

Charles University in Prague

Faculty of Social Sciences

Institute of Economic Studies



MASTER THESIS

**Influence of the knowledge capital of a bank on its
performance**

Author: Pavel Moraru

Supervisor: doc. Roman Horvath Ph.D.

Academic Year: 2013/2014

Declaration of Authorship

The author hereby declares that he compiled this thesis independently, using only the listed resources and literature.

The author grants to Charles University permission to reproduce and to distribute copies of this thesis document in whole or in part.

Prague, January __, 2014

Signature _____

Acknowledgements

I would like to express my appreciation to my supervisor and consultant, doc. Roman Horváth Ph.D., for his valuable advices, incentives, patience and the overall cooperation during the period of research.

Also, I would like to thank Prof. William Greene of Stern School of Business of New York University for his proactivity in making available the software solution which played a very important role for this research.

Any further omissions, flaws and mistakes are the sole responsibility of the author.

Abstract

This research studies the knowledge implications on the efficiency estimates of a bank, using an unbalanced representative panel of 17 banks from Czech Republic, categorized, based on the amount of their earning assets, in three groups: big, medium and small. The period of study is between 2002 and 2011 thus comprising the world financial crisis happened between 2007 and 2009. The main finding is that the management value adding has significant and positive influence on the efficiency of the bank, thus highlighting the importance of knowledgeable allocation of resources and decision making. The structural capital is another important knowledge based capital which impacts efficiency. The study, also, confirms, for Czech banking sector, the importance of economies of scale for the efficiency of banks and suggests that fixed assets might become an obsolete in future developments of banking services. The period of world crisis does not appear to have been crucial for the banks of the country analyzed.

Keywords:

Technical efficiency, Cost efficiency, Knowledge valuation, Knowledge management, Knowledge capital, Economies of scale, Stochastic Frontier Analysis, Czech Republic

Author's e-mail: morarupavel@gmail.com

Contents

CHAPTER 1	6
Introduction.....	6
CHAPTER 2	9
Literature Review.....	9
2.1. Introductory remarks.....	9
2.2. Theoretical Evolution of Knowledge Management and Intellectual Capital Concepts.....	9
2.3 Theoretical Evolution of Efficiency Estimation Models.....	18
2.4 The applicability of frontier efficiency models in banking efficiency estimation.....	20
CHAPTER 3	22
Methodology	22
3.1. Estimating the Knowledge and Intellectual Capital.....	22
3.2. Econometric model for efficiency estimation.....	25
3.3. Cost Function	27
3.4 Hypothesis description	28
CHAPTER 4	31
Dataset	31
4.1. Sample description.....	31
4.2. The variables	32
4.3 Sample analysis	36
CHAPTER 5	41
Results.....	41
5.1. Panel estimation of Inefficiency terms.....	41
5.2. Technical Inefficiency estimates	44
5.3. Correlation between Technical Inefficiency Estimates and variables of interest.....	47
CHAPTER 6	49
<i>Conclusion</i>	49
Bibliography:	52
Appendix	60

CHAPTER 1

Introduction

Considering all the effects related to or provoked by the global financial sector in the last decade, as well as considering all the power and resources managed by banks and financial institutions, it should be stated that the commoditization of knowledge could become one of the main, next, challenges for the sector. There is a great debate and also consensus on the fact that knowledge, as such, would be one of the main factors of success in the twenty-first century (Wiig, 1997). This study attempts to analyze the effect of knowledge that a bank can manage on its efficiency thus it discusses the issue of the importance for Czech banks to consider a knowledgeable management of intangible assets from which knowledge and intellectual capitals are part.

Before starting any analysis of a bank efficiency and its relation with the knowledge that is implied for it we should agree with the literature that banks are firms with some specific particularities (Ting Li and Chengjie Guan, 2008) in comparison with the majority of other firms on the market. The main activity of the Banks is to perform a qualitative risk management and thus providing relevant financial services on the market. The defining particularities are: (a) high financial lever – assets to debt ratio will achieve 90 % which is a much higher indicator than for other firms on the market which implies a necessity of profound understanding and knowledgeable decision making in the banking sector; (b) applicable notion of “too big to fail” or “too connected to fail” which offers to the banks the incentive to “ignore the risk prevention” or “implement investments with high risk” and due to this speculate on both borrowing and lending financial resources; (c) more regulated due to the higher moral and operational risks, (d) banks act in a non-balanced credit market where “the loan price among banks is not confirmed by the auction principle of the product market and services market” thus the “principle that the buyer with higher price gets the loan” works more often; however, the price for loan is stated under the auction price so there is limited possibility of competition based on interest rates but a bigger potential for competition through marketing and service which are driven by skilled and motivated employees; (e) the “benefit conflict” exists under the condition when there is incomplete and asymmetric information on the market thus “debit customer cannot identify loaner and when the debit customer falls across the excessive demand of capital, if the loaner

hastily enhances the interest rate, he will compel the debit customer with low risk to quit the market, and leave the debit customer with high risk, and the conversely selective problem will occur.”. Banking industry is an environment which is characterized by science intensive, knowledge intensive and technology intensive peculiarities, where the maturity and the arrival time of the information have a valuable role. In order to proceed and gather the information required for a successful activity, a bank must have a capable system which can manage this information and transform it into knowledge. In the same time, as economic entities, banks, must publish their financial statements and should be as transparent as possible in order to have a trustfully image for its customers. The ability of a bank to manage its intangible assets, from which knowledge makes the biggest part of it, in order to withdraw, in a relevant time frame, the advantage of these assets is of a fundamental importance. The advantage of being able to do so might be considered as the “efficiency” in terms of the financial results and performance indicators such as market share, brand awareness, employment attractiveness and others.

The banking efficiency is of a particular importance due to its effect on both micro and macroeconomics (Berger and Mester, 1997). The microeconomic aspect is mainly defined by the increase in competition, fostered by the entrance of foreign banks as well as the improvement of the institutional framework, and increase of complexity of regulations and supervision. The macroeconomic perspective is expressed by the fact that the efficiency of the banks is directly influencing the cost of the financial intermediation and the sustainability of the whole financial system as such (Rossi et al., 2005). It is intuitive to suggest that an improvement of the efficiency of banks can be considered as demonstration of better allocation of financial resources, thus fostering the economic growth (Andries and Cocris, 2010).

There are several argumentations of the importance of valuing knowledge and studying its effects on the banks efficiency: a) a big part of the value of a firm is typically represented by its intangible assets, from which knowledge is the main contributor (Hall, 2000); b) a good asset management relies on relevant and on-time information which has to be properly used by managers and transformed in knowledge for future more quick application (Shapiro and Varian, 1999); c) knowledge acquiring is automatically expensed thus distorting the profit figures of banks; d) there are different interpretations of knowledge acquisition through R&D it is considered as an expense while an acquisition of a company, which inherently has knowledge

assets, is considered as an investment; e) traditional services provided by the banks are risk intensive and inquire finding methods of tangible assets valuations thus ignoring the value of intangible, knowledge based, assets (O'Hara and Shadbolt, 2001); f) banks are highly dependent on the "intelligence" it can gather and use, or as Stewart (1997) have stated "*intelligence becomes an asset when some useful order is created out of free brainpower*".

The thesis is organized as follows. First, in Chapter 2, we attempt to explore the vast literature on knowledge definition, valuation methods and descriptions of its effects on a business environment. In the same chapter we cover main developments of the efficiency estimation frameworks as well as the applicability of those in different as well as similar environments as the banking industry. The knowledge valuation methodology applied and the description of the econometric framework used for estimating the efficiency of banks in relation to knowledge describing variables, is presented in Chapter 3 as well as our main hypothesis and research intuitions. In Chapter 4 we introduce the data set with preliminary statistical analysis and the variables employed in the estimations. The main results and findings of our study are presented in Chapter 5 where we comment on overall efficiency estimates of the Czech banking sector as well as we analyze the effect of knowledge describing variables on efficiency estimates for different groups of banks. Through this analysis we provide interesting incentives for understanding the acknowledgement of the importance of intellectual, human, structural and external capitals of a bank. In the last part of our research we provide main conclusions and some motivations for further studies with pinpointing the main withdrawals of the current study.

CHAPTER 2

Literature Review

“Everyone is a genius.

But if you judge a fish on its ability to climb a tree, it will live its whole life believing that it is stupid.”

Albert Einstein

2.1. Introductory remarks

Social Sciences study the way human society acts to continue life on earth. The Economics, Education and Administration (management) are a few from social sciences which incorporate our life in frameworks and tend to explain human behavior and value creation based on empirical evidence and theoretical claims. The more these sciences developed, the more interconnection between issues studied by different sciences are observed. The following section brings relevant review of the literature that provides evidence of these connections between issues studied in Economics, Education and Administration. Our “guiding star”, however, will be the topic and the objectives of this thesis thus we will focus further on literature that exploits Knowledge Capital Management (Education and Administration) and efficiency estimation in decision making units (Economics). Our aim was to comment first of all on works that are studying both of this issues combined but due to a very little evidence of existence of such studies we also reviewed those studies which analyze these issues apart.

2.2. Theoretical Evolution of Knowledge Management and Intellectual Capital Concepts

Specific peculiarities of management procedures and methods are present in all industries and even all business entities. One should make the difference between managing approach of service firms and other types of firms (Bowen and Ford, 2002). Especially in service industries like banks, information technology and consulting, the importance of knowledge is more stringent and is a defining element, more important than money, in discovering and enforcing the competitive advantage (Gratton and Ghoshal, 2003). In essence, it is being accepted, at least in academia, that knowledge of a company is a precious and fundamental resource that needs to be managed and used in achieving strategic goals of the firm (Nonaka and Konno, 1998; Alvarez and Barney, 2001; Bontis and Nikitopoulos, 2001). It is the DNA of the company and its essence.

There are differences in defining and managing knowledge in different industries and business entities but we can distinguish two main aspects of it: Knowledge Management and Intellectual Capital. Both of these aspects are actually determinants of the ability of a firm to concentrate, develop and apply knowledge in order to increase its efficiency.

Knowledge Management

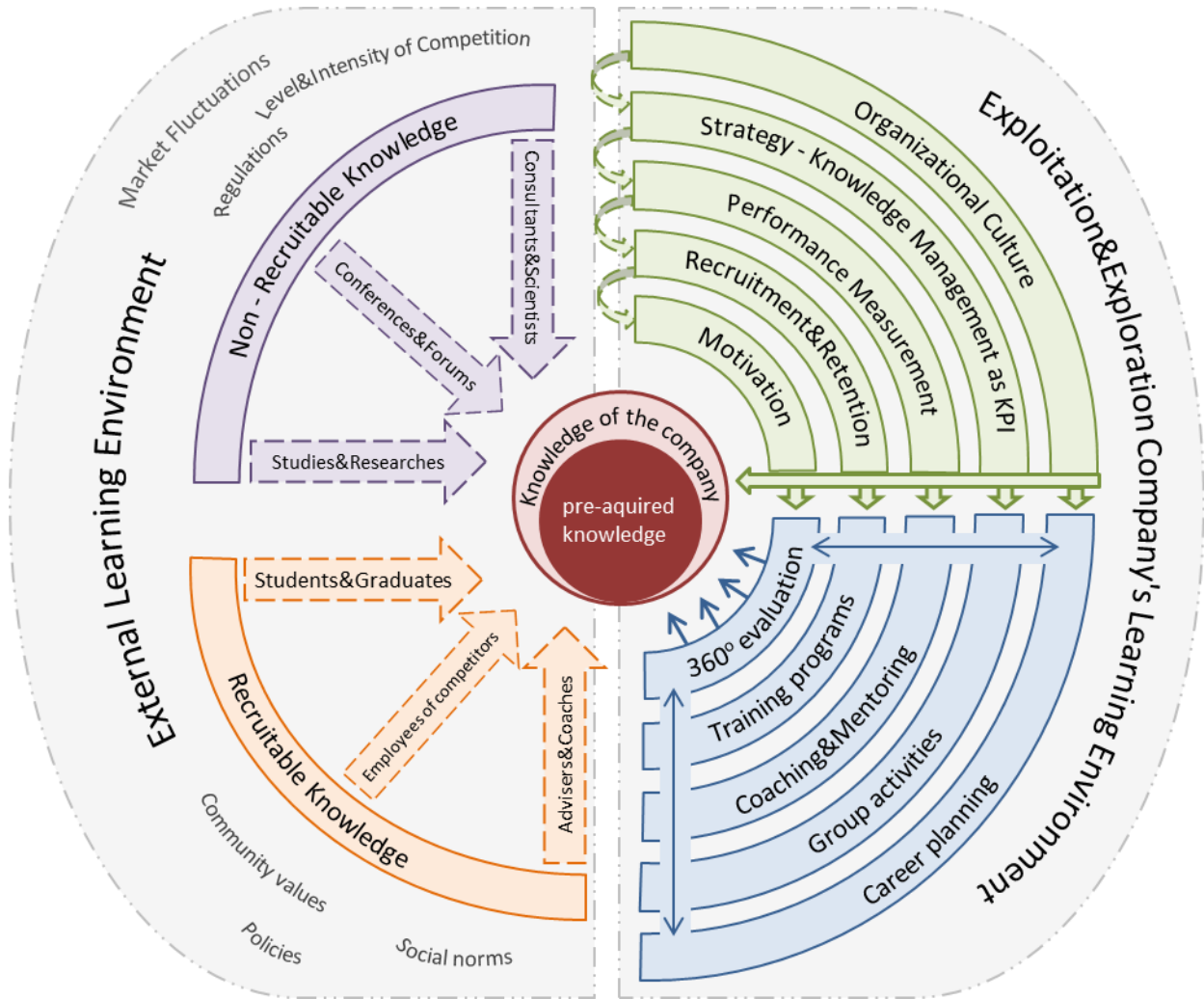
Knowledge Management is the organizational process through which demand and supply of information is matched thus creating a proper learning process within the organization (Huizing and Bouman, 2002). One of the biggest differences of knowledge in comparison with other resources used in business is that it is not being “consumed” while applied but oppositely it is being developed and improved (one can call this “experience”), it can be of less importance with time passing but it does not depreciate as “conventional assets” (Spender, 2002). Even when knowledge is being “replaced” (a specific procedure, or knowledge, is not being used in business activity for different reasons such as inconsistency with technological possibilities, contradiction with strategy or organizational culture, etc) it is not removed, it still remains inside the organization and can be reused in case of necessity. However, managers are those who are responsible to identify the necessities of “replacing” the knowledge and motivating feed-back procedure to estimate the level of replacement needed.

For organizations which apply knowledge-based management approach (Blackler, 2002), the issue of interaction of tacit and explicit “knowledge assets” arises (Polanyi, 1962). When a firm, in our case a bank, consciously or due to market evolution, faces this new organizational “reality”, it goes through a complex review of planning and organizing techniques, leadership and controlling methods, accounting and financial management practices (Guthrie, 2001). The “knowledge intensive firms” are those which “head hunt” and select only “knowledge workers” (Drucker, 1993), these firms become attractive on the labor market also due to the fact that are able to provide learning challenge in everyday activity and diminish the risk of a “routine job” for their employees. Nonaka (1991) said that “... the only true lasting competitive advantage is knowledge . . . ” and this is supported by a later work of McEvily and Chakravarthy (2002) where authors demonstrate that “non-observable” internal factors have a big influence on the

firm performance. They identify management capabilities and competencies, technical knowledge and tacit organizational routines to be one of the main “determinants” of the firm efficiency. A knowledge-based organization is more likely to have a knowledge-based competitive advantage and this advantage is more sustainable than others because firms have the “absorptive capacity” (Cohen and Levinthal, 1990) which basically states that the more a firm knows, the more it can learn. Another important aspect of knowledge as such is that it is hard to be imitated by the market (McEvily and Chakravarthy, 2002). This is possible especially because every person is learning differently (one of distinguishes can be considered the types of learners described by SAVI¹ model) thus any professional experience combined with formal and non-formal learning experience is acknowledged differently by every employee. If analyzing knowledge as an aggregated resource that exists inside the firm than one can say that the firm itself “absorbs” internal knowledge i.e. from employees, external knowledge i.e. market information, outside trainings, conferences, professional forums etc. and combines these two into a new set of knowledge which after words is being mixed with “pre-acquired” knowledge i.e. aggregated internal and external knowledge from past periods, and creates new one (Cohen and Levinthal, 1990). Moreover, it doesn’t matter too much how elevated is the internal knowledge of a firm because in combination with the external knowledge, also available for competitors for almost the same cost, it involves employees in a creative and experience based learning process which generates new, specific only to this particular firm, knowledge (Zack, 2002). It is important to highlight that the allocation of knowledge in a firm is as important as acquiring it. Wong (2008) and Phearak & Dara (2008) determined that a firm which hires unfit talents is exposing itself to a risk, because it impacts the cost of training and retraining. Also, the allocation of knowledge is related to availability of it in different situations, to different levels. A firm must create a cross-functional multi-skilled labor force in order to diminish the likelihood of lack of succession management. For a schematic representation of the Knowledge acquiring process and factors that influence it, please examine the Figure 1 represented bellow.

¹ This is a learning model developed by Meier and which describes people as having four types of learning abilities. S – Somatic (learning by doing); A – Auditory (learning by hearing); V – Visual (learning by seeing); I – Intellectual (learning by Thinking).

Figure 1: Knowledge acquiring process and factors that influence it (Source: computed by the author based on the reviewed literature)



Academia distinguishes two main approaches of Knowledge Management i.e. exploitation and exploration (SubbaNarasimha, 2001; Zack, 2002). These two approaches are different in both, treatment of knowledge and acquisition of it. Exploitation approach motivates the transfer and diffusion of knowledge in the organization, meaning that the knowledge can be gathered from sources that are not directly controlled and developed by the company. It is captured in terms such as: choice, production, efficiency, selection, implementation etc. On another hand, exploration approach motivates creation of knowledge through innovation. It is captured in terms such as: search, risk taking, experimentation, play, flexibility, discovery etc. However none of these two approaches exclusively used can bring the best outcome. A firm that is involved only in

exploration is more likely to suffer high costs of “experimentation” with very low return at least in short-term. Conversely, a firm involved only in exploitation can fall in trap of “suboptimal stable equilibrium” (March, 1991) and being in a stable mode (one can equalize this mode as a “comfort zone”) it is even harder to get out from it rather than stop exploring. One could assume that a combination of these two approaches is best to suit a bank. However it seems that a more concentration on the exploration approach brings better results in the bank industry. A study in this direction was done on the Finnish banks by Tainio et.al. (1991) which demonstrated that top performers in the industry are as well leaders in training and empowering their employees.

