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Productivity in the Financial Services Sector

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PRODUCTIVITY IN THE FINANCIAL SERVICES SECTOR

Edited by
Morten Balling, Ernest Gnan, Frank Lierman and Jean-Pierre Schoder

Chapters by:
Jacob A. Bikker
Barbara Casu and Claudia Girardone
Mohamed E Chaffai and Michel Dietsch
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1. Introduction

Morten Balling, Ernest Gnan, Frank Lierman and Jean-Pierre Schoder

On 11-12 November 2008, SUERF and Banque centrale du Luxembourg organized a conference on *Productivity in the Financial Services Sector* on the occasion of the tenth anniversary of the Banque centrale du Luxembourg. The conference addressed three main themes: *first*, stylized facts on banks' productivity developments and the measurement of productivity; *second*, sources of productivity in banking; and *third*, the possible repercussions and consequences of the financial crisis on financial institutions' future productivity development. These three topics are taken up from various angles in the chapters of the present volume, which represent a selection of the papers presented at the conference.

Governor *Yves Mersch*, Banque centrale du Luxembourg, organised his opening remarks (chapter 2) around three inter-related questions: 1) How should we measure the level of production in financial services? 2) What do measures of financial sector productivity tell us about sources of productivity growth? 3) Which aspects of productivity in financial services have been given new urgency by recent events?

One measure of output is provided by national accounts methodology. The value of depositor services is reflected in the difference between a risk-free reference rate and an average depositor rate while the value of borrower services is reflected in the difference between the average loan rate and the reference rate. It is, however, an open question how to determine the appropriate reference rate. Another open question is how to measure prices in financial services. Turning to productivity in the financial sector existing measures are related to economies of scale and economies of scope. In addition it is common to link the efficiency of individual banks to environmental variables, the quality of management, wage dispersion or information technology investment. The Third question concerns the priorities in the study of productivity in financial services. Some commentators have recently observed that while some banks are 'too big to fail' others may be 'too big to save'. It is, however, not clear that there is a trade-off between scale economies and financial stability. Choice of reference rates should be made with due regard to both the risk characteristics of a bank's loan portfolio and the degree of output diversification. Finally, the Governor raised the question of how far our productivity measures will be distorted by asset price bubbles and bursting of such bubbles.

Chapter 3, "Do Mergers Improve Bank Productivity and Performance" is the keynote speech by *Phil Molyneux,* Bangor University, Wales. The paper gives an extensive overview of the empirical literature on the effects of consolidation in the financial sector. Up to the summer of 2007, the global financial system experienced a strong consolidation trend. Deregulation allowed banks to enter new geographical markets and product areas, and technological advances revolutionized back-office processing, front-office delivery systems and payments systems. These forces encouraged growth in M&A activity in the financial sector but it is unclear whether M&A activity as such has improved performance. Studies of data from before the year 2000 seem to conclude that mergers in the banking system were not motivated (on average) by performance improvement. Studies from 2000 onwards show a different picture. In most recent studies bank mergers seem to have resulted in widespread efficiency gains and value enhancement for stockholders.

Some researchers have referred to managerial motives behind consolidation transactions at the expense of shareholders. Roll's hubris hypothesis, which argues that over-confident managers systematically overestimate the benefits of acquisitions and therefore results in them overbidding for targets is also mentioned. So is managerial empire building and the observation that there is a positive correlation between asset size and CEO compensation.

Evidence from studies of European bank mergers generally finds that poor performing banks are typically acquired. Evidence on the impact of consolidation on small business lending is mixed. By the year 2000, all major financial systems had removed the major regulatory product barriers in the financial services sector. The deregulation has resulted in diversification of bank activities. Studies of the impact of this development on bank performance give, however, a mixed picture. A limited number of recent studies have examined systemic risk issues in European banking. Some find that banking sector concentration increases systemic risk. The author concludes his paper by observing that we now know that safety net subsidies have been huge, and that systemic risks have brought major economies to a near standstill. He expects that after the crises many banking systems will be re-organised via forced consolidation of their banks.

Chapter 4, "Sizing up performance measures in the financial services sector" by *Jacob A. Bikker*, De Nederlandsche Bank, provides a comprehensive overview and evaluation of various measures of banking performance. Since efficiency and competition cannot be observed directly, various indirect measures – be it simple indicators, combined indicators or indicators based on complex models – are used by both academia and practitioners. The paper shows that various indicators differ considerably in their results. The author compares 20 methods to measure banking competition and efficiency for 46 countries, covering 90% of world GDP, and explore their mutual relationships. Apart from important methodological and statistical findings, the author also comes up with economically interesting findings: The received wisdom, that 'Anglo-Saxon' banks are relatively more competitive compared to *e.g.* those in 'continental and Southern Europe' is rejected. Instead, the author finds that German and French banks are highly efficient in an environment of high competition, at low cost and with low profits. While banks in some Southern European countries live up to their low-efficiency image, banks in Italy – and to some extent in Spain – do not fit this picture. In the USA, UK and Ireland cost inefficiencies, interest margins and profits are found to be exceptionally high despite indications of strong competition. This may also be due to a higher proportion of products such as investment counselling where competition is less fierce than in deposit-taking and lending. Finally, as expected, a correlation between bank efficiency and economic development is confirmed: bank efficiency in developed industrial countries is found to be superior compared to emerging economies, with Central and Eastern European banks coming out as least efficient.

In chapter 5, *Marc Niederkorn*, Co-Leader European Lean Banking Initiative, McKinsey & Company, noted that a major productivity improvement will be required from the sector in the coming years. Given scarce capital and liquidity, banks will need to reduce their cost structure by 25 to 30% (at constant volumes) to keep generating a reasonable return on equity. Vast productivity improvements in banks are possible (at current technology) as current productivity is weak according to standard industrial indicators such as Overall Process Effectiveness (OPE) is weak. However, banks' track record of actually improving productivity is very disappointing. Banks' productivity improvements have been hampered by 5 fundamental misconceptions: First, the role of IT investment is over-emphasized, while most of banks' inefficiencies are rather low-tech – production flows are inefficient, customer demand patterns are poorly understood and capacity is not sufficiently adjusted. Second, it is not true that cutting costs and streamlining processes must automatically be at the expense of product quality. Third, the role of economies of scale is vastly exaggerated – many European banks have already reached a critical size. Fourth, outsourcing and offshoring is not the solution – for typical European banks, there is very little to gain from such measures. Finally, cross-border consolidation is no miracle cure – given different cultures, consumer behaviour and regulatory nuances, the already low potential from economies of scale is further diminished in such endeavors. If these pitfalls are avoided, emerging evidence shows that well-established industrial productivity improvement techniques can be successfully applied also to financial services. This insight opens a new strategic playing field for early adopters.

Chapter 6, "Integration and efficiency in EU banking markets" by *Barbara Casu*, Cass Business School, City University, and *Claudia Girardone,* University of

Essex, evaluates the recent dynamics of bank cost efficiency in the euro area by means of Data Envelopment Analysis (DEA). It is a commonly held belief among EU regulators that a well integrated financial system is necessary to increase the efficiency of the euro area economy. In overall calculations of potential gains from European integration in the financial services it is often assumed that banks in different countries will become equally efficient with the removal of cross-border restrictions. The authors use a sample of commercial and savings banks operating in the EU-15 area to study the possible convergence of efficiency levels towards an EU average. DEA measures of efficiency are based on estimates of the degree to which the unit under analysis could have used less input for its output levels. They find evidence of convergence of efficiency but at the same time the potential gains brought about by increased integration seem to have been offset by a decrease in overall efficiency levels.

