H-statistic = 0.08	Chi-square = 0.01	Probab.= 0.9075
Portugal		
H-statistic = 0.107	Chi-square = 0.04	Probab.= 0.8480
France		
H-statistic = 0.32	Chi-square = 0.51	Probab.= 0.0791
Germany		
H-statistic = -0.07	Chi-square = 0.09	Probab.= 0.858

Note: In linear regression on equation (3) a dependent variable has been used ROA. $H < 0$ is disequilibrium while $H = 0$ is equilibrium (5% significance level).

Source: own analysis.