Knowledge as such, and the ability of the firm to apply and to develop it, is surely an issue of a strategic importance. Moreover it is an issue which is directly related to the results of the bank and it can influence these results in both, short and long terms. Steward (1997) claims that knowledge assets are “worth cultivating only in the context of strategy”. The importance of Human Resource Key Performance Indicators² (HR KPI) is indisputable because through this instrument one can formulate, control (monitor) and evaluate the performance he/she is expecting. If the performance of the employees will be “secured”, and if the performance of the employees is directly related to knowledge that they have (human capital) than through HR KPI’s, one is “securing” the overall performance of the bank. Usually HR KPI’s can include satisfaction of employees (both intrinsic and extrinsic motivation), staff violation rate (the share of human mistakes), development programs and training (profession based or soft skills training, outsourced trainings and team-buildings, e-learning etc.) and others. Moreover in Balance Score Card³, another strategic management tool, the knowledge management can be observed in all compartments (Financial, Customer, Internal process and Learning and Growth) especially in Learning and Growth (dealing with extracting, manipulating and use of information/ jobs descriptions and learning experience/ compensation, reward and accountability/ resource allocation). However banks are institutions which usually tend to emphasize the importance of

² Key Performance Indicators - KPI, also Key Success Indicators (KSI), is defined as financial or non-financial metrics used to reflect the critical success factors of an organization. KPIs are used in business intelligence to assess the present state of business and to prescribe the course of action. The KPIs differ depending on the nature of the organization. They help an organization to measure progress towards their organizational goals.

³ The balanced scorecard is a strategic planning and management system that is used extensively in business and industry, government, and nonprofit organizations worldwide to align business activities to the vision and strategy of the organization, improve internal and external communications, and monitor organization performance against strategic goals. It was proposed by Kaplan and Norton in 1992.

the financial performance indicators thus voluntarily, sometimes unconsciously, ignore the knowledge management performance indicators. Financial indicators contain static, past related information and are restricted by the over-conservatism of the accounting thus do not entirely explain the intangible assets. As stated above intangible assets are contained in intellectual capital and knowledge as such, thus these is being fogged if relating only to financial indicators when estimating the overall value creation of a bank.

However, if relating to Czech banking environment and Czech authority's bank failure prevention measures, the main focus is on financial indicators (Podpiera and Podpiera, 2005). Moreover the financial ratios are most common indicators to be analyzed by early warning systems developed to identify failures and non-failures banks (Barr and Siems, 1994). A research made by Derviz and Podpiera (2004) showed that albeit the Czech authorities used early warning system⁴ that contained an evaluation of the quality of management in banks, the rating that was created as a result of usage of this system was mostly based on financial indicators. Based on these findings and on the given fact that Central Banks have the supervisory authority and directly influence the "rules" on the market, one could speculate that authorities actually create incentives for financial institutions, as such, to weight with more importance their financial indicators rather than to have a balanced weighting of all interconnected elements that participate at transformation of inputs into valued outputs on the market.

Academia emphasized, already more than two decades ago, on the quality management of a bank being as one of the fundamental determinants for success. Moreover, Barr and Siems (1994) showed that observing the quality of the management of banks brought strong arguments for commenting on the evolutions of bankruptcy cases in USA. This finding can be explained by the fact that foremost of the management is the identification of the proper production function through fundamental change (Rosenberg, 1982), or through desultory learning process (Schumpeter, 1939). Also, the range of available inputs in a production function is rather limited (Mefford, 1986) thus managers from different banks are almost in similar situations when facing

⁴ CAMELS stands for C-capital, A-asset quality, M-management, E-earnings, L-liquidity, and S-market risk. This rating system was implemented in the USA in the 1980s (Podpiera, Podpiera (2005). Other systems largely used are: a) ORAP, which stands for Organization and Reinforcement of Preventive Action and has been in use in France since 1997; b) PATROL: capital adequacy, profitability, credit duality, organization and liquidity. It was implemented in Italy in 1993 (for an extensive survey, see Sahajwala and Bergh, 2000)

decisions related production functions. The role of Knowledge Management is emphasized when observing the outputs obtained by different banks with almost similar inputs available. The role of management is to acquire more knowledge and built on the existing one in the company through finding the right alignment between knowledge conserved in human resource, technology and process management techniques.

Intellectual Capital

Value, in a firm, is created through physical assets, financial assets and intangible assets. The last are the hardest to be estimated in terms of value creation, quantifiable contribution etc. The first, perhaps, structured descriptions of Intellectual Capital was made by Edvinsson and Malone (1997) who stated that Intellectual Capital can be Human, Customer-based and Structural. However we will see further on, that this description faced some changes. Intellectual Capital is contained in intangible assets (Stewart, 1998; Winter and Szulanski, 2002) and as a concept, “emerged” based on observations regarding the differences between the market and book value (Sveiby, 1997; Edvinsson, 2000) and it represents the ability of the firm to be creative, innovative and flexible thus defining the future of the firm (Bontis, 2002).

Often in specialized literature Intellectual Capital is called “powerful”, “most valuable” resource (SubbaNarasimha, 2001; Bontis, 2002; Stewart, 1997) and sometimes even “the most important asset” in a firm (Wiig, 1997). Intellectual Capital is defined also as the “stock” of knowledge in the firm, the stocks which represent the amount of knowledge components at any point in time and which can be accumulated and used (Bontis et al. 2002). However we deem that one of the most consistent definitions is set forth by Klein and Prusack (1994) “*intellectual material that has been formalized, captured, and leveraged to produce a higher-valued asset*”. The perception of knowledge as “stock” is especially familiar to the resource-based view of the firm (Ariely, 2003) which states that resources can be gained only through “consistent investments”.

An important particularity of the intellectual capital is that the output from the usage of it by a firm is directly dependent on the knowledge management approach (Zack, 2002; Garud and Kumaraswamy, 2002). The returns can increase constantly without necessarily to fall a concave

graphical form as it is happening with other resources. Of course to ensure the increasing rates of return from intellectual capital, the firm must have a proper technological level and organizational structure (Garud and Kumaraswamy, 2002). A very important finding, in the context of intense technologization of all industries of the world economy, was made by the Prasad and Harker (1997) which states that the elasticity of IT capital is positive but with a low significance (7%) while the elasticity of IT labor (Human capital) is large and significant at 100% level. Thus the proper technological level that a bank should have must be dependent on the investments in educating human capital which will put into use this technology and transform it into intellectual capital. Usually Intellectual capital is described as being compound from: Human Capital, Structural Capital and Relational Capital (Bontis, 1998; McElroy, 2002)

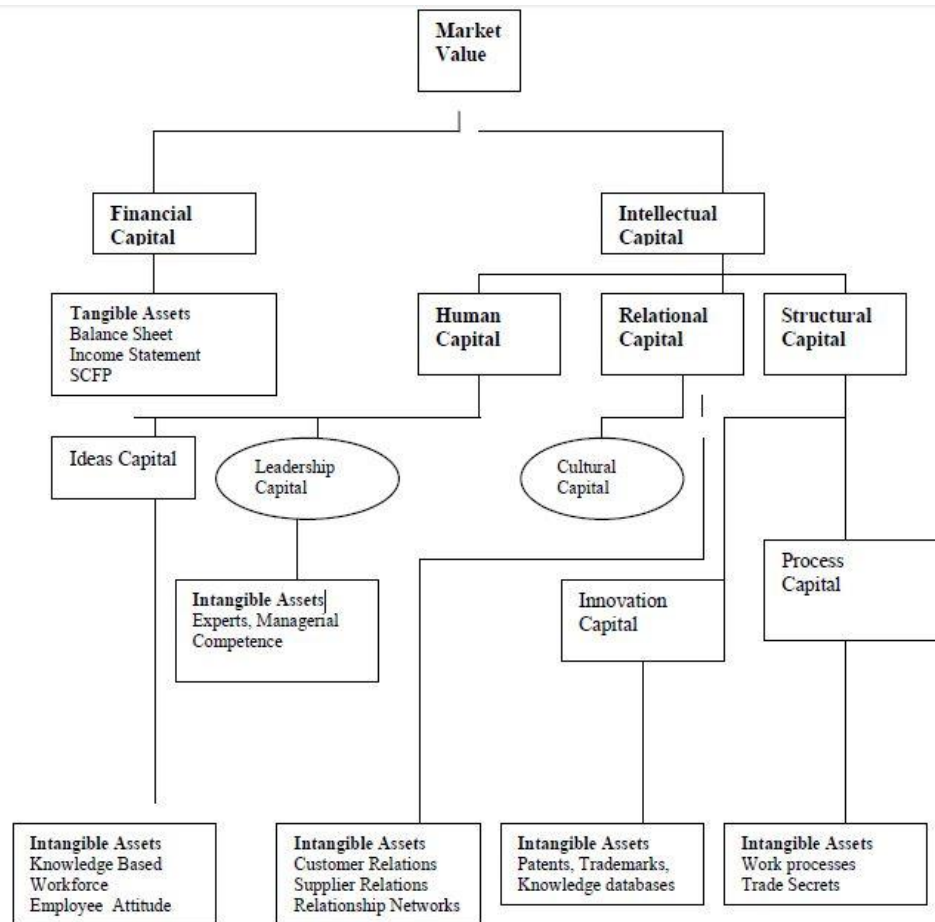
Human Capital is people or better said is value brought by people, by their day by day activity, application of their skills and know-how. It is the knowledge that the company basically doesn't own, it just renting by paying wages and offering social packages for its employees. This knowledge can be lost when a firm fires people. For the matter of this research is important to underline that quality of human capital shows how effectively a firm is using its human resources and how well people are discovered and developed.

Structural Capital refers to the ability of the company to support its employees into achieving their tasks. It is the tacit and explicit knowledge that is contained in supportive infrastructure, methods of work, instruments of communication, trademarks, copyrights, image of the company, organizational philosophy etc.

Relational Capital is basically the ability of the company to have relations with its employees, suppliers (in case of services, with partners and international specialized institutions) and customers.

A graphic representation of a framework for Intellectual Capital influence on the market value (Johnson, 1999) of a firm is represented above.

Figure 2 Intellectual Capital framework: its relationship to market value (Remake by Fraguoli, 2010, based on Johnson, 1999)



All being stated above it is fair to say that knowledge management and intellectual capital has a high importance in determining the comparative advantage of a firm and that without it is arguable if a firm is able to exploit other resources in an efficient manner. Recent studies showed that majority of the banks do not have a necessary level of awareness of the importance and the impact of knowledge on their financial and market performance indicators. Curado (2008), for instance, shows that the banking industry of Portugal is not very familiar with notions discussed above. The author used 11 biggest banks of the country which have a network of over 50 branches. Using qualitative analysis, the research was done using information gathered from top level Human Resource responsible of these banks. The results are as follows:

1. The knowledge management approach mainly applied is the Exploitation. The banks interviewed (82% of the Portuguese market) are not very involved in investing in knowledge gaining through research, innovation and experiment but rather more in

diffusing, distributing and leveraging the knowledge. Remember, that companies which tend to apply exclusively exploitation knowledge management approach are more likely to fall in the trap of “suboptimal stable equilibrium”.

2. However banks have a strong image of innovative and proactive companies on the market. Author explains this by the fact that “innovation” in banks is predominantly present only in Commercial Department while all others are followers.
3. Half of the value of Intellectual capital is consisted in human capital (“related to people, associated to the amount of knowledge that does not remain in the organization when the individuals go out and generally in its tacit form”). Interviewers in the same time estimated, on average, that the share of Intellectual capital in total value of the bank is 55%. From these two statements it is easy to estimate that the share of the capital that the bank actually doesn't own, i.e. human capital, is 27.5%. The banks are highly affected by the highly volatile human capital.
4. The recognition of the importance of intellectual capital however does not create any incentives for the banks to actually create positions and encourage development organizational skills to deal with this importance. Moreover, interviewed top level Human Resource managers agree that on average 34% of the bank result is due to knowledge management but “there is no Knowledge Manager or Chief Knowledge Manager”.
5. Author concludes that the banking sector has “proved” to be an “excellent setting for the study”.

The work analyzed above is of high importance for our research due to the fact that it was done based on a qualitative research method. This method helps the researcher to listen to the data (answers of the respondents) rather than to conclude based on numbers (static financial data). More details to this remark please find in the next chapter of the paper (Methodology).

2.3 Theoretical Evolution of Efficiency Estimation Models

The main issue, when defining the efficiency of a decision making unit, is to estimate the so called “efficient frontier” and the deviations of this frontier would be considered as loss of efficiency. The methods are applied in accordance with the procedures used to develop the

frontier thus according to Berger and Humphrey (1997) survey⁵, two major concepts discussed in literature are: the parametric and non-parametric approaches.

The non-parametric method was firstly proposed by Farrell in 1957 and further developed by Farrell and Fieldhouse (1962) by analyzing the influence on efficiency of increasing returns to scale. Next leap into developing efficiency estimation methods, was made in 1971 when Timmer claimed that some of the observations can be located out from the frontier created. The assumption that Timmer had, can be motivated by the fact that the efficiency, in non-parametric models, is defined by the companies which act the best on the market thus these companies are efficient by the definition. Two main methods are known as non-parametric and these are Data Envelopment Analysis and Free Disposal Hull.

The second approach called parametric method is more sophisticated and complex. The estimation of efficiency is based on cost and profit management, given the assumption of existence of a stochastic optimal frontier. Two of the most applied parametric techniques are the Stochastic Frontier Analysis (SFA) and the Distribution Free Approach (DFA). The SFA was developed independently by Aigner, Lovell and Schmidt (1977) and Meeusen and van den Broeck (1977). Methodologically speaking, the main difference between this approach and the one firstly developed by Farrell is that in parametric approach the production function is being completed with a composed error term. The production function is:

$$y_i = f(x_i; \beta) + \varepsilon_i \quad \text{Equation 1}$$

The error term has the form as follows: $\varepsilon_i = u_i + v_i$ and $i = 1 \dots N$. It decomposes the frontier itself into inefficiency (u_i)⁶ and noise (v_i) by making clear assumption about the inefficiency components distribution. Also it implies a stochastic component that describes the random shocks which affect the activity of a decision making unit and which are not in manage of it.

⁵ The authors analyze 130 papers on bank efficiency

⁶ It can be equalized with the X-inefficiencies first developed by Leibenstein (1966). It is a measure of how well management is aligning all intellectual capital available in a decision making unit. However Frei, Harker and Hunter (1997) argue that it is still not clear if X-inefficiencies are actions derived from the strategy of the bank or just results of actions.

The evolution of the efficiency estimation through SFA was accelerated by the paper of Green (1980) when the author formulated the problem of estimating jointly the allocative and technical inefficiency in a trans-log production function. In the same decade the DFA was developed by Schmidt and Sickles (1984) and Berger (1993). This method does not post any assumptions on inefficiency components distribution. Also Sickles (1984) was first to extend the parametric approach to panel-data.

The next phase in developing of efficiency estimation was started when Bayesian type estimation of stochastic frontiers and Gibbs sampling techniques were introduced and discussed by Koop, Osiewalski and Steel (1995). Further on, the Bayesian inference and the Gibbs sampling were analyzed in the context of more libertine or vice versa, more strict production functions, in Griffin and Steel (2004), Koop and Steel (2001). In recent years more discussions on frontier efficiency models was held on the issue of heterogeneity. The most influential articles on this issue can be highlighted those of Greene (2005) and Greene (2010).

2.4 The applicability of frontier efficiency models in banking efficiency estimation

It is overwhelming to notice how big metamorphosis the frontier efficiency estimation has suffered in their relatively short existence. Also, it is plausible that these models gained such a big popularity in estimation efficiency for different industries and social activities in general. However our focus on literature review for these models is on their applicability in banking industry.

Banking industry is one of the industries which is highly related to and interdependent so as of other industries as well as of households directly. Perhaps this concentrated connection with overall economic actors is making the banking industry to be one of the most analyzed through frontier efficiency models from all. Mainly, the areas of interest are as follows: the impact of regulations on the efficiency of financial institutions; how efficiency is influenced by competition and its level of concentration; the fluctuations of efficiency level and the main determinants of this; European policies and how those influence on the convergences of banks inside the banking

sector and across the borders of the EU members; international comparison studies among efficiency level of different banks; and the area that is of the biggest interest for our research would be, the corporate governance and the quality of management influences on overall efficiency of a bank;

Holló and Nagy (2006) researched the efficiency gap of banks from “old” and “new” European Union (EU) members by analyzing the influence of exogenous “(out of managerial control) and endogenous (under the control of management)” factors. They applied Fourier-flexible cost function and modeled the data through SFA. Their finding is that there is a high importance in acknowledging the “heterogeneity in operational environment” of the bank. Also authors stress that “due to profit-maximization” aim of the bank, “only managerial ability in efficiency improvement is of particular relevance from the point of view of financial stability”. If a bank or the entire banking industry faces a “efficiency surplus” it will provide more advantageous services and products on the market (cheaper credits, deposits with higher return, etc.) thus creating incentives for enhancing investments and economic growth. Moreover, an efficient bank will need less resource to provide the same output than a less efficient bank thus exposing itself to lower risks and enforcing its financial health. An important claim, for our research, made by Holló and Nagy (2006) is that improve in efficiency is usually supported by high expenditures in short-term while the impact is to be observed in long-run thus this discrepancy in the time-frame of a bank activity can be seen as a “discouraging factor” for both, managers who are in charge of accomplishing the strategy and for shareholders who are deciding about the strategy to be taken.

The study of Frei, Harker and Hunter (1999) clearly shows how the costumers of a bank view the overall efficiency of a bank. In this paper, through complex customer satisfaction interviews were found that in 80% of cases when a customer is not satisfied he is blaming the institution however in 100% when the customer is satisfied he is crediting the specific person who serviced him. This represents a good incentive for managers of banks to invest in human resource and process management because it is obvious, at least at individual experience level, employees represent the company that they work for especially in cases of bad fulfillment of their responsibilities.

CHAPTER 3

Methodology

Based on the purpose of this research we had to consider two main issues. First, we had to identify the most suitable model of evaluating the knowledge capital and value of a bank so as to compute the variables which would represent the knowledge value and its usage in a bank. Second, we had to determine the proper econometric model that, with implied variables for knowledge value, would give us the necessary flexibility in estimating the influence of knowledge capital on efficiency of a bank.