Chapter 7 is "Bank output measurement in the euro area – a modified approach" by *Antonio Colangelo*, European Central Bank, and *Robert Inklaar*, University of Groningen. In the paper, the authors argue that the estimation method currently used to measuring bank output by comparing bank interest rates to a reference rate should be changed to take into account the risk characteristics of loans and deposits. The aim is to improve the estimates of interest margins applied by banks on loans and deposits to better reflect the services they provide. The authors introduce adjustments for term premia and default risk premia. They apply their proposed approach to the euro area, estimating monthly bank output from January 2003 to December 2007.

Compared to the current approach, the proposed method has conceptual advantages and is more appealing since it focuses on the banking services provided. The proposed method would improve the comparability of national results, as it removes the structural effects due to different terms and risks.

In chapter 8, "Bank productivity and efficiency in Luxembourg: Malmquist indices from a parametric output distance function", *Paolo Guarda* and *Abdelaziz Rouabah*, Banque centrale du Luxembourg, decompose productivity increases among Luxembourg banks into technical change (shifts in the best-practice frontier) and efficiency gains (changes in the distance of the average bank from the best-practice frontier). Using quarterly data for the period 1994 to 2007, they find that productivity among Luxembourg banks grew by about 1% per quarter on average. Larger banks exhibited above-average productivity growth. Most of the productivity growth stems from efficiency gains rather than technical progress. In other words, few individual banks occasionally shift the efficient frontier outwards, while the bulk of banks merely follow, improving their productivity by reducing inefficiency as compared to the top performers.

Chapter 9 is "Internal wage structure and bank performance" by *Charles-Henri Di Maria*, STATEC, and *Sandy Metzler*, Université Louis Pasteur Strasbourg. The two authors try to assess to what extent wage dispersion inside banks may affect their efficiency through a possible wage incentive scheme. They apply data from the financial statements of Luxembourgish banks and a structure of earnings survey conducted by the National Statistical Institute. Wage dispersion is measured by the Gini index. Efficiency is measured by data envelopment analysis. They find two non linear relationships between efficiency and wage dispersion. Efficiency seems to increase with some inequality but to decrease when inequality reaches a certain level. It is not an easy task to determine the optimal level of wage disparities in a bank.

In chapter 10, "Impact of ICT and Human Skills on the European Financial Intermediation Sector", *Georg Erber*, DIW Berlin and *Reinhard Madlener*, E.ON Energy Research Center, Aachen investigate the impact of ICT- and non-ICT capital and of labour at different skill levels on productivity and employment in the financial intermediation sector of twelve EU member countries plus the US and Japan. Compared to all other industries after 1995, the banking industry exhibits the highest proportion of IT investment. They find that efficiency and productivity depend much more on human capital than on physical capital. This implies that in knowledge-economies driven by rapid technical change the ability to empower the work force by appropriate investments in training and skill-formation is much more important than investment in information and communications technology. Computers or broadband internet terminal devices are general purpose instruments, but the intelligence of their users determines the real benefits obtained in the end.

Chapter 11 is "Are There Any EU Membership-Related Efficiency Enhancements in Banking Sectors of the New EU Member States Detectable?" by *Marko Košak* and *Jelena Zoric*, University of Ljubljana, Slovenia. The authors study the potential effects of EU membership for banking efficiency in new EU member countries. During the process of EU accession, banking sectors in Eastern and Central Europe have undergone a remarkable transformation. The authors estimate a translog cost frontier function by using data from eight CEE countries. Different models lead to similar results with respect to the coefficient estimates. Efficiency measures for the pre- and post-EU accession periods are compared. Contrary to their expectations, the authors do not find strong evidence to support the hypothesis that EU-accession would facilitate efficiency improvements.

In chapter 12, "How Output Diversification Affects Bank Efficiency and Risk: an intra-EU Comparative Study", *Nikolaos Papanikolaou*, Athens University of Economics and Business, looks at the diversification by banks away from traditional financial intermediation into non-interest business and how this shift affects their efficiency and risk-taking behaviour. He uses data from the EU-27 to test whether the shift towards new business has affected the Union's banking systems uniformly. Comparisons are made by constructing a best-practice efficiency frontier. The mean cost efficiency scores for the traditional EU-15 countries seem on average to be better than for the CEE countries plus Cyprus and Malta. It seems that output diversification does not change the risk-taking behaviour of banks.

Chapter 13, "The effect of the environment on profit efficiency of bank branches" by *Mohamed E. Chaffai*, Université de Sfax and *Michel Dietsch*, Université de Strasbourg deals with the environment effect on profit efficiency at the branch level. The authors use a methodology with a parametric directional distance function. Data come from the branch network of a large French banking group. For each branch, information is available about the average wealth of the community's inhabitants, socio-demographical characteristics, unemployment rate, the housing market etc. The analysis concerns the impact of these environmental variables on branch efficiency and profitability. The results show that, at the branch level, the environment is an important source of technical inefficiency.

Chapter 14, "Efficiency and productivity of Russian banks: distinguishing heterogeneity and performance" by *Karligash Kenjegalieva* and *Tom Weyman-Jones*, Loughborough University, applies panel data econometrics for efficiency measurement and productivity decomposition to the Russian banking system. The focus is on comparative analysis of the performance of Russian banks from financial intermediation, production and profit generating perspectives. The authors use parametric stochastic frontier techniques on a panel of over 900 commercial banks. In general, the results suggest that during the period 1997 to 2005 Russian banks experienced productivity decline in financial intermediation and banking service production. However, the profit generating activities of the banks were productive throughout the analysed time span. The main driver of banking productivity seems to be the returns to scale profile. Banks engaged in retail banking are more profit efficient than those which offer only business banking services. Larger banks seem to lag behind and deposit insurance seems to have a positive effect on banking system performance.

Chapter 15, "Best practices as a business strategy for improving productivity: Summary of a panel discussion" is based on contributions by *Marco Colagiovanni*, Dexia Bank Belgium, *Martin Czurda*, Raiffeisen Zentralbank, Vienna and *Roger H. Hartmann*, Luxembourg Bankers' Association. Mr. Colagiovanni gives an overview of the so-called 'lean methodology' used by Dexia. It is very important to focus on what the clients want and what the competitors are able to deliver. Analysis of waste leads to focus on possible cost reductions. In most cases, waste occurs mostly between departments, not inside the individual department.

So, department managers must work together better. The improvement potential is enormous. Waiting time often represents 70-90% of total processing time. The follow-up of performance is very important. People' positive perception of the importance of process is essential to ensure support. Mr. Czurda presents an overview of banking developments in Central and Eastern European countries. UniCredit, Raiffeisen, Erstebank, Societé Generale, KBC, Intesa, Swedbank and Commerzbank have all invested in bank entities in the region. They have taken over existing banks and there have also been greenfield investments. The return on equity of these investments has in most cases been good. A particularly interesting slide shows the market share increase potential in CEE countries. Mr. Hartmann focuses on best practices in wealth management. The dramatic increase in the complexity of financial products has implications for the cost level. Approximately 70% of costs are salary. Qualified people are expensive. Pooling of resources is an effective approach. The cost-income ratio is expected to increase. Something has to be done. Outsourcing of back-office functions has already been carried out to a considerable extent.

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Returning to the three themes mentioned at the outset, the conference yielded some interesting results and raised many issues for further research.

As regards *theme 1*, the papers presented overall suggest that financial integration in Europe has brought some, perhaps limited, convergence of bank efficiency among countries but on average productivity improvement has been weak. Various interesting attempts to capture banks' output were presented, but the various performance and efficiency measures yield different results. Linked to the difficulty of measuring the value of financial institutions' services, it remains far from clear what the 'fair value' of a bank should be. This problem may also in part explain the very sharp ups and downs of bank stocks recently.

Concerning *theme 2*, sources of productivity in financial services, several potentially important factors were mentioned: investments in ICT, investments in human resources, the quality of managers and remuneration policy, process effectiveness, mergers and acquisitions and economies of scale, privatizations, risk diversification versus regional and/or product specialisation, and risk-taking. Yet, no unambiguous picture emerged on which of these factors are most important.

Regarding *theme 3*, the financial crisis may have far-reaching implications on our view of financial innovation and efficiency, on how to measure productivity appropriately as well as on the future development of financial institutions' productivity.

First, the quest for productivity and profitability may under certain circumstances compromise the quality of banks' services (such as, *e.g.* credit assessments and risk monitoring) and as a consequence put the stability of banks and the financial system at risk. As the recent crisis and its underlying causes suggest, there may at times be trade-offs between innovation and financial stability. If financial supervision and risk management do not keep up with financial innovation, the social value of such innovation may not be positive at all times. Financial innovation may also have blurred signals on banks' financial and risk positions, and thus have misled bank shareholders, clients and supervisors in their assessment of banks' business models and conduct of business.

Second, the crisis might also affect banks' future performance: Increased government interference and stricter surveillance and capital adequacy rules might curb banks' profitability and efficiency, as measured by traditional performance indicators. However, the conventional measures of performance as presented and discussed at the conference – however varied and multifaceted they may be in trying to measure efficiency (*i.e.* the avoidance of unnecessary costs in the production process) and competition (the avoidance of inappropriately high profits) – basically seem to have a short-term focus. A longer-term perspective would also consider *e.g.* the financial institutions' solvency and the safety of deposits, as well as their stability and continued performance in periods of severe stress. Such extensions to the concept of 'performance' should certainly be explored more deeply in the light of the current crisis. In particular, bank efficiency should be considered by supervisors with a view to its influence on risk behaviour.

The current debate on regulatory reform in response to the crisis also addresses the need for closer international coordination among supervisory regimes. Tighter regulatory coordination may, on the one hand, close regulatory loopholes, thus curbing banks' profit opportunities, at least in the short run. On the other hand, international harmonization of regulatory rules may generate considerable cost savings for internationally active financial institutions. By contributing to financial market integration it could also stiffen competition and in this way improve efficiency.

A related issue is how the crisis will affect the size of banks in the future. Will consolidation in the sector ultimately result in fewer and bigger banks? Or will governments' and regulators' bad experience with institutions which are 'too big to fail' create pressure towards more and smaller institutions? The outcome may in turn have implications for competition and thus, ultimately, on future innovation, efficiency and productivity developments.

Finally, in the coming months and years the issue of exit strategies from state intervention will have to be solved. In particular, how long should partial or full nationalisations of troubled banks last? Historical experiences vary, ranging from rather rapid re-privatisations in some cases to continued strong government influence lasting decades. How can banks' increased reliance on government assistance be scaled back and market-based incentives for productivity-enhancing strategies be restored, given the massive moral hazard created by the – unavoidable – government bailouts of banks?

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In conclusion, the conference demonstrated that various disciplines – business administration, management, organisation and economics – as well as different professional perspectives – those of academia, practitioners and of policy makers – need to be combined to do full justice to the complexity of the subject at hand. SUERF's triple constituency and multiple-discipline approach again proved particularly suitable to approaching such a far-reaching topic.

The Editors
June 2009

2. Opening Remarks

Yves Mersch

It is my pleasure to welcome you on behalf of the Banque centrale du Luxembourg. You probably know that ours is a relatively young institution and that we are hosting this conference as part of the celebrations for our 10th anniversary. You are here to discuss productivity in financial services, and you are probably aware that tomorrow evening (following the end of this conference) there will be a High-Level Panel where three senior central bankers will provide their perspective on the challenges for monetary policy represented by financial sector growth and productivity. We hope this will give you a chance to see how some of the issues raised in your research are implemented in practice and also how new issues appear in the policy context requiring further study. In any case, you are warmly invited and I hope at least some of you will be able to stay with us for this interesting discussion.

The subject today is productivity in the financial sector, and as a central banker, I do not need to remind you that this sector is going through what are sometimes called 'interesting times'. During the recent financial turmoil, central banks responded to short-term tensions and contributed to stabilising conditions for borrowers and lenders. The focus until now has been on liquidity and financial stability issues; however, as light appears at the end of the tunnel, policymakers are asking themselves how to avoid repeating the same mistakes next time. An overhaul of the regulatory framework seems inevitable and in this context, it is crucial to understand the structural issues in the sector behind the short-term volatility. This is why I believe that careful study of financial sector productivity is required to improve our understanding of the current situation and to shape our long-term response to recent events.

I will organise my remarks around three inter-related questions: First, to measure productivity, how should we measure the level of production in financial services? Second, what do existing measures of financial sector productivity tell us about its sources of productivity growth? Finally, I will attempt to identify which aspects of productivity in financial services have been given new urgency by recent events.

Let me begin with the measurement of financial services output. Not long ago, national accounts methodology underwent a significant improvement in evaluating and allocating financial services indirectly measured (FISIM). The new methodology is based on the observation that depositors are usually paid an interest flow that is below the risk-free reference rate. The difference represents the value of depositor services produced by banks, in the form of safekeeping, bookkeeping and payment services. On the other hand, borrowers almost always pay an interest flow above the risk-free reference rate. In this case, the difference represents the value of borrower services provided by banks in the form of credit rating and monitoring. Using a reference rate to split banks' interest margin into depositor and borrower services makes it possible to allocate the consumption of these services to households and firms, thus distinguishing between financial services destined for intermediate and for final consumption. For Luxembourg in particular, this change to national accounts methodology was important because our financial services industry primarily serves the export market, so the previous practice of allocating all such production to intermediate consumption by a fictitious sector was particularly implausible.

While national accounts methodology has been much improved by this change, some open questions still remain. In particular, what is the appropriate reference rate? For the average depositor, it may be true that something close to the risk-free rate could be earned by forgoing the services attached to a bank account and instead investing in the money market. However, for the average borrower it is not reasonable to assume that funds would be available at the risk-free rate by issuing securities instead of approaching a bank for a loan. Term-mismatch between savers and borrowers and informational asymmetries explain why the financial intermediation services provided by banks are so important for the operation of market economies. This suggests that to measure borrower services accurately the appropriate reference rate must take account of the term-structure and the risk profile of the resulting bank assets. I am glad to see from the program that several papers presented in this conference will address these issues.