3.1. Estimating the Knowledge and Intellectual Capital

Certainly both Knowledge and Intellectual Capital are mainly composed by intangibles upon which many methods of evaluations are tested and analyzed but none of those are yet assigned as the most accurate and best fitting all the necessities of evaluation. There is a great debate on the topics related to methods applied, assumptions considered and value definition at the moment of intangibles evaluation as well as knowledge and intellectual capital evaluation in specific. Bouteiller (2010) categorized two main groups of methods of analyzing and evaluating the knowledge and intellectual capital:

- a) The “Global” Approaches which embrace methods such as: Market to Book Value, Tobin’s Q, Calculated Intangible Value, Total Value Creation, Normalized Earnings
- b) “Asset by Asset” Approaches which embrace methods such as: Cost methods, Market methods, Income methods, Option – pricing methods.

A “performance based approach” to knowledge and intellectual capital valuation is presented by Jae-Hyeon Ahn and Suk-Gwon Chang (2002) which implies that knowledge contributes to business performance indirectly through product and processes of a business unit. Albeit the fact that this approach could present a detailed analysis of the knowledge valuation, it is impossible without detailed information regarding operations and product development of the banks analyzed. Considering the fact that this type of information has a confidential label, we did not succeed into obtaining it from the sample of the banks that we have. In fact, we must say, that the banks officials that were approached by us, were very skeptical about our study and by their responses confirmed the paradigm that banking industry is a highly conservative and protective

environment, regarding their operations (from 17 banks contacted, only 4 respondent and all with a negative answer).

The evaluation approach that we applied is somehow generalizing the operations based approach of Jae-Hyeon Ahn and Suk-Gwon Chang by the fact that it considers the value creation through operations that are supported and fueled through overheads expenditures and R&D investments. In the same time is relying on Total-Value creation principles in considering the knowledge and intellectual capital formation. The approach was developed by P. A. Strassmann and is considering the knowledge and intellectual capital as one of the fundamental inputs for Economic-Value Adding. Strassmann considers that the “creation of Economic Value-Added is something that defies the laws of conservation of energy” (Strassmann, 1999) which states that the output of a system can be never bigger than the input of it. Still, firms do generate economic value-adding through “creative energy” the source of which is the knowledge capital (Strassmann, 1999). Strassmann infers the value of knowledge capital from its periodic yield and states that “if Economic Value-Added is the interest earned from an accumulation of knowledge residing with the firm, then the value of this principal can be calculated by dividing the Economic Value-Added by the price one pays for such capital”. The approach considers the fact that it is unlikely to differentiate between financial and knowledge investment thus as an approximation for the price of knowledge capital is taken the price of “all capital”. The value of knowledge capital is obtained from the formula:

$$\text{Knowledge Capital} = \text{Economic Value-Added} / \text{Price of Capital (1)}$$

We applied this formula for estimating one of our variables which is named Knowledge Value (KV) and stands for knowledge and intellectual capital gains of each bank.

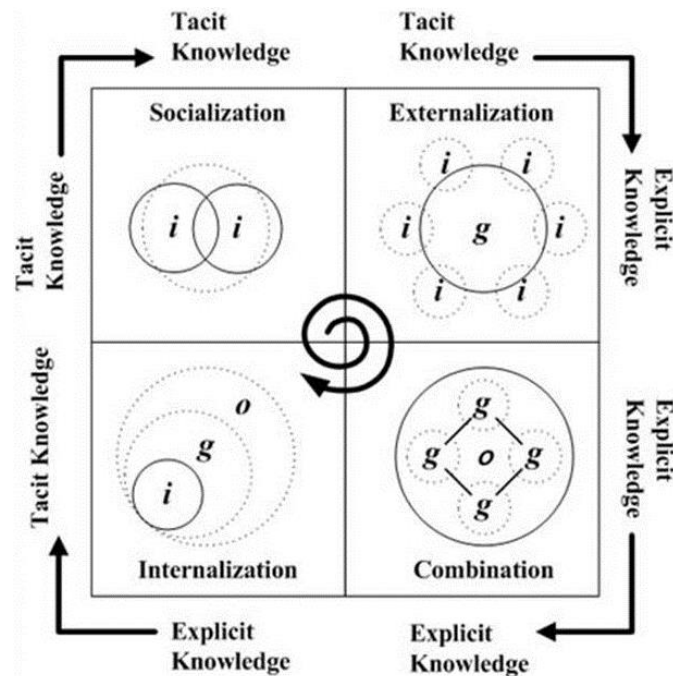
Based on the Deming arguments - “The worker is not the problem. The problem is at the top! Management!” as well as his claim that 94% of the quality problems, variations and improvements belong to the system which is the responsibility of the management and just 6% depends on employees, we consider that the knowledge capital of a company is in control of the management as well. To account for the result of the activity of the management in terms of acquiring the knowledge capital, thus we will consider the Economic Value-Added and will call the variable Management Value-Added.

The author's approach to knowledge influence on the results of a company is based on the argument that a business unit is supporting its operations through exploitation of employees' knowledge and technology in place by spending overheads while through exploration of its employee's knowledge and new technology developments it is assuring operations excellence and development of better products. Another variable that was derived from the approach that is described by Strassmann is called Overhead- to- assets Conversion Ratio which is obtained from the formula:

$$\text{Overhead- to- assets Conversion Ratio} = (\text{Knowledge Capital} / \text{Overheads} + \text{R\&D expenditure}) * 100\% \quad (2)$$

Through this variable we are assuming that one should consider any overhead expenditure as a potential investment in knowledge and try to assure a positive conversion ratio. As shown in Figure 3, the process of transformation of tacit into explicit knowledge is basically an interaction thus if proper working spaces, logistic conditions, working policies and specially designed activities are in place then the probability of overheads and R&D expenditures to have a bigger footprint on the knowledge assets of the company is larger.

Figure 3: The process of transformation Tacit into Explicit Knowledge (Nonaka and Takeuchi 1995)



As shown in Figure 3, above, knowledge being contained in different forms in different sources has to be communicated and applied in order to truly value it. One of the main goals of a bank

must be to facilitate the circulation of knowledge so as to transform it, as much as it possible, from a tacit state to an explicit state. This transformation allows the firm to have more control and influence on the knowledge asset it has.

3.2. Econometric model for efficiency estimation

The econometric approach that fits our necessities is to be Stochastic Frontier Analysis (SFA). SFA is a parametric, deterministic method of estimation the efficiency frontier which assumes a functional relation between inputs and outputs of a business unit. The Battese and Coeili (1995) formulation of a SFA model is suitable for our purpose because it allows the expression of inefficiencies as specific functions of variables. Also it offers the possibility of analyzing the time variant inefficiencies for each bank in every year of analyzed period.

The stochastic frontier production function for the panel data, proposed by Battese and Coeili (1995), is as follows

$$Y_{it} = \exp (x_{it}\beta + V_{it} - U_{it}) \quad (3)$$

- Y_{it} stands for production of firm i -th firm ($i = 1, 2, \dots, N$) at the t -th observation ($t = 1, 2, \dots, T$). This approach assumes that there are T time periods for which observations are available for at least one of the N banks but it does not request that all the firms N must be observed for all time periods T .
- x_{it} is a vector of explanatory variables which are represented values of known functions of inputs of production of the i -th firm at the t -th observation;
- β is a vector of unknown parameters that will be estimated;
- V_{it} are assumed to be independently and identically distributed $N (0 , \sigma^2_v)$, random variables and independent of U_{it} ;
- U_{it} are non-negative random variables, which describe the technical inefficiency of production, which are assumed to be independently distributed. The U_{it} is obtained by truncation (at zero) of the normal distribution with mean $Z_{it} \delta$, and variance, σ^2 ;
- Z_{it} is a vector of explanatory variables associated with technical inefficiency of production of banks;
- δ is a vector of unknown coefficients.

The Equation (1), above, specifies the stochastic frontier production function in terms of the original values but the technical inefficiency effect U_{it} are assumed to be a function of explanatory variables Z_{it} and the vector of unknown coefficients δ . The technical inefficiency is represented by the following formula:

$$U_{it} = Z_{it} \delta + W_{it} \quad (4)$$

The explanatory variables include the input variables which are of interest of analysis for our research so as to identify if the inefficiency effects are stochastic. This model can also be applied if the first Z variable is equal to one and there is no other Z variable included into the model (or equal to zero). In this case, one is applying the model specified by the Stevenson (1980) and Battese and Coelli (1992). In our case we include Z variables which should show the stochastic inefficiency effects.

The W_{it} is defined by the truncation of the normal distribution with mean zero and variance, σ^2 . The point of truncation is $-Z_{it} \delta$ i.e., $W_{it} \geq -Z_{it} \delta$. The W_{it} are random variables are not required to be identically distributed and non-negative as well as the mean $Z_{it} \delta$ is not required to be positive for each observation.

The parameters of the model (β, δ, σ^2) are simultaneously estimated using maximum likelihood estimator (MLE). The MLE function and its partial derivatives are presented by Battese and Coelli (1993). The variance parameters $\sigma^2_s = \sigma^2_v + \sigma^2_u$ and $\gamma = \sigma^2_u / \sigma^2_s$.

The technical efficiency of production for the i-th firm at the t-th observation is defined by equation as follows:

$$TE_{it} = \exp(-U_{it}) = \exp(-Z_{it} \delta - W_{it}) \quad (5)$$

The prediction of the technical inefficiency, TE_{it} is given based on its conditional expectation. More on this is presented in Battese and Coelli (1993).

3.3. Cost Function

As Coelli, et al. (2005) have described, the cost function have the following properties:

- Non – negative → the costs cannot be negative;
- Non – decreasing in p → an increase in the prices of inputs cannot decrease costs;
- Non – decreasing in q → more costs are incurred by producing more outputs;
- Homogeneity → a 50% increase in input prices implies a 50% increase in total costs;
- Concave in p → input demand function cannot slope upward.

The cost function properties, however, are not fulfilled in real life and thus the cost inefficiencies occur. These cost inefficiencies in literature are described as a combination of technical and allocative inefficiencies. The stochastic frontier function is a linearized version of the logarithm of the Cobb-Douglas production function. Besides the fact that a Cobb-Douglas production function has the disadvantage of being less flexible than the translog function, considering our relatively small sample size together with the fact that it secures against loss of degrees of freedom we will construct our model based on a Cobb-Douglas production function.

$$\ln Y_{it} = \beta_0 + \sum_{m=1}^M \beta_1 \ln x_{it} + V_{it} + U_{it} \quad (6)$$

We are using the framework presented in Battese and Coelli (1995) where the formula is formed from two main parts. First part, containing the input and output variables, is explaining the endogenous variable and the second part contains variables which are meant to explain the efficiency level.

Our model is represented by the following formula:

$$\log (TC) = \beta_0 + \beta_1 \log(TEA) + \beta_2 \log(TNOI) + \beta_2 \log(PL) + \beta_2 \log(PF) + \beta_2 \log(PFA) + V_{it} + U_{it} \quad (7)$$

The technical inefficiencies are represented by the variables discussed above and are shown in the formula bellow:

$$U_{it} = \delta_0 + \delta_1 TNe + \delta_2 FA + \delta_3 PE + \delta_4 OCR + \delta_5 KV + \delta_6 MVA + W_{it} \quad (8)$$

The description of each variable will be presented in the next section.

The assumptions regarding the distribution of the inefficiency effects permit, in addition to the intercept parameters, to identify the effects of technical change and time-varying behavior of the inefficiency effects. Thus, we will be able to analyze the variations of efficiency estimates per bank per year and compare those estimates with the median for the sample analyzed.

3.4 Hypothesis description

Having all the econometric and knowledge evaluation methodologies in place we must determine the specific hypothesis for which to test. It is worth mentioning that from the very beginning of our research the intent was to be as focused as possible on the educational programs and institutionalized learning that banks have implemented in order to assure the exploration and exploitation of human capital thus knowledge assets created by people. The initial purpose was to questionnaire a representative sample of Top Managers of Czech banks so as to gather necessary information regarding the issue stated above, but due to the confidentiality aspects, not enough bankers were willing to discuss these issues for a research. For a better understanding of the initial scope please consult the Questionnaire from Annex XX. Still, we believe that all the variables formed, following the methodology described above (3.1), we can accomplish the estimations which will be representative enough to conclude on the topic and perhaps find other research paths for future analysis. All the hypothesis that are of the biggest interest for this research are described as follows.

Hypothesis #1: A bank with a positive knowledge valuation result performs better than a one with negative results.

The findings under this hypothesis must help us to understand better the effects that knowledge capital has on the overall activity of a bank. One has to acknowledge that the differentiation of the financial and physical capital gains from knowledge capital gains is rather challenging to do (Sudarsanam, Sorwar, and Marr, 2005) especially nowadays when technology and knowledge intensive practices are no longer a tool of doing business but a fundamental part of it. Moreover, there are voices among knowledge management professionals who bow to the idea that perhaps the differentiation should not be the purpose in itself but a consequence of knowledge

measurement attempts. We will consider the variable of Knowledge Valuation (KV) to be a proxy for knowledge capital gains thus we expect it to have a positive and significant influence on the efficiency of a bank.

Hypothesis #2: The ability of a bank to transform and preserve its overheads and R&D expenditures into knowledge assets influences positively the efficiency of a bank.

The modern business and accounting language, refers to overheads expenditures and to R&D investments as to different ways of spending capital. Our approach is that, as in process management, any activity which does not create value is considered as a waste, or sometimes a support activity, the same is in case of spending capital. Any expenditure that is not oriented on maximizing the throughput of the business can be considered as a waste. One of the biggest challenges of the modern business is to understand how the knowledge is created and transformed in a controllable capital (Kanevsky and Housel, 1998, p. 1) and the tipping point in this will be made when accurate and precise measures of knowledge “units” will be made. We will consider the variable of OCR as a good representation of how well a bank is succeeding into spending their operational capital and how well they invest in new products in relation to the increase in external, structural and human capital.

Hypothesis #3: The higher are the accomplishments of management in terms of adding value to the business the higher are the efficiency indicators of the bank.

The confirmation of this hypothesis might suggest that by default, any management decision has to influence the overall system efficiency at all levels thus confirming the rule of Dr. Deming, that the share of managers’ activity on the quality problems and system variations is 94-98% and just 2-6 % is due to activity of the personnel. The biggest implications of the system of management in place, is not only on the business decisions regarding strategy and business model but as well on the culture it creates which might motivate people to share and gain knowledge or might encourage hostile, egoistic behaviors . If management succeeds to promote cooperative working techniques, focus on process improvement rather than on identifying the guilty, this facilitates the exploration of tacit knowledge and exploitation of explicit knowledge impacting the bottom line of the profits and loss statement of a bank. We expect to find a positive impact of MVA variable on the efficiency of the bank.

Hypothesis #4: *The insufficiency of Structural Capital of a bank has a negative impact on efficiency indicators.*

In order to be able to answer precisely for this statement, one must analyze all the institutionalized knowledge of a bank. This is possible by identifying and evaluating the tools for knowledge preservation such as: poka yoke⁷ features, all the processes described and analyzed through SPC, Standard Operation Procedures, Service and Operations Level Agreements, the number of Ishikawa diagrams⁸ and other specific to the business analyzed, tools and techniques. All these elements help a company to explore the tacit knowledge of its employees and preserve it in a explicit and clear manner so as it becomes and knowledge asset for the company. Unfortunately, as stated above, we did not succeed in pursuing banking staff to show as all these details thus we will use all the Non interest Expenditures as a proxy for estimating how the quality and intensity of Structural Capital can influence the efficiency of the bank.

Hypothesis #5: *Bigger banks are more efficient than smaller ones.*

Through this analysis we would like to test if bigger banks means more efficient in Czech banking industry. There is enough evidence that economy of scale is playing a big role in efficiency indicators for banking industry. It is also a very important argument in terms of bargaining power with government and regulatory institutions thus bigger the bank more influence it can have on some market conditions through lobby or internal capacity. The last evidence of this effect was during the financial crisis when the notions of “to big to fail” along with “to connected to fail”, appeared in the specialized literature.

⁷ Poka Yoke - Japanese approach to 'mistake proofing' in all aspects of manufacturing, customer service, procurement, etc. It employs visual signals that make mistakes clearly stand out from the rest, or devices that stops the a operator or process if a part or step is missed.

⁸ Ishikawa diagrams (also called fishbone diagrams, herringbone diagrams, cause-and-effect diagrams, or Fishikawa) are causal diagrams created by Kaoru Ishikawa (1968) that show the causes of a specific event.

CHAPTER 4

Dataset

This chapter comprises the main peculiarities of the dataset and the sample used for analysis. It covers the description of each variable and offers findings regarding statistical analysis of the data.

4.1. Sample description

The dataset represents yearly data for a time span of 10 consequent years, the period of 2002-2011, for a sample of 17 banks from Czech Republic. The main source for yearly financial data was Bankscope Data Base; however websites of the banks were used as well. Based on the scope of the research, there were formulated 3 main criteria for banks selection:

1. The institution has to have a Commercial bank type activity
2. The institution is operating on the territory of Czech Republic
3. The institution has provided financial data for at least 3 years of the analyzed period

After applying the criteria stated above, only 17 out of 63 Czech Banks registered in Bankscope Data Base, were feasible for further analysis.

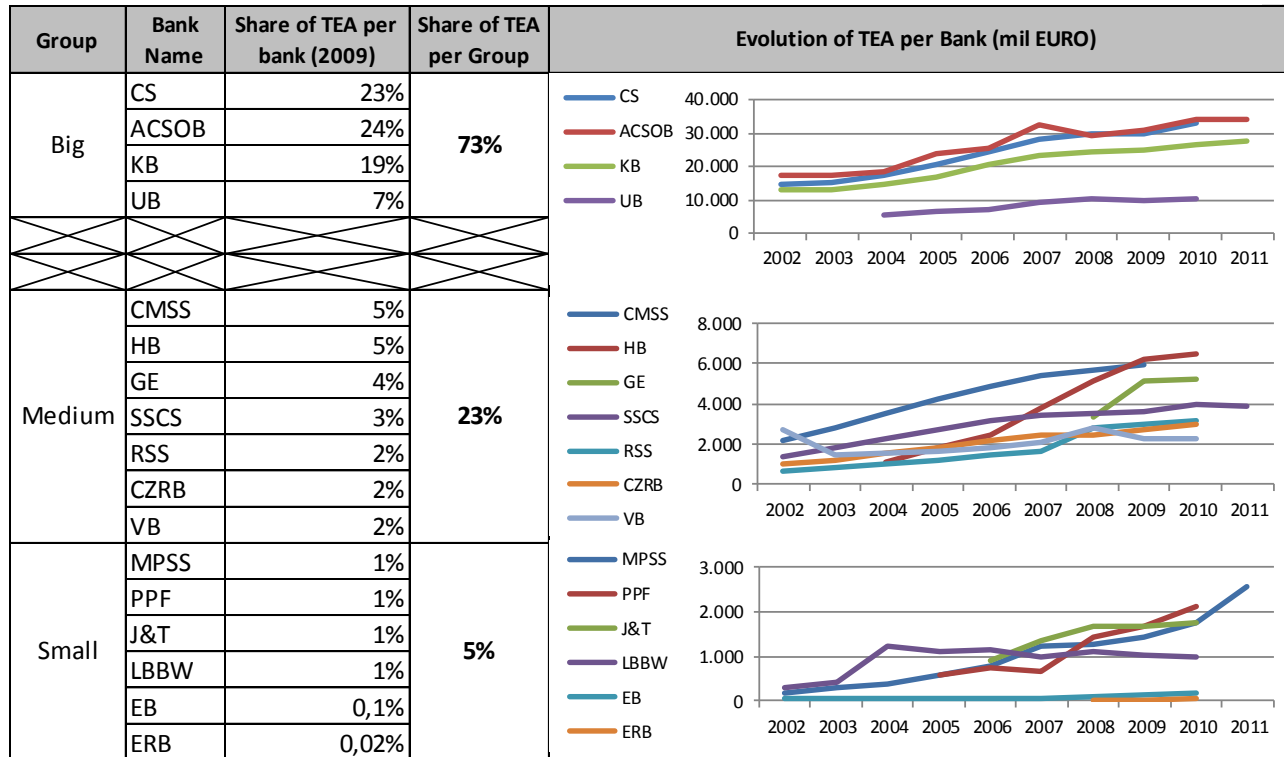
In order to assure the representation of the whole Czech bank sector in the study, the sample was compiled from banks of different sizes in terms of Total Earning Assets (TEA). The years with the registrations for all the banks were 2008 and 2009 from which 2009 was considered for the selection of the banks. The sample was categorized as follows:

- Group “Big” – banks with TEA bigger than 10 million EURO per year
- Group “Medium” – banks with TEA between 10 and 2 million EURO per year
- Group “Small” – banks with TEA less than 2 million EURO per year

As shown in Figure 4, bellow, the group “Big” contains 4 banks and comprises 73% of the TEA of the sample. The group “Medium” contains 7 banks and comprises just 22% of the TEA of the sample, while the group “Small” consists of 6 banks which all together represent only 5% of the total TEA of the sample. The sample follows, relatively well, the Pareto rule which states that

80% of result is due to 20% of input, in this case circa 80% of the Total TEA of the sample is hold by circa 30% of the banks.

Figure 4: Categorization of banks according to TEA



All the banks register a positive trend in terms of TEA throughout the analyzed period.

4.2. The variables

For definition of the outputs and the inputs, there are two main approaches vastly discussed in the literature. One is “production approach” which states that banks exploit labor and capital so as to produce deposits and loans. The second is “intermediation approach” which states that banks involve labor and capital in collection of deposits and transformation of those, in loans. In our research, we adopted⁹ the intermediation approach. This approach gives us the possibility to

⁹ A few studies have shown that the choice of approach has an impact on efficiency levels but it does not influence much the rankings (Wheelock and Wilson, 1995; Berger et al., 1997).

consider the knowledge based activity of labor as a, potentially, value creation activity¹⁰ thus allowing us to analyze the impact of knowledge based activity on overall efficiency of a bank.

Following the scope of our research, we could not apply blindly an existent model of a cost function thus we combined approaches of Sealey and Lindley (1977) with our necessities. The dependent variable of our cost function is considered to be Total Cost (TC) which is the sum of total interest expenses and total non-interest expenses¹¹. The function is composed of three main groups of variables:

1. Output variables

1.1. Total Earning Assets (TEA) – represents all the assets which generate revenue for the bank and are mainly a result of the financial activity of the bank.

1.2. Total Non-interest Operating Income (TNOI) – represents all the income that is generated through operational activities of a bank and it comprises value adding services for the clients which are not necessarily directly linked to financial activity of the institution. This variable is of a great interest for us because, for the creation of value adding services, one needs creative, skilled and knowledgeable labor.

2. Input variables

2.1. Price of Labor (PL) – is formulated through division of the Personnel Expenses by the Number of Employees of each bank. This variable can be considered as a proxy for human capital investment of a bank as well as for a part of the structural capital.

2.2. Price of Funding (PF) – it is represented by the PRIBOR indicator normalized by the Interest Expense on Customer Deposits divide by Average Customer Deposits.

2.3. Price of Fixed Assets (PFA) – it is a division of Operating Expenses with Fixed Assets. This variable offers an image of the amount of financial effort that a bank is giving to its network of assets. One can consider this variable as a proxy for the business model through which the bank is delivering its services to the customers. Meaning that owning more offices and branches can increase the operating expenditures while implying more

¹⁰ As in lean services and manufacturing, a value adding activity is considered the one which follows these three criteria: 1) it makes a transformation; 2) the transformation is correct from the first time; 3) the client wants to pay for the transformation.

¹¹ This approach is designed and applied by Fries and Taci 2005.

“self-service” approach to delivery through internet and mobile solutions can decrease this category of expenditures.

3. Technical Inefficiency Variables – these are variables which according to (Battese & Coelli 1995) state for the inefficiency term rather than all other variables defined above which state for the dependent variable.
 - 3.1. Fixed Assets (FA) – the effect of this variable on the inefficiency term is not straight forward but it is highly important to understand if nowadays when businesses tend to focalize more and more on technological intense (knowledge based) solutions for their services and communication channels with their clients, the fixed assets remain as an important resource for creating value or those are traditionally used by inertia without realizing the impact on efficiency.
 - 3.2. Price of Equity (PE) – it is used in order to account for alternative sources of funding, so called External Capital. Even if equity is a very expensive source of funding, especially during the crisis, banks have to consider this source as well.
 - 3.3. Total Non-Interest Expenses (TNiE) – is a variable which accounts for the waste that a bank is facing in its day by day activity. Due to the fact that these expenses are not necessarily a derivative of the core business of the bank, we consider it as a good proxy for all the insufficiencies of the Structural Capital¹² of a bank.
 - 3.4. Overhead to assets Conversion Ratio (OCR) – as explained above in CHAPTER 3, it is a variable which is used as proxy for the ability of a bank to acquire structural knowledge through overhead expenditures. The fact that it comprises the Research and Development expenditures gives a better understanding of how well a bank, as a business unit, succeeds to explore knowledge of its employees (Human capital). As stated above, Human capital, in its “normal” state is an outcome of all tacit knowledge that exists in a bank and it has to be transformed in explicit knowledge (Structural Capital) if a bank wants to preserve and somehow control it in its operational activity.
 - 3.5. Knowledge Valuation (KV) – is a proxy variable for the estimated value of the knowledge that a bank has acquire in a year of activity. Due to the fact that, regardless of

¹² Nonaka and Takeuchi [1995] calls this capital as - explicit knowledge

the type, an investment is a complex effusion of resources, it impacts the overall quality and amount of knowledge of a bank. Any expense, in terms of capital acquisition, has to have an influence on the efficiency of the business unit.

- 3.6. Management Value Adding (MVA) – represents the ability of the management of a bank to make decisions referring to all the aspects of a bank business. The resources chose and allocation, the prioritization of focus areas, the targets set, the organizational structure imposed, the operations and process management and other elements which are in the control and influence zone of the management, are of crucial interest in terms of the efficiency of the bank.

4.3 Sample analysis

For a better understanding of the data used for efficiency estimation, we made a few types of analysis, such as SPC¹³ and distribution analysis. The summary statistics of the entire dataset are presented in Table 1, below. A detailed view on each group of banks statistics is presented in Appendix 2. One of the common characteristics for almost all the variables is the fact that the distribution is positively skewed with no flat distribution whatsoever. The only variable that has a negative skewness is Overhead Conversion Ratio (OCR).

Table 1: Summary Statistics for the entire Dataset

Variable	Mean	Median	Minimum	Maximum	Std. Dev.	C.V.	Skewness	Ex. kurtosis
TC	275,796	91,5856	0,259994	1331,21	374,783	1,35891	1,43733	0,492335
TEA	7014,52	2448,45	19,0873	33955	9494,5	1,35355	1,57151	1,11115
TNOI	98,3159	14,4367	-87,061	592,5	156,95	1,59639	1,49374	0,741526
PL	0,028814	0,0279762	0,0116069	0,0742628	0,008949	0,31058	1,54249	5,16986
PFA	1,90979	0,951961	-1,03575	22,8993	2,85307	1,49392	4,44208	24,6003
PF	2,91821	2,56397	0,994012	26,4561	2,24332	0,768733	7,38411	70,8931
OCR	1,93355	3,13229	-75,8208	36,6379	11,332	5,86071	-2,8039	17,9692
FA	99,2162	16,0764	0,334622	639,199	167,41	1,68733	1,69673	1,50041
PE	61,7514	9,9615	0,0928551	331,274	97,4816	1,57861	1,47892	0,562861
TNIÉ	145,974	25,6342	-3,06177	745,446	222,625	1,5251	1,41166	0,336224
MVA	54,099	10,315	-93,2671	418,423	99,1017	1,83186	1,82009	2,43329
KV	682,933	117,428	-1289,41	5606,56	1255,56	1,83848	1,85263	2,63389

The difference from minimum and maximum is high for all variables which considered together with the fact that besides Price of Funds (PF) variable, all other variables register a higher standard deviation then their mean values, indicates on a heterogenic data with different realities among the banks analyzed. When analyzing the standard deviations between banks of the same

¹³ SPC - Statistical process control (SPC) is a method of quality control which uses statistical methods and which was first applied to process analysis by Genichi Taguchi a Japanese business statistician. This set of statistical tools for process stability and capability measure was then brought to the international level use by Dr. W. Edwards Deming. This method helps to identify if there are any variations in a process which are the result of a special cause and which are of common causes.

group, one can see (Table 2) that there is no legitimacy at the level of groups of banks. Each group of banks registers less variation at some variables and more at others, in comparison with other groups.

Table 2: Standard Deviation per Group

Variables	Big	Medium	Small
TC	321,094	59,5942	33,1851
TEA	8575,13	1550,45	852,989
TNOI	148,856	31,3437	6,80578
PL	0,005346	0,006269	0,012173
PFA	0,633053	1,68766	4,39493
PF	0,750413	3,29912	0,852222
OCR	2,48359	11,3172	13,2247
FA	172,573	17,2276	9,82962
PE	81,6728	15,4571	4,60453
TNiE	187,035	43,992	10,833
MVA	116,404	17,2279	9,18534
KV	1493,13	213,857	106,173
3	highest		
2	between		
1	lowest		

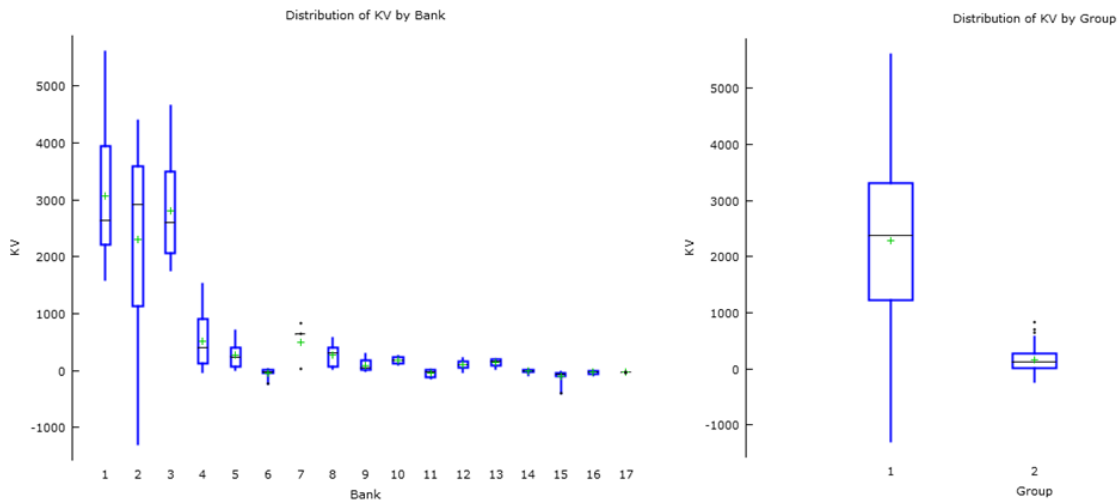
One can notice that for variables in which group of banks “Big” register the highest variations (Table 2) the group of banks “Small” are on the other extreme, registering the lowest standard deviation. And the vice versa effect is found for variables in which banks from group “Small” register highest standard deviations, the lowest are found for the group “Big. The exception is made by the Price of Funds (PF) for which the biggest standard deviation is registered by the group “Medium”. This variable actually suggests that funds are a resource which, for medium size banks, is acquired based on some bargains which are much more

then in case of large and small banks. It is rather curious that for input variables (PL, PFA, PF) the lowest variations among banks is noted in group “Big” this suggesting that the most closed up conditions for attracting and operating the resources, in Czech banking sector, are formed for the big players. Another observation, one can make, is that regardless of the low variations in inputs for the group “Big”, the same group registers the highest standard deviation for the outputs (TC, TEA, TNOI). This is findings can be a notion of further analysis in order to be able to better understand the causes of this differences and not to overlook the effects.

As for the purpose of our research, it is very important to analyze more detailed the variations among groups of banks and each bank individually, for the MVA, KV and OCR variables. In Figure 5, Figure 6 and Figure 7, the distributions of these variables are presented through boxplots for each bank individually and for groups. The numbers from 1 to 17 represent ascending, on the basis of TEA, the banks. The numbers from 1 to 3 represent the groups, 1 being group “Big”, 2 is group “Medium” and 3 is group “Small”. As one can notice the most unstable in its capacity to preserve knowledge (KV) was the bank nr 2 from the group “Big”. As the SPC

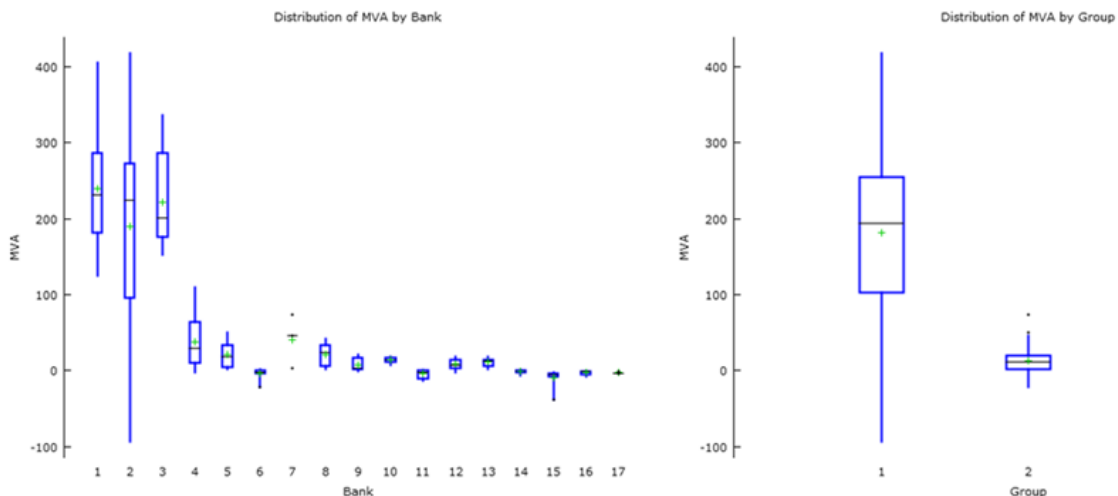
analyses have shown (Appendix), the bank 2 faced a dramatic drop for all 3 variables in 2008. We due to the fact that our attempts to contact directly the management of the bank, we could not succeed, thus we can only speculate that this drop correlated to the acute state of the financial crisis in that period. Even if banks from “Small” and “Medium” groups faced a reduced variation in their results, they accomplished rather humble results. The results of these groups are oscillating, with a slightly better situation for group “Medium”, around zero.

Figure 5: Distribution of KV



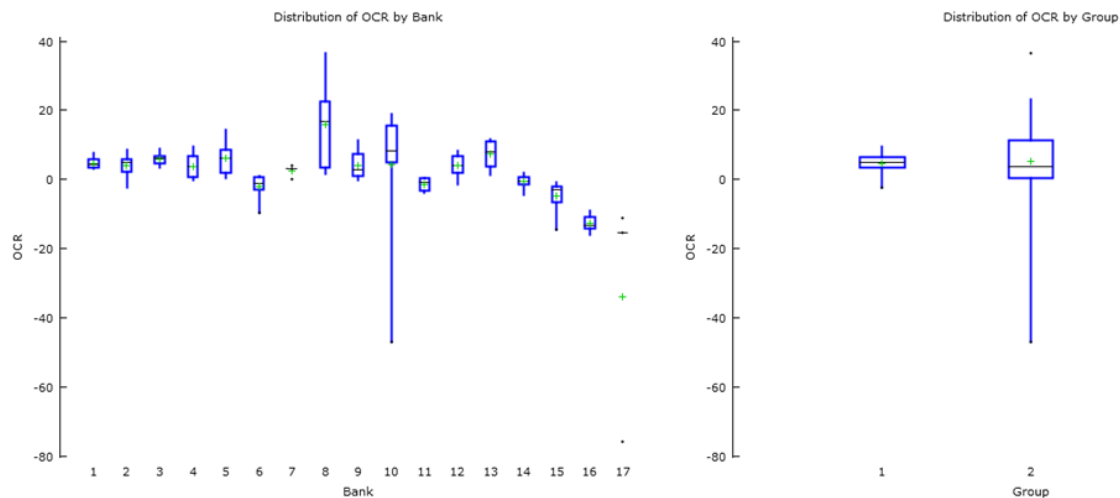
As for value added that was brought by the management of the banks, one can notice from Figure 6 that bank nr. 2 is a special case for both, the entire set and for the group “Big”, accomplishing dramatic variations in the analyzed time period.

Figure 6: Distribution of MVA



The picture is changing, however, for the ability of banks to transform their overheads and R&D expenditures to knowledge assets. As shown in Figure 7, the groups “Medium”- 2 and “Small” – 3 register the biggest variations. These effects can be caused by the inefficiency of these banks to assure the usage of operational resources with a learning gathering experience.