Another open question is how to measure prices in financial services. Value added in the financial intermediation has grown faster than real GDP in the euro area, but it has retained a constant share in nominal terms. This suggests that prices have been rising more slowly in this part of the economy. In Luxembourg we could be tempted to congratulate ourselves for specialising in an industry with above average real growth and below average price inflation. But is this really the case or is it an artefact of how prices are measured in financial intermediation? When banks double the value of the assets and liabilities on their balance sheet, this does not necessarily double the number of transactions, or the amount of labour or physical capital required to produce the necessary services. This observation seems to undermine the justification for deflating asset values using a general price index such as the GDP deflator or the consumer price index.

Furthermore, the recent fall in asset prices and the de-leveraging process under way may lead to some surprising results in the breakdown of financial services into prices and quantities.

Let me turn to my second set of remarks, concerning existing measures of productivity in the financial sector and what they tell us about its sources. Perhaps the most natural starting point is the measurement of scale economies, an issue on which academic researchers have long provided advice for competition policy. Empirical evidence on returns to scale in the banking industry has sometimes suggested that larger institutions benefit from greater cost efficiency. However, studies of mergers and acquisitions have often failed to find such improvements. I think it is important to improve methods in this area for at least two reasons. First, increasing European financial market integration is likely to raise the size of the average bank. Central banks often repeat that the European financial services industry is excessively fragmented. Increasing integration should allow a more efficient provision of financial services, improving the allocation of capital to investments with better risk-return profiles and therefore raising the potential for economic growth. Second, the recent depressed value of financial equity and public intervention in the banking sector to rescue distressed institutions will probably accelerate the process of mergers and acquisitions as the outlook recovers. Thus the existence and extent of scale economies remain timely questions for research and policy.

Scale economies are only one source of productivity growth. What used to be called *scope* economies are improvements in efficiency obtained by altering the mix of outputs or the mix of inputs. In academic research, these have proven even more difficult to measure than scale economies. However, I would encourage you to think about these issues in light of recent events. The demise of the investment bank suggests a return to universal banking, with large groups taking over specialised financial institutions. Such a development may be motivated by a need to improve risk management, but it could also bring benefits in terms of an improved mix of different financial outputs that are jointly produced.

Finally, an additional source of productivity growth is efficiency change, meaning the extent to which individual banks move towards (or away from) the best practice frontier. Again, looking at the conference programme, I notice a couple of papers that ask whether past trends towards deregulation or the creation of a single market in Europe have encouraged convergence towards a best-practice frontier. Unfortunately, a common result in the literature is that there is convergence towards *average* efficiency levels rather than convergence towards the *best* efficiency levels. This suggests that some isolated financial institutions may be pushing the frontier forward while the majority are falling steadily behind (a failure of the catching-up hypothesis). It is hard to interpret this result: is it good news because it means that technology is improving rapidly? Or is it a sign that even banks with low efficiency can survive, meaning that there is little incentive to adopt innovations? One may speculate that the answers depend on how one defines the best-practice frontier and whether it is valid to assume that the same technology is available to all institutions. It is common to link the efficiency of individual banks to environmental variables, the quality of management, wage dispersion, or information technology investment. Such an approach may help to identify unrealistic assumptions concerning the availability of a common technology.

I have come to the third part of my remarks. Following the recent financial turmoil, what are the priorities in the study of productivity in financial services? I have already mentioned that the recent wave of restructuring is likely to increase the size of the average bank. As I have said, this means we need better tools to measure not only scale economies but also scope economies, as activities that were once performed by separate institutions are brought under a single roof. On the issue of optimal size, public interventions have prompted some recent commentators to observe that while some banks are 'too big to fail' others may be 'too big to save'. It is not clear that there is such a trade-off between scale economies and financial stability. Rather, the 'too big to fail' label stresses the need for better international co-operation in regulation and supervision, an objective that should by now be familiar but that has taken on greater urgency as the international links in the financial industry become more apparent.

Another aspect of financial productivity that merits closer scrutiny is the treatment of *risk*. I am not going to add to the discussion of 'black swans' and the impact of rare events on Value-at-Risk models used by traders (and regulators). Instead, I am referring to the more 'mundane' issues raised in my previous remarks. In terms of measuring bank output, interest flows usually include a risk premium that will generally be more important when measuring borrower services produced by a bank. Therefore, the appropriate reference rates should be chosen to more closely match the risk characteristics of a bank's loan portfolio. Failure to allow for risk will lead to an overstatement of bank output that will distort productivity measures. It is therefore important to consider banks' risk when studying their efficiency or productivity and I am pleased to see that several papers on the conference programme address these issues.

Closely related to banks' risk profile is their degree of output diversification, which is likely to increase as specialised financial institutions seek safety in larger and more diversified groups. In principle, diversification lowers risk, but it may also lead to cost savings when jointly producing several outputs. Greater output diversification is a likely concomitant of the increase in average bank size that will accompany consolidation in the banking sector. By now, academic research generally recognises that banks must be modelled as multi-output firms, but more work is needed on the measurement of the costs and benefits of joint production.

Finally, on the priorities for research emerging from the financial turmoil, I would like to leave you with an open question: The bursting of asset price bubbles is likely to lead to a decline in balance sheet values and a fall in productivity. Is this a problem of measuring prices or measuring productivity? I realise that this is a very difficult question as even central bankers have a hard time distinguishing bubbles from the fundamental level of prices. However, recent events have focussed our attention on the real consequences of assuming that asset prices are always at equilibrium. If we are going to discuss productivity in financial services, we need some indication of how far our measures will be distorted by asset price bubbles.

In conclusion, I am pleased to see you here in Luxembourg, where the financial services industry is such an important part of our national economy. It only remains to me to wish you a fruitful discussion and an enjoyable visit to our country.

3. Do Mergers Improve Bank Productivity and Performance?[1]

Phil Molyneux

Abstract

This paper presents an overview of the recent bank M&A literature. Typically, the general consensus from the bank M&A literature in the 1990s concluded that mergers were generally performance destroying and that the motives for such deals must therefore be motivated by managerial rather than performance objectives. These stylized facts relating to the motives for M&A in banking still prevail in some of the more recent reviews of the literature. However, a different picture emerges if we consider the empirical literature from 2000 onwards! In general, recent studies provides more support to the view that North American bank mergers are (or can be) efficiency improving although the event-study literature (as before) presents a mixed picture. However, there is incontrovertible evidence that European bank deals have resulted in widespread efficiency gains and value enhancement for stockholders.

3.1. Introduction

Up until the widespread crises experienced in global banking markets since the summer of 2007, over the previous twenty years or so one probably the major features impacting on global financial systems has been the consolidation trend. This has been a consequence of deregulation and innovation (technological and financial). Deregulation has allowed banks to enter new geographical markets and product areas. Technological advances have revolutionized both back-office processing, front-office delivery systems and payments systems (Berger (2003)). Financial innovations, characterized by the widespread use of new financial engineering and risk management tools coupled with the significant involvement of financial institutions in new and broader derivatives and other markets (asset-backed securities, credit default swaps and so on) have also been another factor changing the financial landscape (Frame and White (2004) and DeYoung (2007)).