Figure 7: Distribution of OCR



From SPC point of view, the year 2008 was a special year for at least 7 banks from our data set. One bank’s result for all 3 variables, registered value out from the control limits (Upper Control Limit), while for all other 6 banks, the result were at the Upper Alert Limit. One can speculate that even if the financial crisis in 2008, was already sparked, the banking sector from Czech Republic was facing a very promising trend. The year 2009 was a special year for the majority of banks from our data set, because almost all trends changed to down slope direction. Especially, 4 banks, from which 2 banks from group “Small”, faced a dramatic drop violating the Lower Control Limit (LCL). The years of 2010 and 2011 were characterized by slow recovery for almost all the banks, exception being made only by 4 banks. Another interesting observation is that year 2004, for at least 4 banks represents a drop behind the Lower Alert Limit (LAL) with a graduate recovery till 2008. As Podbiera and Weill (2008) state, the period of 2001 – 2005 was “quite”, with no dramatic changes in the Czech bank sector thus there were no big entrances or failures that could affect the market whatsoever. We can only speculate that for the banks,

registered drops in 2004, this was a “refresh” year on which those banks changed their strategy or politics, because all these banks have increasing results in further years.

CHAPTER 5

Results

In this section of our work we present the results obtained by applying the methodology described before. We are testing the results against our hypothesis and try to extract sufficient and necessary information from the data, so as to be able to conclude with relevant findings. The analyses are undertaking the technical efficiency indicators for the entire sample as well as for each group, as described in Chapter 4, and finally per each bank individually. Also, we analyse the changes of indicators in time and if the period analysed affected those.

In order to accomplish our research goals, we had to use two software solutions. For the first phase of calculations we used *NLOGIT 4.0* software developed by Professor William Greene from Stern Business School of New York, and for the second phase we used *R*¹⁴ which is an open source software environment for econometrical and statistical computations.

5.1. Panel estimation of Inefficiency terms

Before commenting on the results and stating the findings, one should remember that this study is approaching a topic of measuring the influence of an intangible resource on a rather straightforward and specific outcome which is costs. Having this in mind, we should stress that the most important for us would be to identify the relation, if any, between the level of efficiency of a bank and its ability to explore and exploit knowledge capital. Also, it is important to highlight the fact that our analyses comprise the period of 2002 – 2011 which contains the financial crisis of 2007-2009. As Paul Samuelson putted it “What we know about the global financial crisis is that we don't know very much.” thus it is of a particular interest to identify any changes in patterns for efficiency estimates of our sample and if these changes could be influenced by variables related to knowledge capital, in this period.

¹⁴ R is an implementation of the S programming language combined with lexical scoping semantics inspired by Scheme. S was created by John Chambers while at Bell Labs. R was created by Ross Ihaka and Robert Gentleman at the University of Auckland, New Zealand, and is currently developed by the *R Development Core Team*, of which Chambers is a member. R is named partly after the first names of the first two R authors and partly as a play on the name of S. <http://www.r-project.org/>

By applying Stochastic Frontier Analysis model which is determined by the equation (7) stated in our methodology described in Chapter 3, we allow for time variance for inefficiencies and are interested to observe the differences based on scale of banks.

Table 3: Empirical Results for SFA Efficiency Estimates

	Estimate	Std. Error	z value	Pr(> z)	
(Intercept)	-0.61021670	0.33483869	-1.8224	0.0683913	.
log(TEA)	0.74526284	0.02723379	27.3654	< 2.2e-16	***
log(TNOI)	0.01808557	0.03153623	0.5735	0.5663162	
log(PL)	0.06845237	0.06880665	0.9949	0.3198087	
log(PF)	0.17007006	0.04265012	3.9876	6.676e-05	***
log(PFA)	0.06326708	0.02752484	2.2985	0.0215308	*
Z_(Intercept)	1.01710695	0.11577576	8.7851	< 2.2e-16	***
Z_FA	-0.00895739	0.00265946	-3.3681	0.0007568	***
Z_PE	0.00806953	0.00834967	0.9664	0.3338198	
Z_TNIE	-0.00928697	0.00374754	-2.4782	0.0132065	*
Z_OCR	-0.01846342	0.00316748	-5.8291	5.574e-09	***
Z_KV	0.00038365	0.00037526	1.0224	0.3066077	
Z_MVA	0.00828884	0.00412797	2.0080	0.0446468	*
sigmaSq	0.02718866	0.00479156	5.6743	1.393e-08	***
gamma	0.34589621	0.28746792	1.2033	0.2288790	
Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1					
log likelihood value: 49.27291					

The main results of our SFA application are presented in Table 3, above. First thing that we should mention is that not all the input and output variables seem to be statistically significant. The Earning Assets (TEA) and Price of Funds (PF) appear to be significant at 1% level, the Price of Fixed Assets (PFA) are significant at 5%, while Total Non-interest Operating Income on the side of output variables and Price of Labor (PL) on the side of input variables seem to have a low statistical significance. These results suggest that Czech banks, in this period, were obtaining much result mainly from the borrowing activity and less by providing additional services to the clients. Usually adding value services in a financial sector is mostly focused on providing additional to the main service of borrowing, products. It implies more of a cross-selling framework which is built on gathered knowledge about the client and knowledgeable personnel.

As for input and output variables, the situation regarding the statistical significance is similar in case of technical inefficiency variables. One can observe that for Price of Equity (PE) and Knowledge Valuation (KV) there is no evidence of their significance when we want to understand the efficiency terms of a bank at the sample level. These results are contra intuitive for us especially when acknowledging the insignificance of KV variable. The only explanation of ours is that the proxy KV, considered for gains of knowledge might not represent entirely the reality of this process and what is more important of the effect. This is supported by the overall opinion on the issue of knowledge measure and valuation, in the academia. As we stated before, there is no consensus whatsoever, among knowledge valuation researches and professionals, on which, the best method of identifying and measure knowledge, is.

The Management Value Added (MVA) and Total Non-interest Expenditures (TNiE) are both significant at 5% level and support our assumptions of the way how these variables influence the efficiency of Czech banks. The result suggests that an increase in MVA, as well as a decrease in TNiE i.e. expenditures which comprise operational waste, must increase the overall efficiency of the banks. The fact that MVA is significant and positive in relation to the efficiency is a confirmation of the findings as stated by Podpiera and Podpiera (2005) that “[...] bad management increases the likelihood of bank failures”.

Fixed assets (FA) are significant in relation to the inefficiencies of a bank and an increase in FA can decrease efficiency.

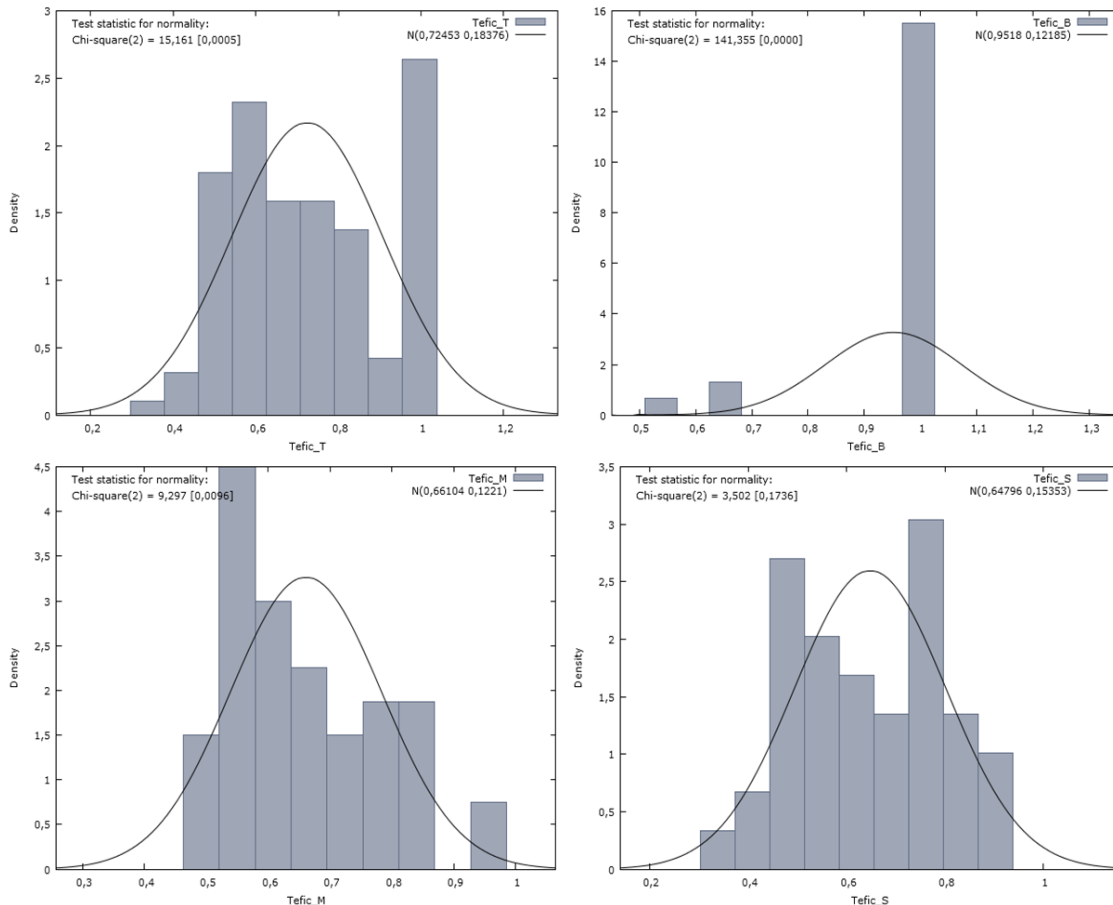
Albeit the fact that Overhead Conversion Ratio (OCR) is used in business environment and some professionals (one of the main advocate is Paul A. Strassmann) consider it to have a positive impact on efficiency of a firm, in our study, the data shows the opposite. We speculate that, the OCR indicator was mainly used in business models which are different from a financial institution as a bank is; thus, we consider that it might not represent the result of conserving and maintaining knowledge in this specific environment. Still, given the fact that almost everything that can be considered as a knowledge accumulation is usually paid for and written off as an overhead, nevertheless, it is a bank or any other type of business, we consider that a much more detailed analysis of overheads structure of payment might bring valuable information. For our research goals, however, this finding is suggesting that maybe such a holistic approach in terms

of interpreting conservation of knowledge unfortunately does not give incentives for a straightforward conclusion.

5.2. Technical Inefficiency estimates

To start with, we will have a general overview on efficiency estimates by plotting histograms for the entire sample and for each group of banks separately (Figure 8). The distribution of efficiency terms for the entire sample is bimodal with high density between 0.5-0.6 indicators and another high density between 0.9 and 1. Also, the distribution shows that the majority of efficiency estimates lay between 0.5 – 0.8. The smallest indicator of efficiency is registered for a bank from group “Small” and represents circa 9% while the highest estimate is registered by a bank from group “Big” and it implies an inefficiency estimate of less than 1%.

Figure 8: Histogram and test vs normal distribution for efficiency estimates, Total Sample (upper left), Group “Big” (upper right), Group “Medium”(lower left), Group “Small”(lower right)



If analyzing the distribution for each group separately, one can notice that group “Big” (Figure 8 – upper right) has an evidenced density between 0.9 and 1, with a few outliers in between 0.5 and 0.7 while the groups “Medium” and “Small” follow the bimodality of the sample. The distribution shows that “big” banks, in Czech Republic, have more uniformity in terms of efficiency thus suggesting that for these market players the realities are somehow normalized in comparison one to another while for banks of medium and small sizes, the realities which those are facing are more different from one to another. Given the fact that any knowledge is a “commodity which benefits from network effect” (Shapiro and Varian, 1999) we consider that the network externality of know-how present in a large network of bank institutions might be one of the factors influencing the uniformity and high results on efficiency estimates for big banks. Albeit the fact that by the end of 2005 the foreign investors controlled circa 96% of the Czech banking sector (Podpiera and Weill, 2008) it seems to be that

Table 4: Mean Efficiency Estimates per year

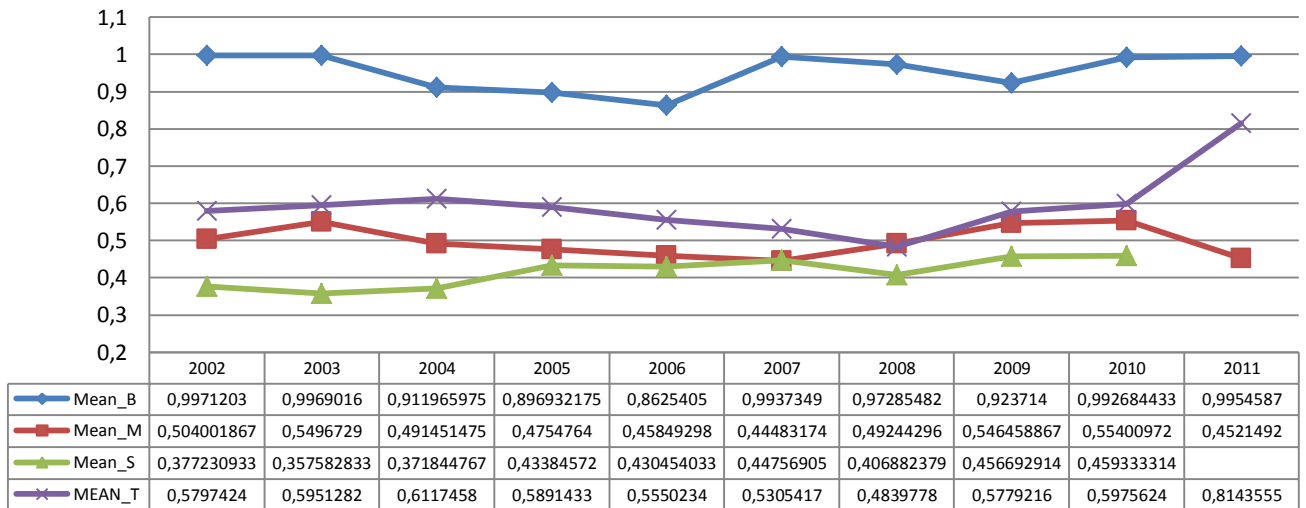
Mean efficiency of each year	
2002	0.5797424
2003	0.5951282
2004	0.6117458
2005	0.5891433
2006	0.5550234
2007	0.5305417
2008	0.4839778
2009	0.5779216
2010	0.5975624
2011	0.8143555
Mean efficiency for the period	
	0.5725499

According to the results obtained from our computations, one can state (Table 4) that Czech banks register a rather small rank off efficiency terms. On average, for the period analyzed, the efficiency level is concluded to be circa 57% which is a rather small indicator. Due to unavailability of data for 2011, the efficiency estimator for this year is calculated only for a few banks thus the average might not be representative for the entire sample.

As one can notice (Table 4) the worst average efficiency indicator is stated for the 2008 year which, as it is well known, was one of the years of financial crisis. However, when comparing average efficiency estimators per groups of banks (Figure 9), one can notice that for each group separately there is no evidence that this particular year was somehow different. When analyzing evolution of efficiency per year per bank, one can notice that 13 banks out of 17, registered their lowest efficiency indicators in the period of 2007 – 2009. The most affected group of banks

appears to be the group “Medium” with 6 out of 7 banks registering the lowest efficiency estimators between 2007 and 2009 (Appendix 4).

Figure 9: Mean efficiency estimates per group of banks per year



The Czech banking sector appears to behave (Figure 9) as it is stated in the academic literature, (Rossi, Schwaiger and Winkler (2008) and Kumbhakar, Subal and Tsionas (2002)) the bigger the bank the higher are the efficiency estimates. This suggests that bigger banks are able to utilize the economies of scale effect and profit from it. Larger banks register an average efficiency estimate of 95%, medium banks have an average of circa 50% efficiency term and small banks accomplish on average approximately 42% efficiency estimate. Based on these, we can infer that on average big banks have opportunities to improve their efficiency with 5% while small banks more than 50%. Remembering that the effect of scale has deep roots, defined by the Kleiber’s law¹⁵, in nature itself, is rather empowering when noticing that this effect impacts quite the same the economic and financial environment.

¹⁵ Kleiber's law, named after Max Kleiber's biological work in the early 1930s, is the observation that, for the vast majority of animals, an animal's metabolic rate scales to the $\frac{3}{4}$ power of the animal's mass. Symbolically: if q_0 is the animal's metabolic rate, and M the animal's mass, then Kleiber's law states that $q_0 \sim M^{\frac{3}{4}}$. Thus a cat, having a mass 100 times that of a mouse, will have a metabolism roughly 31 times greater than that of a mouse.

5.3. Correlation between Technical Inefficiency Estimates and variables of interest

As we stated above, there are some surprises regarding the results of SFA estimated inefficiency terms. In order to understand better how inefficiency terms are influenced by variables of interest for each group separately we computed the Spearman's correlation coefficient. This approach will offer us more information on relations that inefficiency estimates can have with variables meant to comprise the knowledge measures of a bank (Appendix 3).

The Table 5 below contains the results of Spearman's correlations between efficiency estimates and our Technical Inefficiency Variables as well as with macroeconomic indicators to see the impact of these effects on banks from different groups.

Table 5: Spearman's Correlation Coefficients for Efficiency VS Variables of interest

Group of Banks	OCR		KV		MVA		TNiE		FA		Inf		GDP	
Total	1%		4%	**	3%	*	4%	**	5%	**	0%		3%	*
Big	10%		3%		5%		37%	***	90%	***	2%		1%	
Medium	0%		4%		3%		18%	***	63%	***	6%	*	1%	
Small	0%		7%	*	7%	*	37%	***	58%	***	0%		8%	*

One of the most striking result is related to OCR, because it appears to have lower than 0.1 significance level, for all groups and the sample, when applying Spearman's correlation equation. The second finding is related to Knowledge Valuation (KV) which appears to show a weak and significant correlation with changes of efficiency terms for the sample and for small banks in particular. This can suggest that for small banks every gain in knowledge units has a more pronounced effect on its efficiency than in case of bigger banks. For smaller banks, given the fact that they can't profit from effects of scale, the issue of acquiring knowledge represents a matter of being competitive.

The MVA follows the reality of KV and suggests that in case of smaller banks, the conservation of structural and human capital through management activity, is of a more significance than in case of their larger competitors.

Still, it is fair to mention that for all three variables, described above, the coefficient is frugal, influencing not more than 10% of the variations in efficiency terms.

The non-interest expenditures register the highest significance level for all groups of banks and influence the changes of efficiency terms equally for big and small banks (37%) while for medium banks the influence is lower (18%). This finding supports our intuition that any expenditures related to operational activity influence the efficiency of a firm. Given the fact that qualitative and updated structural capital (knowledge) helps to accomplish operational excellence, we can conclude that process management, Operational Service Agreements, standards and procedures and other tools of operational improvement, can influence the overall results of a bank.

As for Fixed Assets, we can notice that the significance is high for all the groups and that the biggest impact of FA on inefficiency level is present in case of big banks (90%). This can be explained by the fact that usually big banks have a rather bigger network of offices as well as more assets in form of buildings and facilities than smaller ones. Fixed assets owned does not necessarily imply that these are used for services providing value to the customer.

In case of macroeconomic variables, a significant influence on efficiency terms, is observed in case of medium banks for Inflation (Inf) and in case of Small banks for GDP. In case of medium banks the effect of inflation on efficiency is supporting the finding related to the influence of Price of Funds and is suggesting that overall, medium banks are more vulnerable if facing fluctuations on the financial and monetary markets. The GDP effect, can make one to speculate that economical growth of the country, facilitating the increase of demand for banking services, increases the business opportunities especially for small banks which with just slight growth already benefit by diminishing the bargain of expenditures on the bottom line of the P&L statement.

CHAPTER 6

Conclusion

“Learning is not compulsory, neither is survival” W. Edwards Deming

This research provides new evidence of the importance of knowledge, in any forms of it, for the results of a bank. This issue is of a high importance especially nowadays after the world has passed through a financial crisis which was mainly triggered from within the banking activity. A profound and serious understanding of the issue of the ability of a bank to explore and exploit its knowledge capital can lead to new opportunities for the financial sector to enlarge its marge in the economic activity of the state. As stated before, in our research we embraced the “intermediary” role of a bank in an economy and we consider that intermediation is plausible only if the intermediate is capable of identifying, gathering and applying the right knowledge at the right time. By this, a bank, besides its increase in performance can truly participate in enforcing and empowering the economic growth of the environment it’s activating in.

Applying the SFA methodology we arrived at results which made us to confirm three out of five hypotheses, to question another one and to confirm a well debated issue of the complexity of measuring knowledge capital impact by neither confirming nor abolishing one of the hypotheses. Our study could not spot and measure the influence of the overall knowledge value added per year on the efficiency of a bank from Czech sector, but it did show, however, that structural capital, which is a component of knowledge capital, is of a very significant importance. As Sudarsanam, Sorwar, and Marr (2005) stated, relative to other types of a firm’s capital, the knowledge related capital is much more difficult to “define, measure, manage, and value” than other types of capital, thus we do accept that our knowledge value estimator might have been improved by more detailed analysis on the case of each bank through evaluating all the instruments of attracting, gathering and utilizing the knowledge. We must mention that this was our first intent but due to the lack of proactive responses from banks we had to stick to a much more quantitative approach. Still, we consider that interviewing banks, and analyzing their knowledge management systems in place thus gathering qualitative data, which then could be

used as proxy in estimating knowledge influence on efficiency, could bring to more exact and accurate results and perhaps give more incentives for both, measuring the knowledge capital as well as estimating the efficiency through econometric instruments. Some examples of the structural as well as human capital management instruments that one might consider to analyze in a qualitative research, could be: Standard Procedures, Process Management tools and standards, internal good case practice libraries, process capability analysis, number and quality of learning circles or any other learning activities, trainings and coaching programs and many other tools which literature has ever documented or the know-how that the bank might have developed on its own.

Without disregardment to the results stated above, our study confirmed the importance a knowledgeable management activity for a bank. As Podpiera and Weill (2008), confirm that for Czech banks, bad management decisions lead to more intoxicated loans portfolio thus worse efficiency levels, we added to this the fact that accounting the overall economic value adding as the result of management's activity, the bad management decisions can affect not only the portfolio of loans but the entire business whatsoever. As Deming said "A firm can exist with bad management, for a while." thus highlighting his rule of 94/6 which states that 94% of the problems with quality are due to the managers activity and just 6% are happening because of the shops floor personnel. This finding supports the idea of a questionnaire (see Aneex XX) of top and middle managers from Czech banks in order to estimate the level of awareness of those regarding the importance of knowledge management on their result.

A rather surprising result of this study is the fact that the ability of the bank to assure the conversion of overhead and R&D expenditures to knowledge assets is influencing its efficiency in a negative manner. This is contra intuitive because it interferes, at the edge, with the theory of "absorptive capacity" defined by Cohen and Levinthal (1990) which, after some developments, can be expressed, in simplified terms as - the more a company knows, the more it can learn. Our results can be explained by the fact that any firm, as formulated in the development of the same theory by Zahra and George (2002), has two types of absorptive capacities. The first is the "potential absorptive capacity" and another is the "realized absorptive capacity". We consider that the ability of Czech banks to absorb knowledge might be underused thus the inconsistency of our estimates with the intuition provided by the theory. Perhaps a relevant development of

researching the issue of overheads and R&D conversion ratio might be done through qualitative analysis of elements suggested by the theory, which are: the number of years of experience of the R&D department and the amount of R&D investment; the number of cross-firm patent citations and publications; the number of new product ideas, the number of new research projects initiated; the number of patent, the number of new product announcements, the length of product development cycle and other.

Overall our study supports the general opinion found in the academia and the professional environments that knowledge capital and intellectual capital are both valuable resources and components for prosperity of a business activity. Albeit the fact that the difficulty to measure an intangible asset's value, in this case knowledge capital, is not overtaken by this study, we cannot, supporting the opinion of Fraguoli (2010), ignore the importance of this intangible asset for Czech banks. Moreover we consider that based on these findings, a more focused research, utilizing qualitative data, could be relevant and insightful for the academia and the bank sector.

Bibliography:

Research Papers

Aigner, D.J. & Lovell & C.A.K. & Schmidt P. "Formulation and estimation of stochastic frontier production functions". *Journal of Econometrics*, 6, 1977: 21–37.

Alvarez, S.A. & Barney, J.B. "How entrepreneurial firms can benefit from alliances with large partners?" *Academy of Management Executive*, 15, 2001: 139 – 148.

Ariely D. & Gal Zauberaman. "Differential Partitioning of Extended Experiences". *Organizational Behavior and Human Decision Processes*, Vol. 91, No. 2, 2003: 128 – 139.

Battese G.E. and Coelli T.J. "A Model for Technical Inefficiency Effects in a Stochastic Frontier Production Function for Panel Data", 1995

Barr & Lawrence M. Seiford & Thomas F. Siems. "Forecasting Bank Failure: A Non – Parametric Frontier Estimation Approach." *Discussion Papers (REL - Recherches Economiques de Louvain), Université catholique de Louvain, Institut de Recherches Economiques et Sociales (IRES)*, 1994.

Bartel A. P. "Human Resource Management and Organizational Performance: Evidence from Retail Banking", *Industrial and Labor Relations Review*, Volume 57 | Number 2 ,2004

Berger, A.N. & Mester, L.J. "Inside the black box: what explains differences in the efficiencies of financial institutions", *Journal of Banking and Finance* 21, 1997: 895 – 947.

Berger, A. N. and De Young R., "Problem loans and cost efficiency in commercial banks", *Journal of Banking & Finance* 21 (1997) 849-870, 1997

Berger, A. N. and Humprey D.B. "Efficiency of financial institutions: International survey and directions for future research ", *European Journal of Operational Research* 98 (1997) 175-212, 1997

Bierly, P. & Daly, P. "The strategic management of intellectual capital and organizational knowledge", *Edited by chan Wie choo & Bontis, N. Oxford university press*, 2002: 493 – 515.

- Blackler, F. "Knowledge, Knowledge work, and organizations: An overview and interpretation.", *The Strategic Management of Intellectual Capital and Organizational Knowledge*, New York: Oxford University Press, 2002.
- Bontis, N. "Assessing Knowledge Assets: A review of the models used to measure intellectual capital." *International Journal of Management Reviews*, 3(1), 2001: 41–60.
- Bowen J & Ford R. "Managing Service Organizations: Does Having a “Thing” Make a Difference?", *Journal of Management* V 28 nr. 3, 2002: 447 – 469.
- Cohen & Wesley, M. & Levinthal, Daniel A. "Absorptive Capacity: A New Perspective on Learning and Innovation", *ASQ*, 35, 1990: 128 – 152.
- Curado C. "Perceptions of knowledge management and intellectual capital in the banking industry", *Journal of Knowledge Management* V 12 nr. 3, 2008: 141 – 155.
- Derviz A. & J. Podpiera, "Predicting Bank Camels & S&P Ratings: The Case of the Czech Republic." *Czech National Bank WP* nr. 1, 2004.
- Garud R. & Kumaraswamy, A. & Langlois, R. "Managing in the modular age: Architectures, networks and organizations" *Blackwell Publishers*, 2002: 1 – 14.
- Gratton. L. & Ghoshal, S. "Managing personal human capital: New ethos for the ‘volunteer’ employee", *European Management Journal*, 21, 2003: 1 – 10.
- Greene, W. „A Gamma Distributed Stochastic Frontier Model.” *Journal of Econometrics*, 1990: 141-163.
- Greene, W. „A Stochastic Frontier Model with Correction for Sample Selection.” *Journal of Productivity Analyssi*, 2010: 15-24.

- Greene, W. „Distinguishing Between Heterogeneity and Inefficiency: Stochastic Frontier Analysis of the World Health Organization's Panel Data on National Health Care Systems.” *Health Economics*, 2004: 959-980.
- Greene, W. *Frontier Production Functions*. Vol. II, în *Handbook of Applied Econometrics*, de H. Pesara and P. Schmidt. Oxford: Oxford University Press, 1997.
- Greene, W. „Maximum Likelihood Estimation of Econometric Frontier Functions.” *Journal of Econometrics*, 1980: 27-56.
- Greene, W. „Reconsidering Heterogeneity in Panel Data Estimators of the Stochastic Frontier Model.” *Journal of Econometrics*, 2005: 269-303.
- Greene, W. „The Econometric Approach to Efficiency Analysis.” În *The Measurement of Productive Efficiency*, de H. Fried, K. Lovell and S. Schmidt. Oxford: Oxford University Press, 1993.
- Greene, William. „Alternative Panel Data Estimators for Stochastic Frontier Models.” *Current Developments in Productivity and Efficiency Measurement*. University of Georgia, 2002.
- Farrell & M. Fieldhouse. "Estimating Efficient Production Functions under Increasing Returns to Scale," *Journal of the Royal Statistical Society*. Series A, 125 (2), 1962 : 252 – 267.
- Fragouli E. "Intellectual capital and organizational advantage: an economic approach to its valuation and measurement". *Paper presented at 9th Annual Meeting of the EEFS International Conference – Global Imbalances, Financial Institutions, and Reforms in the Post-Crisis Era, Athens, Greece*, 2010.
- Frei, F.X. & Harker, P.T. & Hunter L. "Process Performance and Customer Satisfaction: Evidence from the Retail Banking Study," *Working Paper, Wharton Financial Institution Center, The Wharton School, University of Pennsylvania*, 1999.
- Frei, F.X. & Harker, P.T. & Hunter L. "Innovation in retail banking", *Wharton Financial Institution Center, The Wharton School, University of Pennsylvania*, 1997.

- Ikujiro N & Tokyo Hirotaka Takeuchi. "The concept of "ba": Building a foundation for knowledge creation", *California Management Review*; 1998: 40.
- Griffin, J. E. & Steel, M. F. J., "Semiparametric Bayesian inference for stochastic frontier models," *Journal of Econometrics, Elsevier*, vol. 123(1), 2004: 121-152.
- Holló D. & Márton Nag. "Bank Efficiency in the Enlarged European Union", *Bank for International Settlements Publication*, nr.3, 2006.
- Huizing, A., & Bouman, W. "Knowledge and Learning Markets and Organizations." *The Strategic Management of Intellectual Capital and Organizational Knowledge*, New York: Oxford University Press, 2002.
- Knoth A. "Statistical Process Control -- Collection of Some Useful Functions", 2013
- Klein, D.A & Prusak, L. "Characterising Intellectual capital", Cambridge, MA, *Centre for Business Innovation, Ernst and Young*, 1994.
- Koop G. & Osiewalski & M.F.J.Steel. "Posterior analysis of stochastic frontier models using Gibbs sampling" *Computational Statistics* 10, 1995: 353 – 373.
- Kumbhakar, S. & Efthymios T. "Non-parametric Stochastic Frontiers." *NAPWII at Schenectady, New York and ACEPI at Taipei*, 2002.
- Leibenstein H. "Allocative efficiency versus X-inefficiency", *American Economic Review*, 1966.
- McEvily, S., & Chakravarthy, B. "The persistence of knowledge-based advantage: An empirical test for product performance and technological knowledge", *Strategic Management Journal*, 23, 2002: 285–305.
- Meeusen, W. & J. van den Broeck. "Efficiency estimation from Cobb-Douglas production functions with composed error," *International Economic Review*, 8, 1977: 435–444.
- Mefford, R.N. "Introducing management into the production function," *The Review of Economics and Statistics* 68, 1986: 96 – 104.

- Nonaka, I. "The knowledge-creating company", *Harvard Business Review*, November-December, pp. 96-1004, 1991
- Nonaka, I. and Konno, N. "The concept of ba: building a foundation for knowledge creation", *California Management Review*, Vol. 40 No 3, pp 40-45, 1998
- Podpiera J., Weill L. "Bad luck or bad management? Emerging banking market experience", *Journal of Financial Stability*, 4(2), 2008: 135 – 148.
- Pruteanu – Podpiera A. & Podpiera J. "Deteriorating Cost Efficiency in Commercial Banks Signals an Increasing Risk of Failure." *Working Paper nr. 6, Czech National Bank*, 2005.
- Polanyi, M. "Personal knowledge: Toward a post-critical philosophy." Chicago: University of Chicago Press, 1962
- Prasad B. & Harker P.T. "Examining the contribution of information technology toward productivity and profitability in US retail banking". *Report 97 09, Financial Institutions Center, The Wharton School, University of Pennsylvania*, 1997.
- Pruteanu – Podpiera A. & Weill L. & Schobert F. "Market Power and Efficiency in the Czech Banking Sector", *Comparative Economic Studies*, 2007.
- Rosenberg, N. "Inside the Black Box: Technology and Economics", *Cambridge University Press, Cambridge, United Kingdom*, 1982.
- Rossi, S.P.S., Markus S. Schwaiger, Gerhard Winkler. "Banking Efficiency in Central and Eastern Europe.", *Financial Stability Report, Austrian National Bank*, 2008.
- Spender, J. "Knowledge, uncertainty and an emergency theory of the firm", *The Strategic Management of Intellectual Capital and Organizational Knowledge*, New York: Oxford University Press, 2002.
- Schmidt, P. & R. Sickles. "Production Frontiers and Panel Data." *Journal of Business and Economic Statistics* 2, 1984: 367–374.

Schumpeter, J. A. "Business Cycles", *New York: McGraw Hill*, 1939.

Sudarsanam, S., Sorwar, G., & Marr, B. "A finance perspective on intellectual capital", In B. Marr (Ed.), *Perspectives on intellectual capital*, Boston, MA: Butterworth-Heinemann, 2005: 56–6.

Tainio, R., P. J. Korhonen, & al. "In search of explanations for bank performance – some Finnish data" *Organization Studies*, 12(3), 1991: 426 – 450.

Ting Li & Chengjie Guan. "Study on the Behaviors of Commercial Banks Based on Bank Particularities", *International Journal of Business and Management*, 2008.

Wiig Karl. "Knowledge Management: An Introduction and Perspective", *Journal of Knowledge Management*, Vol. 1 Iss: 1, 1997: 6 – 14.

Zack, M. "Developing a Knowledge Strategy: Epilogue", *The Strategic Management of Intellectual Capital and Organizational Knowledge: A Collection of Readings*, N. Bontis and C. W. Choo (eds.), *Oxford University Press*, March, 2002.

Zhaoyong & Lv, Ruobin. "On the Particularity of Commercial Banks and Its Influence on the Corporate Governance". *International Business*. nr. 2, 2006.

Books

Bouteiller C. & Karyotis C. "The evaluation of intangibles: introducing the optional capital", *Investment Management and Financial Innovations*, Volume 7, Issue 4, 2010.

Deming, W. Edwards. "The New Economics: For Industry, Government, Education". *MIT Press*, 2000.

Drucker, P. "Post-capitalist society." *New York: HarperCollins*, 1993

Edvinsson, L. & M.S. Malone. "Intellectual Capital" , *Piatkus, London*, 1997.

Edward Deming. "Out of the Crisis", 1986.

Ikujiro N, Tokyo Hirotaka Takeuchi. "The Knowledge-Creating Company : How Japanese Companies Create the Dynamics of Innovation" 1995.

Johnson, D. W., & Johnson, R.. "Learning together and alone: Cooperative, competitive, and individualistic learning" (5th Ed.). *Boston: Allyn & Bacon*, 1999.

Jae-Hyeon Ahn & Suk-Gwon Chang. "Valuation of Knowledge: A Business Performance – Oriented Methodology", *International Conference on System Sciences* , 2002.

Stewart T. A. "Intellectual capital: the new wealth of organizations", *Business and Economics*, 1997.

Sveiby, K. "The New Organizational Wealth: Managing & Measuring Knowledge-Based Assets". *Berrett-Koehler Publishers*, 1997.

SubbaNarashimha, P. "Salience of knowledge in a strategic theory of the firm", *Journal of Intellectual Capital*, Vol 2 No. 3, pp. 215 -24, 2001

Business Articles

Berger, A. & DeYoung, R. "Problem loans and cost efficiency in commercial banks." *J. Banking Finance* 21, 1997: 849–870.