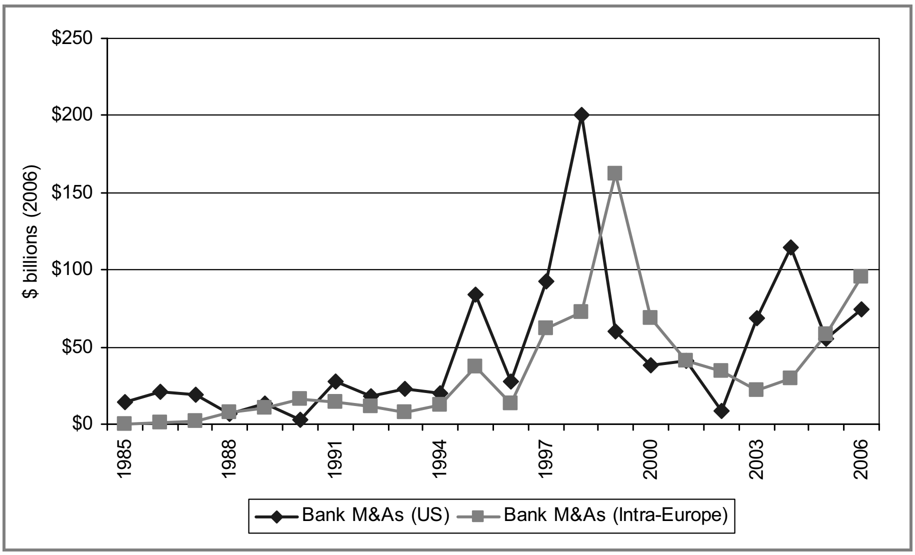
These forces promoting the consolidation trend have been well documented in previous reviews of the consolidation literature (Berger, Demsetz and Strahan

[1] A substantial part of this talk came from an early version of a paper completed by Bob DeYoung (University of Kansas), Doug Evanoff (Chicago Federal Reserve Bank) and myself that reviews the financial sector M&A literature. The paper is forthcoming in the Journal of Financial Services Research, December 2009.

(1999), Group of Ten (2001), Amel, Barnes, Panetta and Salleo (2004) and Jones and Critchfield, (2005)). However, despite general agreement on the broad forces that have encouraged growth in M&A activity in the financial sector, the aforementioned reviews provide little consensus as to whether banks and other financial firms in general benefit from M&A activity in terms of improved performance. In addition, they also offer a varying picture on other dimensions of the consolidation process such as the impact of M&As on risk, access to finance, the features of targets and so on. These generally mixed findings, however, could be a consequence, not only of the different methodological approaches taken, but also because the literature under review in the aforementioned studies typically examines bank (and other financial sector) M&A activity at early stages in the consolidation process, mainly from the mid-1980s to the mid-1990s. Most of the earlier literature does not take into account the record peaks of M&A activity that occurred in the US and Europe in 1998 and 1999, respectively, as well as more recent trends as illustrated in figure 1.

The aim of this paper, therefore, is to provide an update of the previous reviews on financial sector consolidation, focusing primarily on the post-2000 literature.

Figure 1: Bank M&A in Europe and the US 1995-2006



Source: Thanks to Gayle DeLong for providing data for figure.

3.2. CONSOLIDATION AND PERFORMANCE

Gains from mergers emanate from either efficiency improvements or market power (Berger, Demsetz and Strahan (1999)) and there is a substantial literature that has sought to directly or indirectly investigate these relationships. The direct test seeks to establish whether there are cost or/and profit improvements post-merger. Studies use either frontier techniques or simple accounting ratios to gauge efficiency changes comparing pre- and post-merger performance. The consensus view from studies that (mainly) examined bank M&A during the 1980's up to the mid-1990s was that cost and (although less studied) profit efficiency improvements resulting from mergers tended to be elusive (see the reviews of Berger, Demsetz and Strahan (1999); Dymski (1999); Group of Ten (2001)). Another major strand of the literature uses the 'event-study' methodology to gauge market reactions to M&A announcements. The event study approach seeks to evaluate stockholder reactions to merger announcements. The combined effects of the abnormal returns (measured as the difference between the actual stock price and that predicted by CAPM or a related market model) to bidders and targets around the announcement date reflect value creation or destruction for shareholders. This approach is regarded as an indirect measure because even if positive abnormal returns are generated it is not clear as to whether the positive shareholder reaction is due to perceived improvements in performance resulting from greater market power (higher prices) or improved efficiency. The consensus view that has emerged from the event studies that examine bank M&A in the 1980s and during the 1990's (Houston and Ryngaert (1994); Pilloff (1996); DeLong (2001)) is that while target shareholders tend to earn strong positive abnormal returns, bidder stockholders earn marginally negative returns – the combined abnormal returns being insignificant[2]. While the majority of this literature found that bank M&As do not create value for shareholders there were some exceptions (Brewer *et al.* (2000); Cybo-Ottone and Murgia (2000); and Houston, James and Ryngaert (2001)).

The general finding that mergers in the banking system were not motivated (on average) by performance improvement (whether efficiency, profits or shareholder wealth gains) directed researcher's attentions to various managerial motives – including objectives geared to such things as maximizing CEO remuneration, choosing a 'Quiet Life', managerial entrenchment and maximizing asset size as alternative explanations for the consolidation trend.

These stylized facts relating to the motives for M&A in banking still prevail in some of the more recent reviews of the literature. However, a different picture

[2] Although Kane (2000) notes that for bank mega-mergers in the US acquirer stockholders earn positive abnormal returns the larger the target (and for in-market deals) and he argues that this may be a consequence of access to greater market power and/or regulatory subsidies. We discuss this in more detail in Section 5 of this paper.

emerges if we consider studies from 2000 onwards! In general, the recent literature provides more support to the view that North American bank mergers are (or can be) efficiency improving although the event-study literature (as before) presents a mixed picture. However, there is incontrovertible evidence that European bank deals have resulted in widespread efficiency gains and value enhancement for stockholders. Kwan and Wilcox (2002), for instance, in their study of US bank mergers during the 1990s find evidence of significant cost reductions once specific merger accounting rules are taken into account. Cornett, McNutt, Tehranian (2006) find evidence of revenue efficiency improvements for large and focused (product and geographical) mergers and Knapp, Gart and Chaudhry (2006) also find that in the case of BHC mergers between 1987 and 1998, substantial profit gains appear up to five years post-merger (once adjustments are made for profits mean reversion). Hannan and Pilloff (2006) use a hazard function approach to examine the features of acquired banks between 1996 and 2003 and this shows that cost efficient banks tend to acquire their inefficient counterparts, and this finding is again suggestive of potential performance improvements.

Studies that examine bondholder/shareholder reactions to bank merger announcements tend to yield more conflicting findings[3]. Penas and Unal (2004) find evidence of bondholder gains and a lower cost of debt post merger, and Olson and Pagano (2005) also identify shareholder gains (related to pre-merger growth). DeLong and DeYoung (2007) also find positive abnormal returns relating to bank merger announcements although this effect dissipates quickly, they also find that the short-run market reactions (as well as long-run merger performance) tends to be related to the number of mergers that took place in years prior to the deal announcement. In contrast to the above performance/value enhancing evidence, Knapp, Gart and Becher's (2005) study of large bank deals between 1987 and 1998 finds strong evidence of negative returns to shareholders and a reduction in profits, credit quality and fee income post merger[4].

The recent studies on European bank mergers provides more compelling evidence of performance improvements both via efficiency gains or/and stockholder returns. Huizinga, Nelissen and Vander Vennet (2001) examined 53 European bank M&As between 1994 and 1998 and found evidence of cost efficiency improvements and positive (but relatively small) profit efficiency gains. Other pan-European studies find either efficiency or/and profit gains post merger (Diaz and Azorfa (2004); Campa and Hernando (2006); Altunbas and Ibáñez (2007);

3 Hagendorff, Collins and Keasey (2007) suggest that weak governance structures may be the explanation for the (supposed) negative abnormal returns to bank bidders in the US shareholder wealth studies.

4 Other event studies on US bank M&A include: Henock (2004) who finds that banks subject to takeover speculation yield significant returns to shareholders, while defensive deals destroy value; Gupta and Lalatendu (2007) who examine the influence of the relative size of bidders and targets and finding asymmetric effects on stockholder returns.

Fritsch (2007)). These studies also generally suggest that focused deals – those where banks have a similar strategic fit (Altunbas and Ibáñez (2007)) or bank-bank M&A (Diaz and Azorfa (2004)) tend to perform better in terms of efficiency and profits performance. Profits improvements can also take a while to appear (Díaz, García and Sanfilippo (2004); Campa and Hernando (2006)). In addition, the more general finding of De Guevara, Maudos and Perez's (2005) study of market power in EU banking (using the Lerner index) are also suggestive of increased efficiency resulting from the consolidation process (as market power has increased as a consequence of marginal costs falling faster than prices). In addition to the pan-European studies there is also a variety of individual country evidence that confirms performance improvements resulting from M&A. Positive profit effects are found by Carbó and Humphrey (2004) who use a variety of estimation approaches (translog, Fourier, and cubic spline cost functions) to predict scale-related cost effects from 22 mergers involving Spanish savings banks between 1986 and 2000. They find that post-merger that unit cost falls by 0.5% boosting returns by 4%. De Guevara and Maudos (2007) also finds that the cost efficiency of Spanish banks improved between 1986 and 2002 during a period of consolidation – again suggestive of potential efficiency gains from merger – although because marginal costs have been driven down faster than prices the Lerner index measure of market power increased. Koetter's (2005) study on German bank mergers during the 1990's finds that every second merger is a success in reducing cost efficiency (although the cost efficiency gains take seven years to materialize) and Ashton and Pham's (2007) analysis of 61 UK bank mergers between 1988 and 2004 also finds that these deals are on average efficiency improving and they appear to have little adverse pricing effects on retail deposit rates. In contrast to the above individual country studies that find direct (or are suggestive of) efficiency improvements resulting from the merger process, others, such as Carbó, Humphrey and Fernández (2003) find that mergers in the Spanish savings banks sector had no impact on efficiency, as savings bank costs rose at the same rate as the industry average over 1986 to 1998.

In addition to the aforementioned studies that examine the efficiency and accounting ratio performance resulting from consolidation, the more limited number of studies that examine shareholder wealth effects in European banking also present a general picture of positive value creation resulting from mergers. Cybo-Ottone and Murgia (2000) in their study of 54 relatively large European bank mergers (typically banks with assets in excess of $100 billion) between 1989 and 1997, found evidence of positive abnormal returns for in-country both bank/bank and diversifying bank/insurance deals (no significant effects for bank / securities or cross-border deals). Resti and Sciliano's (2001) event study analysis of Italian bank mergers between 1992 and 1997 also finds positive shareholder wealth effects. Beitel, Schiereck and Wahrenburg (2004) use a sample of 98 large

European bank mergers from between 1985 and 2000 to investigate the drivers of excess returns. Overall, the results indicate positive cumulative abnormal returns for combined bidder and target shareholder's over the study period. They also note that more than 60% of all transactions were value creating. Positive wealth effects are found to be greater for non-diversifying transactions, when acquirers have engaged in fewer M&A transactions and when the target exhibits a poor past stock performance. Campa and Hernando (2006) examine 244 European bank M&As between 1998 and 2002 and investigate both shareholder value effects as well as pre-and post merger profits and efficiency. They find evidence of positive abnormal returns to target shareholders with no significant influence on bidder's stock prices. (They also found evidence of significant improvements in target bank's performance beginning around two years after the transaction was completed. The return on equity of target banks' performance also increased by an average of 7%, and these also experienced efficiency improvements). Schmautzer (2006) also finds that target shareholders gains outweigh bidder losses in the case of cross-border deals involving European, US and other banks, particularly when relatively cost efficient banks are acquired.

Lepetit, Patry and Rous (2004) and Ekkayokkaya, Holmes and Paudyal (2007) both use event study approaches to examine bidder returns involving European bank M&A and they find that bank/non-bank deals result in positive abnormal returns, the latter finding that value enhancement was greater for pre-Euro (1999) transactions.

It can be seen that the evidence from the post-2000 literature on the features of European bank M&A (in contrast to the US literature) point to strong performance improvements – whether they be measured by efficiency, accounting profits or stock market return indicators.

3.3. MANAGERIAL MOTIVES FOR M&A

The previous section illustrates that evidence from the literature post-2000 suggests that compared to earlier studies there is stronger evidence (particularly from Europe) that mergers in the financial sector (mainly banking studies) tend, on average, to increase performance and shareholder value. The fact that many earlier merger studies found little evidence of performance improvements encouraged researchers to investigate alternative explanations for the consolidation phenomenon with a particular attention paid to managerial motives. Here the argument goes that managers engage in M&A in order to maximize their own utility at the expense of shareholders. Managers' utility may relate to growth if their pay and other benefits are linked to firm size. Similarly, managers' utility may also be related to size if they wish for a 'Quiet Life'. Larger firms may be able to exert greater market power and insulate themselves from various competitive pressures forcing them to improve efficiency/performance (Berger and Hannan (1998)). Another managerial explanation as to why mergers may destroy value is Roll's hubris hypothesis (Roll (1986)) which argues that over-confident managers systematically overestimate the benefits of an acquisition and therefore results in them over-bidding for targets leading to value destruction / no performance improvements.

Bliss and Rosen (2001) find that CEO compensation increases with changes in asset size due to mergers (or internal growth) for a sample of 32 billion-dollar US banks from 1986 to 1995. The aforementioned authors interpret the positive relationship between merger-related changes in firm size and compensation as evidence of managerial empire building and suggest that the increase in compensation occurs irrespective of value creation or productivity improvements. Anderson, Becher and Campbell (2004) examine mergers for a similar sample of banks and find that CEO compensation post-merger is positively related to the anticipated gains from merger (measured at the announcement date). They also note that other changes to CEO compensation packages are based on managerial productivity (as well as incentive restructuring). Rosen (2004) finds that where CEOs can expect to have large compensation increases from acquisition they tend to engage in merger programs and Hughes, Lang, Mester, Moon and Pagano (2003) notes that BHCs that have higher levels of managerial ownership tend to make performance destroying acquisitions. On perhaps a more positive note, there is some evidence that managers do not take account of insider information concerning bank M&A as Madison, Roth and Saporoschenko (2004) identify that target bank insiders significantly decrease both share purchases and share sales before merger announcements.