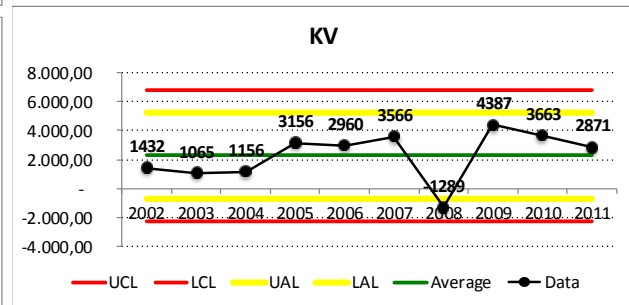
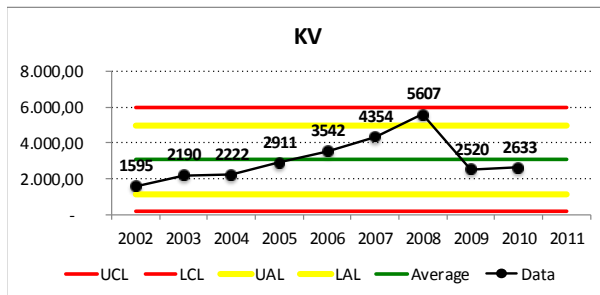
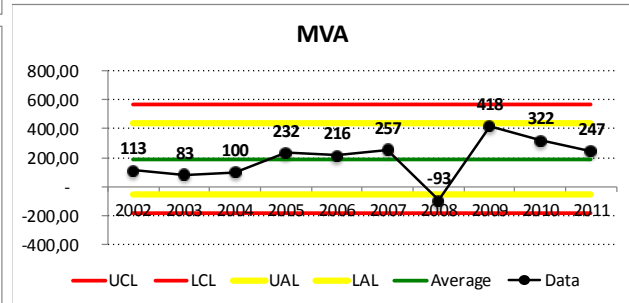
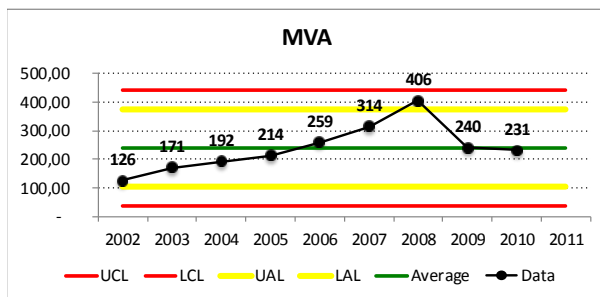
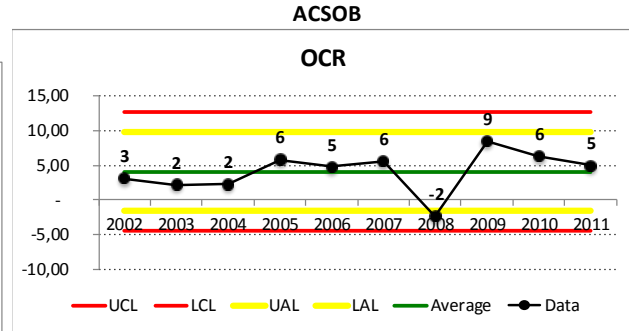
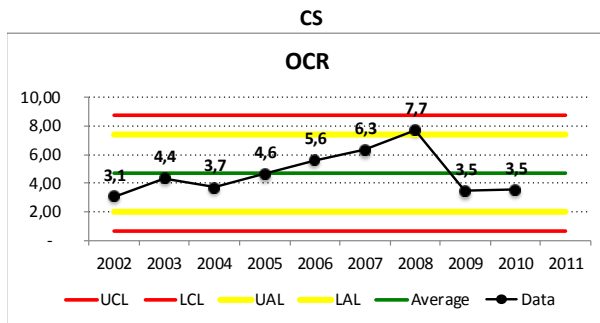
Berger, A., Leusner, J., Mingo, J. "The efficiency of bank branches." *J. Monetary Econ.* 40 (1), 1997: 141–162.

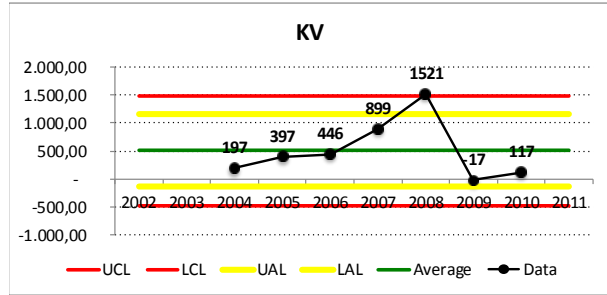
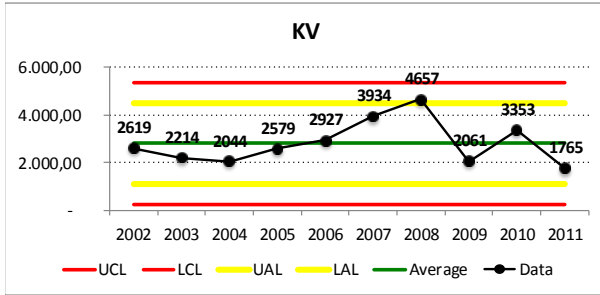
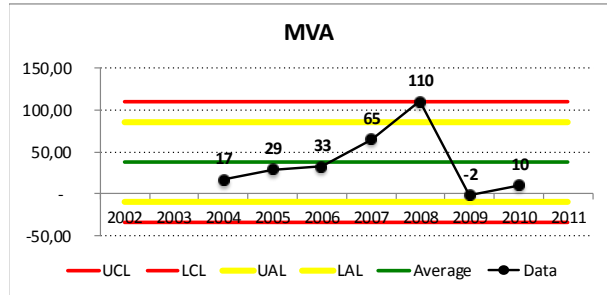
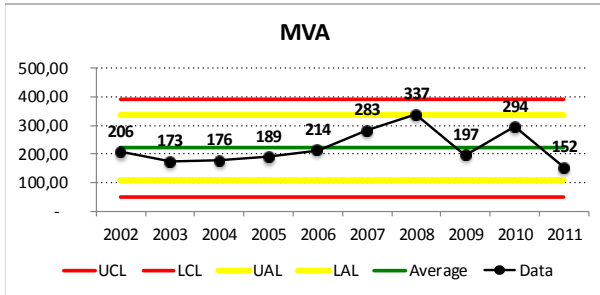
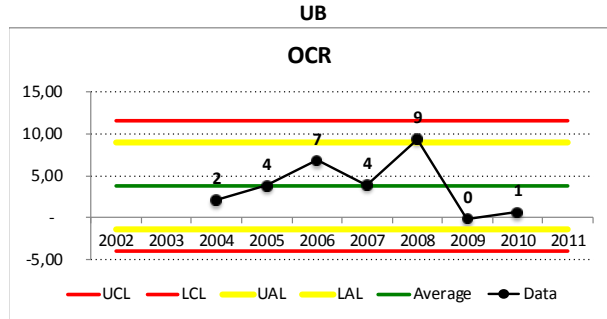
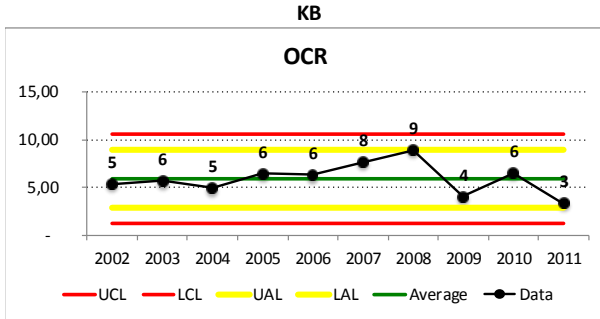
Coelli, T., Prasada D.S. Rao, Christopher J. O' Donnell, & George E. Battese. "An Introduction to Efficiency and Productivity Analysis " 2nd. *Boston: Kluwer Academic Publishers*, 2005.

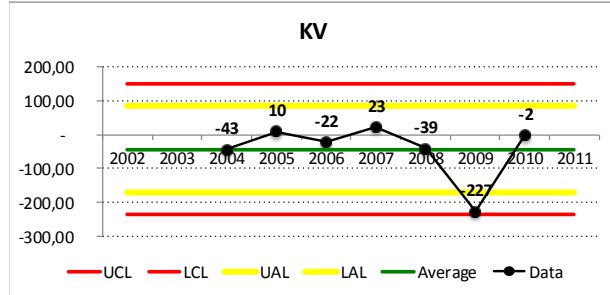
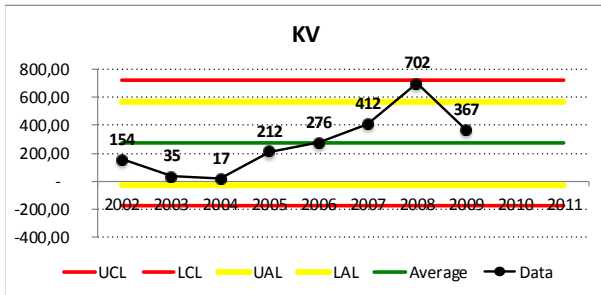
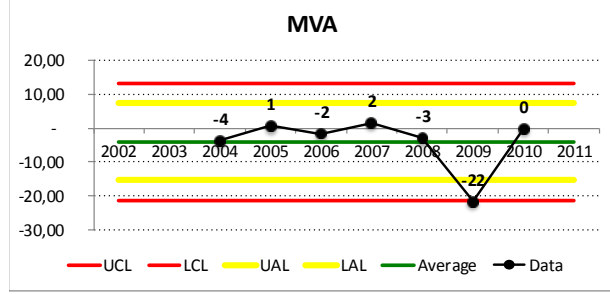
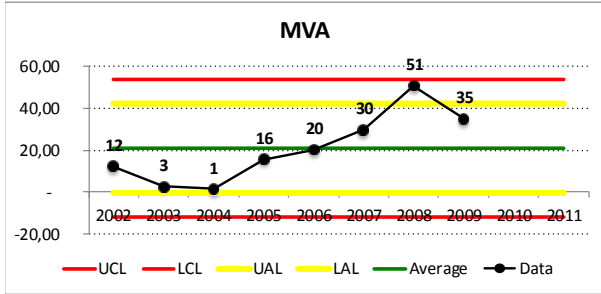
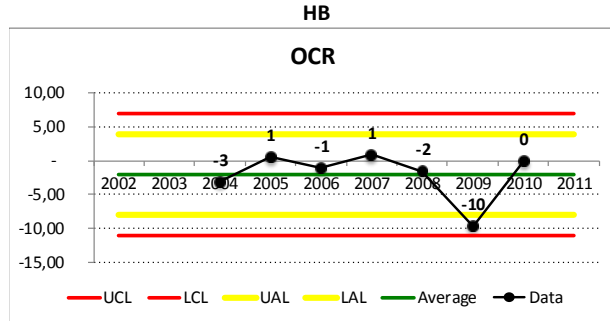
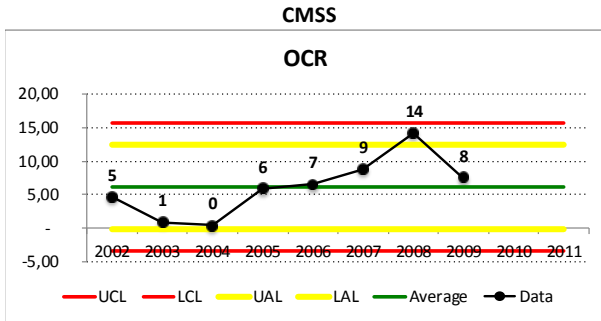
- Fries, S. & Tac, A. "Cost Efficiency of Banks in Transition: Evidence from 289 Banks in 15 Post-Communist Countries." *Journal of Banking and Finance*, 2005: 55 – 81.
- Strassmann Paul A., "The Value of Knowledge Capital", 1098
- Strassmann Paul A., "Calculating Knowledge Capital", 2001
- Strassmann Paul A., "Measuring and Managing Knowledge Capital", 1999
- Strassmann Paul A., "Accumulating Knowledge Efficiency", 2000
- Strassmann Paul A., "The Importance of Knowledge Capital", 2000
- Sealey, W C, & T J Lindley. "Inputs, Outputs and a Theory of Production and Cost at Depository Financial Institutions." *Journal of Finance*, nr. 32(4) 1977: 1251 – 1266.
- Szulanski, G. & Winter, S. "Getting it right the second time", *Harvard Business Review*, January 2002: 62 – 69.
- Wheelock, D., Wilson, P. "Evaluating the efficiency of commercial banks: does our view of what banks do matter? " *Rev. Federal Reserve Bank Saint-Louis* 77 (4), 1995: 39–52.

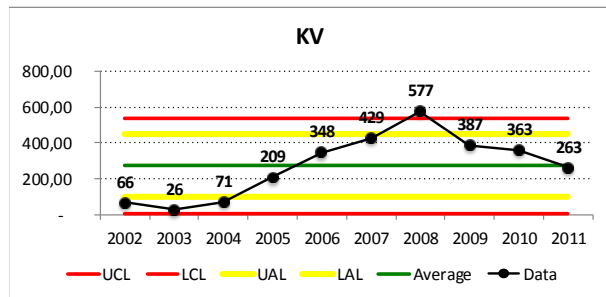
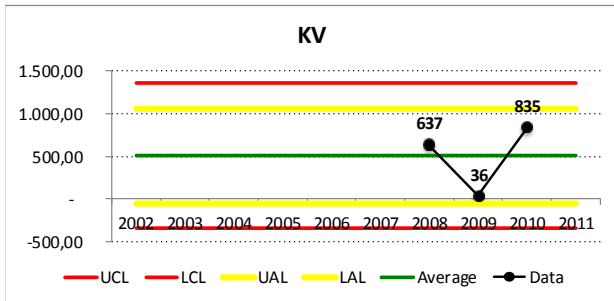
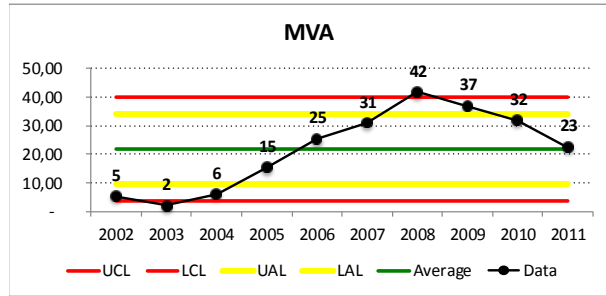
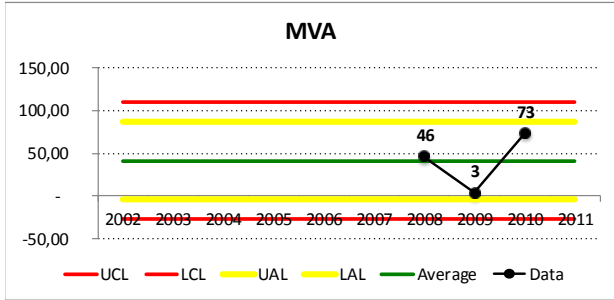
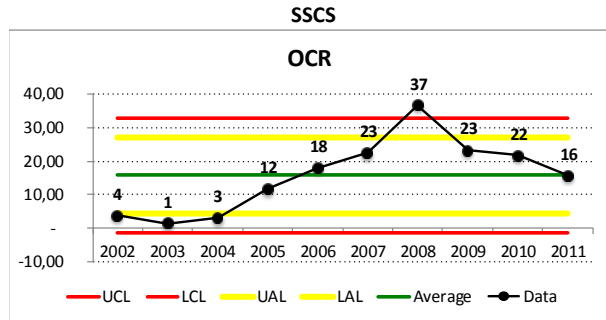
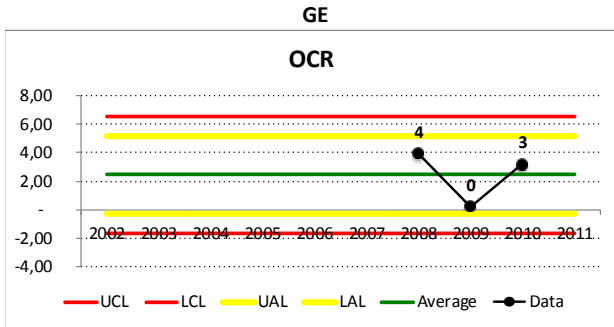
Appendix

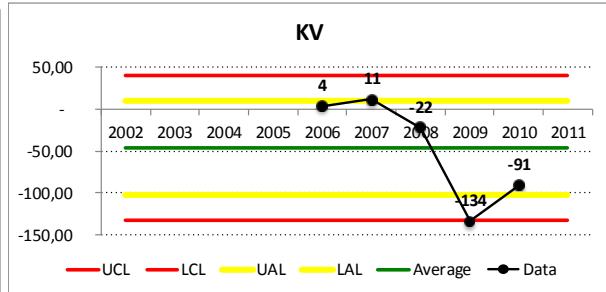
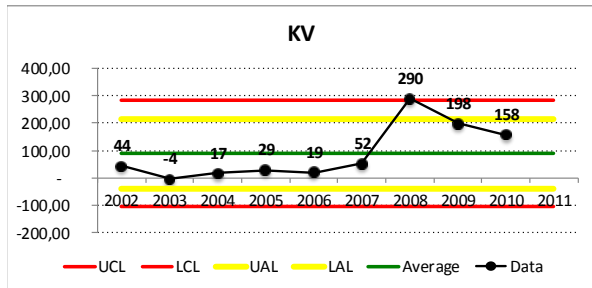
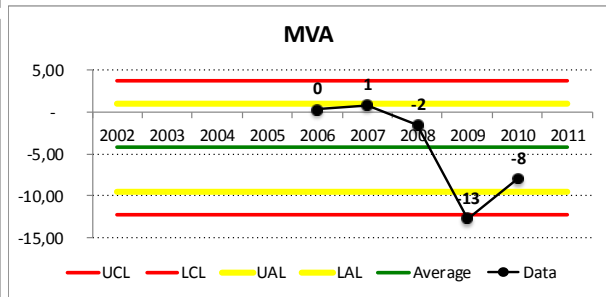
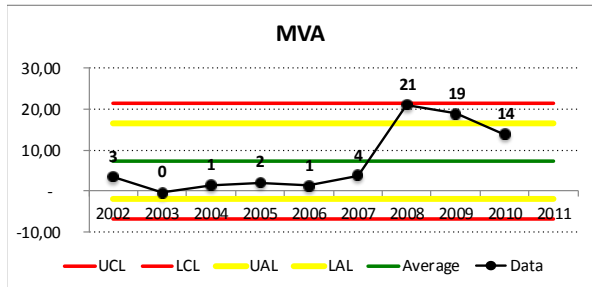
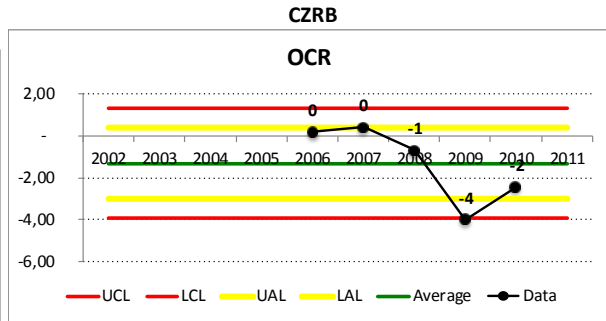
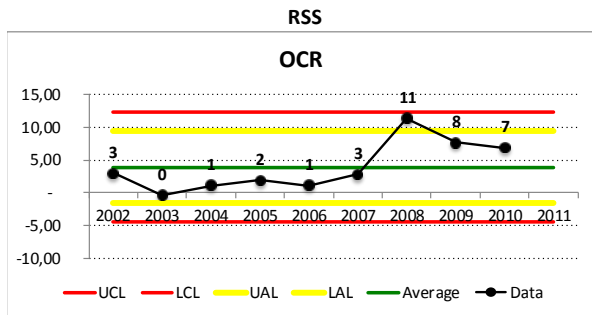
Appendix 2: Statistical Process Control of knowledge variables, per bank