Outside the US, there does not appear to be any recent studies that focus on the managerial motives for bank merger. In the case of Europe this may be because of the overriding recent evidence that bank mergers are performance enhancing. The cross-country study by Corvoisier and Gropp (2002) indicates that increased banking sector concentration between 1993-1999 leads to less competitive pricing on demand deposits (but not on other types of deposits) and this perhaps may partially suggest evidence of managers seeking a 'Quiet Life'. Also, others (De Guevara, Maudos and Perez (2005); De Guevara and Maudos (2007)) who find evidence of lower competitive pressures could also perhaps be related to managerial motives if CEO pay and market power are positively related – although as far as we are aware this has never been specifically tested. Focarelli and Panetta (2003) in a study on merger behaviour and deposit pricing find that in the long-run deposit rates rise post-merger and more for efficient banks thus indirectly countering suggestions of managerial motives for consolidation in the Italian market.

3.4. FEATURES OF ACQUISITION TARGETS

Another interesting recent strand of the M&A literature seeks to identify the features of actual or potential bank acquisition targets. Evidence from studies of European bank mergers generally finds that poor performing banks are typically acquired. For instance (Beitel, Schiereck and Wahrenburg (2004); Pasiouras, Tanna and Constantin (2007)) show that targets are less cost or profit efficient than acquirers. Focarelli, Panetta and Salleo (2002) find that acquiring banks tend to be more service orientated and have better credit management. However, Valkanov and Kleimeier (2007) who examine large bank deals in the US and Europe between 1997 and 2003 show that there is no difference between the capital strength of European banks engaged in M&A and US targets tend to be more highly capitalised. Koetter, Bos, Heid, Kolari, Kool and Porath (2007) in there study of distressed and nondistressed German bank mergers find that banks that engage in M&A are poorer performing (in terms of their CAMEL ratings) and a similar finding is presented by Hosono, Sakai and Tsuru (2006) on Japan where cost and profit inefficient banks are most likely to engage in M&A activity.

A related literature, although typically not focusing on the features of acquisition targets, which examines the determinants of cross-border banking also identifies efficiency (as well as country differences in information costs, regulatory, economic and other factors) as being important in influencing overseas expansion. Generally this literature finds that large efficient banks (from developed financial systems) are more likely to be engaged in overseas expansion (Berger, DeYoung, Genay and Udell, (2000); Focarelli and Pozzolo (2001); Buch and DeLong (2004); Berger (2007)) – for US banks in 'Old Europe' and developed European banks entering 'New Europe'). The reasons for bank and insurance firm expansion within Europe also appear to be similar (Pozzolo and Focarelli (2007)).

3.5. CONSOLIDATION AND BANK CUSTOMERS

A substantial literature has emerged investigating the impact of consolidation on bank customers. The early survey literature typically finds that US bank consolidation in the 1980's resulted in market power effects (lower deposit rates and higher loan rates in more concentrated markets) although studies that focus on the 1990's tended to indicate weaker relationships between local market concentration and deposit rates (Shull and Hanweck (2001)). There was also considerable evidence that large banks allocate a lower proportion of their assets to small business loans compared to small banks and this effect is more pronounced for merging banks. These adverse effects, however, appeared to be counteracted by the increased credit supply to firms by small incumbent banks (Berger, Saunders, Scalise and Udell (1998); Berger, Demsetz, and Strahan (1999)). Overall, the pre-

2000 literature suggests that the overall impact of bank mergers on both the price and availability of banking services are relatively modest.

More recent studies predominantly focus on the influence of bank consolidation (mainly) on small businesses, focusing on the availability and price of such services post merger. This focus has been influenced not only by the desire to examine possible market power effects resulting from merger but also by the recent interest in relationship lending and the role of soft and hard information processing in bank's credit decisions. (Boot (2000); Boot and Thakor (2000))[5]. Kahn, Pennachi and Sopranzetti (2000) found that mergers appeared to increase rates on unsecured personal loans charged by all banks in the markets in which the merger took place, although the opposite effect was observed for rates on automobile loans. Calomiris and Pornrojnangkool (2005) examine the specific case of the merger between two US banks (Fleet and BankBoston) and find that higher spreads are charged for medium sized mid-market borrowers post merger (although spreads for small sized mid market borrowers remain unchanged). Consolidation is also found to have led to lower credit availability for small borrowers (Craig and Hardee, (2007)) as well as capital constrained firms (Carow, Kane and Narayanan (2006)). Although decline in lending to small business has been found in the US to be matched by increased credit from other incumbent banks (Avery and Samolyk (2004)) as well as increased entry of newly chartered banks (Berger, Bonime, Goldberg and White (2004)). Others, however, find no difference in the small business lending behaviour of small and large banks (Berger, Rosen and Udell (2007)). There are also conflicting market power effects according to specific products (Park and Pennachi (2007)) – large US multimarket banks are found to increase competition in concentrated loan markets whereas they reduce competition in less concentrated deposit markets. Garmaise and Moskowitz (2006) examine the influence of US bank mergers and show that they typically results in higher loan (as well as crime) rates[6].

Evidence on the impact of consolidation on small business lending is also mixed. Sapienza (2002) examines Italian bank mergers between 1989 and 1995 and finds that rates on loans fall when banks with small shares of local banking markets merge, although in the case of large bank deals the results are reversed. Another study of the same banking system covering a slightly later period finds that mergers have a substantial adverse effect on credit availability that lasts at least three years after the merger (see Bonaccorsi di Patti and Gobbi (2007)). In contrast, Marsch, Schmieder and Forester van Aerssen (2007) find that consolidation in German banking has no impact on small firm credit availability. In their

5 For example, Cole, Goldberg and White (2004) found that large banks tended to base their small business lending decisions more on financial ratios than on prior lender-borrower relationships. Small banks, on the other hand, rely more on the character of the borrower in making lending decisions.

6 The elasticity of property crime with respect to merger-induced banking concentration is 0.18.

study of Belgium banking between 1997 and 2003 Degryse, Masschelein and Mitchell (2006) find that acquiring bank borrowers are less likely to lose lending relationship compared to target bank borrowers. Karceski, Ongena, and Smith (2005) find for Norwegian bank merger announcements the equity value of small publicly traded firms that are target customers falls and the decline increases with the size of the target bank. This indicates reduced competitive pressure on customer bargaining power post merger.

3.6. IMPACT OF DIVERSIFICATION (PRODUCT AND GEOGRAPHIC)

As identified above, an important feature of the consolidation trend in the financial sector has been the strategic focus on both geographical and product diversification. The Gramm-Leach-Bliley (GLB) Act 1999 (also known as the Financial Services Modernization Act) effectively repealed the Glass-Steagall Act 1933 and granted broad-based securities and insurance powers to commercial banking companies in the US. Japan's 'Big-Bang' reforms (also completed in 1999) removed the separation of commercial and investment banking and the earlier 1992 EU Single Market Program also legislated for a universal banking system. By 2000, therefore, all major financial systems had removed the major product barriers in the financial services sector (although restrictions still remain and vary relating to financial firms involvement with commerce). This product sector deregulation followed the earlier removal of national bank branching restrictions in various countries. The Riegle-Neal Interstate Banking and Branching Efficiency Act, 1994 repealed the McFadden Act of 1927 that inhibited nationwide branching in the US, and similar restrictions were removed in both Italy and Spain in 1992[7]. In addition to banks having the freedom to expand nationally and across product lines the strategic desire to enter new international markets has also been another key trend. This has led to a substantial literature that has sought to identify the impact of these various diversification features.