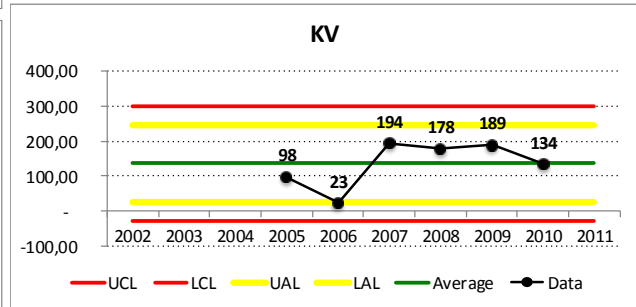
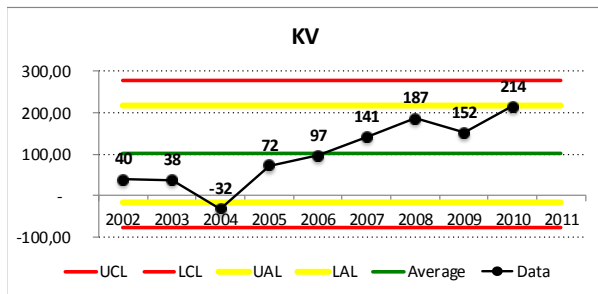
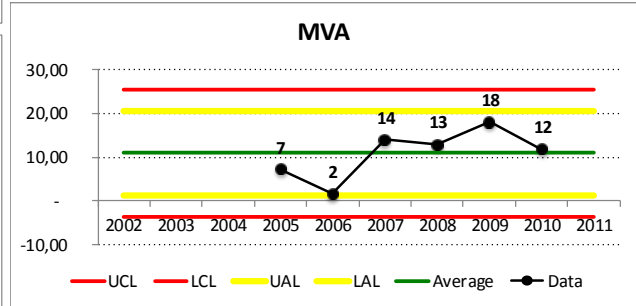
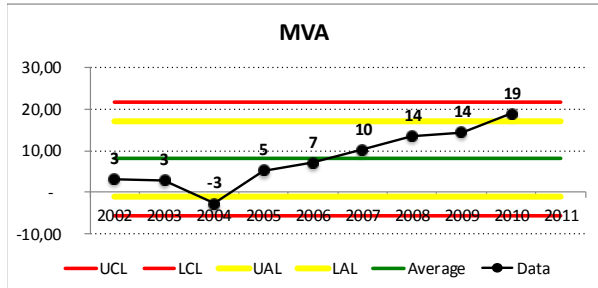
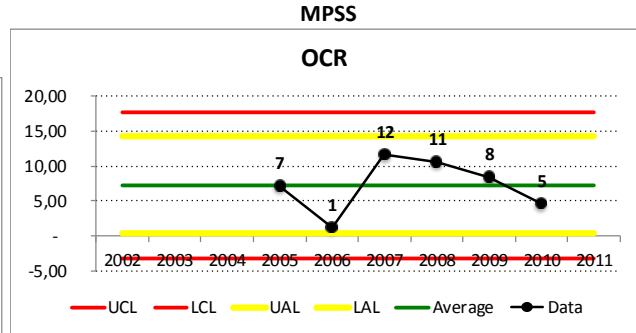
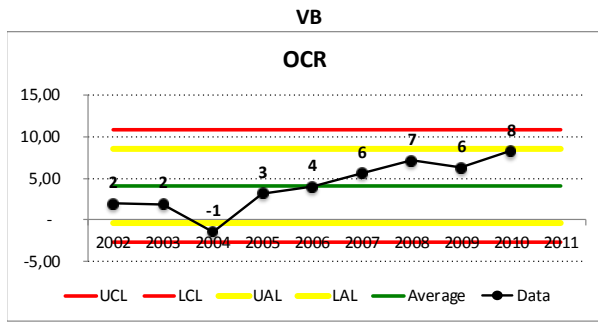


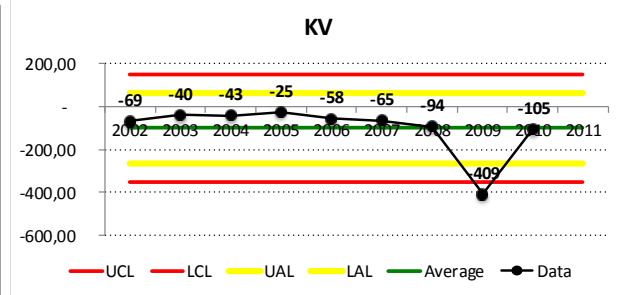
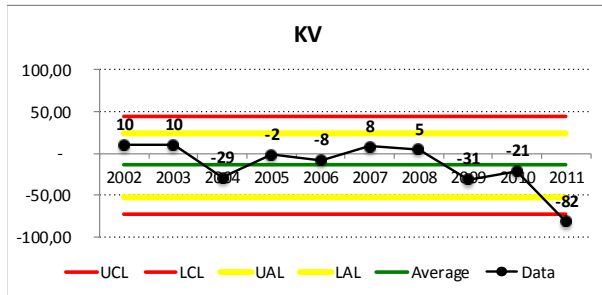
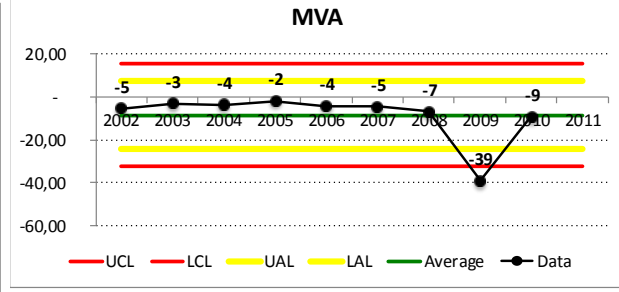
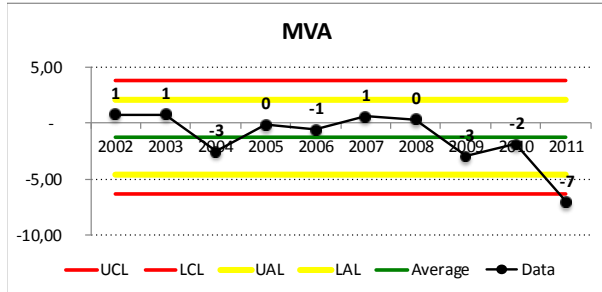
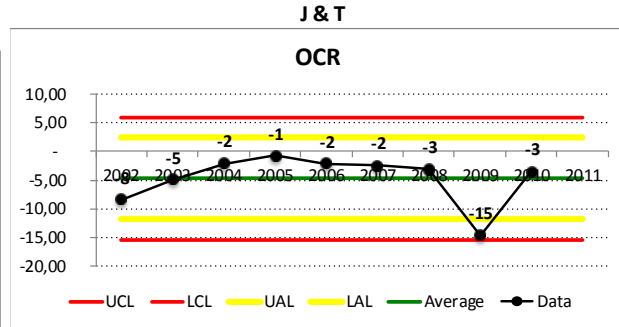
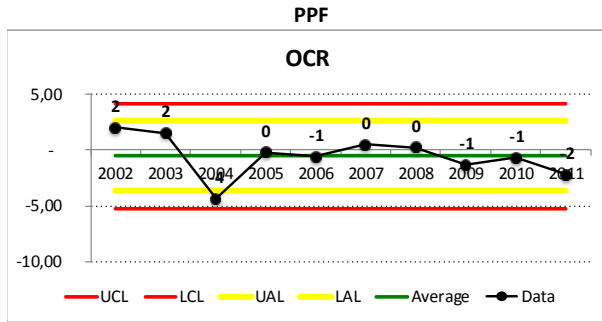


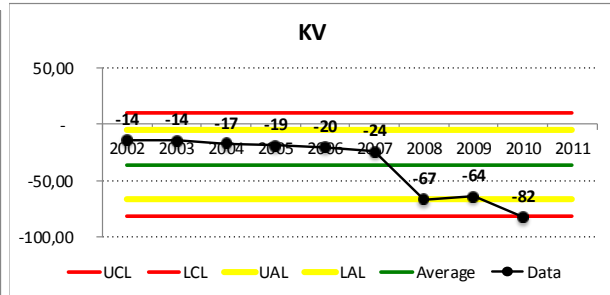
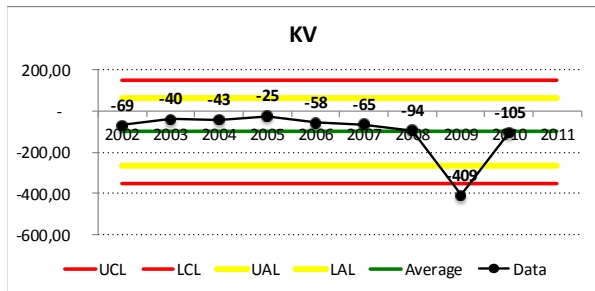
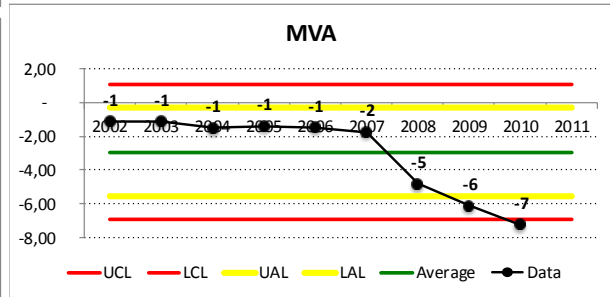
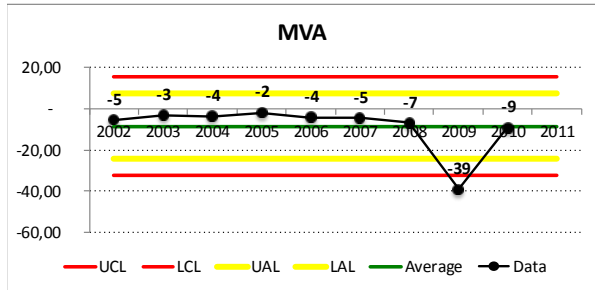
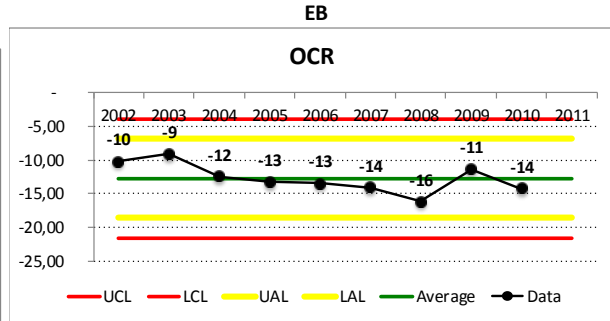
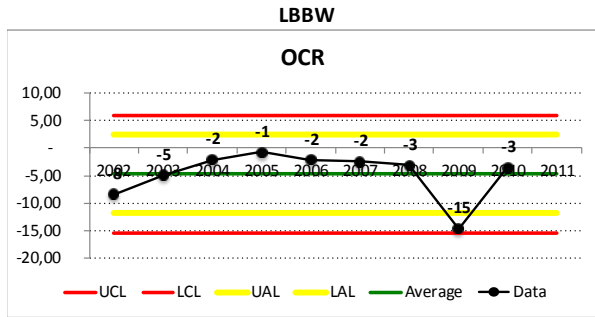






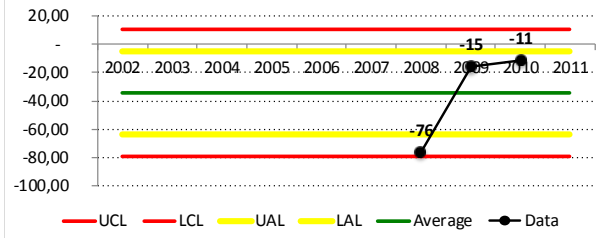




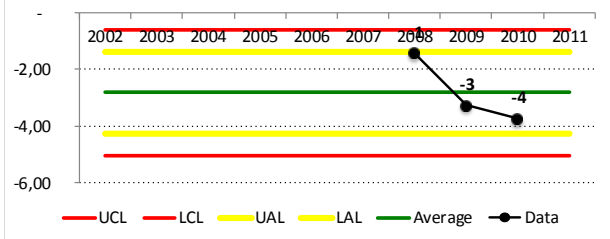


ERB

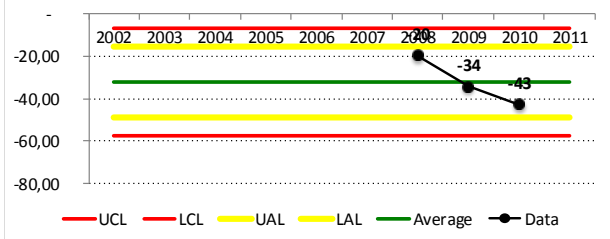
OCR



MVA



KV



Appendix 3: Spearman's Rank Correlation of Efficiency terms with efficiency control variables and country variables

Total				Big			
	Spearman's rank corr. coefficient (rho)	z-score	two-tailed p-value		Spearman's rank corr. coefficient (rho)	z-score	two- tailed p- value
Tefic - OCR	0,09461848	1,01025	0,3124	Tefic - OCR	-0,32234432	-1,64364	0,1003
Tefic - KV	-0,18719325	-1,99868	0,0456	Tefic - KV	0,17216117	0,877853	0,38
Tefic - MVA	-0,17819774	-1,90263	0,0571	Tefic - MVA	0,21733822	1,10821	0,2678
Tefic - TNiE	-0,20291959	-2,16659	0,0303	Tefic - TNiE	0,60805861	3,1005	0,0019
Tefic - PE	-0,21029748	-2,24536	0,0247	Tefic - PE	0,56471306	2,87948	0,004
Tefic - FA	-0,22331729	-2,38438	0,0171	Tefic - FA	0,94627595	4,82508	0
Tefic - Inf	0,05695562	0,606431	0,5454	Tefic - Inf	-0,14956063	-0,75631	0,4565
Tefic - GDP	0,17010819	1,83502	0,0691	Tefic - GDP	-0,11152306	- 0,561116	0,5797
Tefic - Year	0,16218066	1,74713	0,0833	Tefic - Year	-0,11643868	- 0,586181	0,563

Medium				Small			
	Spearman's rank correlation coefficient (rho)	z-score	two- tailed p- value		Spearman's rank correlation coefficient (rho)	z-score	two- tailed p- value
Tefic - OCR	-0,0386679	-0,259392	0,7953	Tefic - OCR	0,05696459	0,364751	0,7153
Tefic - KV	0,19629972	1,31682	0,1879	Tefic - KV	-0,26213435	-1,67848	0,0933
Tefic - MVA	0,18125193	1,21587	0,224	Tefic - MVA	-0,25694838	-1,64527	0,0999
Tefic - TNiE	0,42263336	2,83511	0,0046	Tefic - TNiE	0,60716311	3,88774	0,0001
Tefic - PE	0,36416898	2,44292	0,0146	Tefic - PE	0,67004295	4,29037	0
Tefic - FA	0,79660808	5,34381	0	Tefic - FA	0,76355239	4,88912	0
Tefic - Inf	-0,24769212	-1,69585	0,097	Tefic - Inf	-0,01710042	- 0,108168	0,9144
Tefic - GDP	-0,11110044	-0,741548	0,4623	Tefic - GDP	0,28737742	1,89758	0,065
Tefic - Year	-0,04933655	-0,327661	0,7447	Tefic - Year	0,34418364	2,31846	0,0256

Appendix 4: Evolution of Efficiency terms in time and evidence of smallest values per year

Banks	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	Average per Group
CS		0,997875	0,997931	0,99786	0,997383			0,99828	0,998455		
ACSOB	0,997745		0,997805	0,995056	0,997133	0,997043		0,777354	0,991527	0,994928	
KB	0,996496	0,995929	0,995689	0,992014	0,993818	0,990427	0,972855	0,995509	0,988072	0,99599	
UB			0,656439	0,6028	0,461829						
Mean_B	0,99712	0,996902	0,911966	0,896932	0,862541	0,993735	0,972855	0,923714	0,992684	0,995459	0,9543907
CMSS	0,582601	0,613935	0,594918	0,56164	0,558128	0,517597	0,447808	0,486091			
HB			0,4394	0,401741	0,397437	0,398551	0,399544	0,518613	0,4888		
GE							0,763943	0,989001	0,981091		
SSCS	0,491119	0,485411	0,487021	0,469664	0,463156	0,455321	0,471075	0,436928	0,450298	0,452149	
RSS					0,422455	0,421983	0,414268	0,401576	0,411687		
CZRB	0,438285		0,444467	0,468861	0,451289	0,430707	0,45802	0,446545	0,438173		
Mean_M	0,504002	0,549673	0,491451	0,475476	0,458493	0,444832	0,492443	0,546459	0,55401	0,452149	0,4968988
VB					0,419466	0,43773	0,482969	0,512408	0,493911		
MPSS				0,517172	0,506922	0,497337	0,485264	0,466704	0,470002		
PPF				0,386886	0,420794	0,44322	0,368927	0,414048	0,459027		
J&T	0,434859	0,40786	0,37929	0,392138	0,423269	0,452706	0,508866	0,488483	0,514657		
LBBW	0,406043	0,360034	0,451387	0,592897	0,535208	0,572582	0,599422	0,621624	0,576157		
EB	0,290791	0,304854	0,284857	0,280136	0,277065	0,281841	0,315592	0,333114	0,331273		
ERB							0,087137	0,360469	0,370307		
Mean_S	0,377231	0,357583	0,371845	0,433846	0,430454	0,447569	0,406882	0,456693	0,459333		0,4157151
MEAN_T	0,579742	0,595128	0,611746	0,589143	0,555023	0,530542	0,483978	0,577922	0,597562	0,814356	0,5935142

The more intense red the smallest is the estimate in comparison with the whole period per bank