The early literature tended to find that diversification (whether geographical or product) was likely to lead to reductions in risk, although it was noted that these positive benefits could be offset by shifts to higher-risk portfolios (income streams) or/and operational risks (Berger, Demsetz and Strahan (1999); Group of Ten (2001)). The more recent literature from the US and elsewhere, as illustrated below, still appears to confirm this mixed picture.

[7] The US branching deregulation resulted in the highest-ever five-year run of bank mergers in the country's history in terms of both the number and the value of the banks acquired (Berger, Buch, Delong and DeYoung (2004)). Brewer, Jackson, Jagtiani, and Nguyen (2000) also find that merger premiums increased by around 35 percent as a result of geographic deregulation. See also DeYoung (2007b) for a detailed analysis of the recent evolution of the US banking system. Similarly in Spain and Italy mergers (as well as the number of branch numbers) grew significantly post-deregulation (ECB (2000)).

One approach to investigating the possible impact of diversification is to study the accounting or stock return features of hypothetical bank-non-bank mergers. The handful of these mainly US studies that use this approach tend to find evidence of risk diversification benefits. (Lown, Osler, Strahan and Sufi (2000) – BHC and life insurance firms; Estrella (2001) – banks and insurers; Emmons, Gilbert, and Yeager (2004) – community banks).

Another strand of the diversification literature uses stock-return event-type studies and these (again) typically reveal conflicting findings. Hendershott, Lee and Tompkins (2002) examine the stock price reaction of different types of financial firms to the passing of Gramm-Leach-Bliley Act 1999 and find that insurance firms and investment banks experienced positive market reactions, whereas commercial bank stockholders returns were statistically unaffected.

In other words, diversification (and other) benefits are more likely to accrue to non-bank financial service firms. Cornett, Hovakimian, Palia and Tehranian (2003) focus on US bank bidder returns and find that significantly higher returns accrue for geographical and product focused deals, a finding also confirmed by DeLong (2003). Cross-country European bank merger studies also tend to reveal mixed results. Beitel, Schiereck and Wahrenburg (2004), for example, find that focused mergers do better than diversifying deals in terms of returns to stockholders, whereas (as noted earlier) Lepetit, Patry and Rous (2004) and Ekkayokkaya, Holmes and Paudyal (2007) find the opposite.

The recent literature that focuses on cross-border mergers involving US and European banks tends to find evidence of no cost efficiency improvements (Berger, DeYoung and Udell (2000); Vander Vennet (2002)) although there is some evidence of profit efficiency or accounting returns improvements (Vander Vennet (2002); Elsas, Hackethal and Holzhauser (2006)). Again, we get a mixed picture if we consider European country-specific bank diversification studies. Rime and Stiroh (2003) find no cost efficiency diversifications in their study of Swiss banks between 1996 and 1999 (and no evidence of scale or scope economies for large banks). Hayden, Porath and von Westernhagen (2006) similarly find no gains for financial sector diversification in their study of German banks (although there may be some benefits from diversification into non-financial areas/commerce).

3.7. Exploitation of Safety Net Subsidies and Systemic Risks

The recent bank bailouts that have occurred as a consequence of the credit crisis highlight the concerns about the increased size of banking firms, the risk implications and the implications for systemic stability. As banks become larger, irrespective of the performance implications, they may have the opportunities to exploit safety net subsidies if they are viewed as 'Too-Big-To-Fail' (TBTF) or 'Too-Big-To-Discipline-Adequately' (TBTDA) (Kane (2000); Stern and Feldman (2004); Mishkin, (2005)). While it is generally recognized that TBTF subsidies are difficult to evaluate (Ennis and Malek (2005)), evidence from the US suggests these are likely to be substantial. Shull and Hanweck (2001) suggest that because the top 10 largest banks paid less for funds than smaller banks and operated with lower capitalization rates this indicated advantages of TBTF implicit guarantees. Morgan and Stiroh (2005) note that after the naming of eleven US banks as TBTF in 1984 this increased the ratings on new bond issues of these banks relative to other (unnamed) banks. In addition they found that the relationship between bond spreads and ratings for the TBTF banks tended to flatten after that event. Overall, this suggests that investors were more optimistic than credit raters about the probability of support for the TBTF banks. (Mishkin (2006) argues that FIDICIA may have reduced the TBTF subsidy although this view is not supported by Morgan and Stiroh's (2005) other findings that the spread-rating relationship in the 1990s remained flatter for TBTF banks (than other unnamed banks) post FIDICIA). Other studies tend to focus on merger premium paid for mega-banks as an indicator of the safety net subsidy – the argument being that higher premiums will be paid for banks that have implicit bailout guarantees. Schmid and Walter (2006) examine large conglomerate deals between 1985 and 2004 and find that significant premiums are paid in mega-conglomerate ($100 billion+) deals, as do Brewer and Jagtiani (2007) who note that higher premiums are paid for targets over a critical size. Jones and Oshinsky (2007) use a Markov (regime) switching approach to examine the probability of insolvency of the FDIC-administered bank insurance fund over time. They find that insolvency risk has increased and that the size of ten largest banks posed an increased insolvency risk to the bank insurance fund. This body of literature points to growing concerns about TBTF subsidies resulting from the consolidation process (in the US at least) As far as we can ascertain no studies have examined safety net subsidy issues relating to consolidation in Europe or elsewhere.

Closely related to the arguments linking consolidation to safety net subsidies are those that consider systemic risk – an area of current major concern in global banking systems. Trends in international consolidation (as well as conglomeration) are also likely to increase risks for large complex financial firms (De Nicolo, Bartholomew, Jahanara and Zephirin (2003)). It has also been shown that financial sector consolidation can also influence liquidity in money markets and the influence depends on divisional capital allocations post-merger (D'Souza and Lai (2006)). A limited number of recent studies have also examined systemic risk issues in European banking. Dermine (2006) reviews recent regulatory developments in European banking and discusses concerns over large banks and the potential bail-out costs. Uhde and Heimeshoff (2007) examine concentration and risk issues using a large sample of EU-25 banks between 1997 and 2005. Using the z-score indicator of risk they find that that banking sector concentration increases instability, although it results in greater profitability. Baele, De Jonghe, and Vander Vennet (2007) use a stock-return model to examine the franchise values of European banks between 1989 and 2004 and also disentangle systematic and idiosyncratic risk. They find that higher level of bank diversification into non-interest income boosts franchise values although systematic risk increases suggesting that bank returns become more highly correlated with the market – perhaps suggesting that the potential for systemic risk is heightened.

3.8. CONCLUSIONS

The various trends that have encouraged consolidation have resulted in a handful of key institutions dominating their banking systems. The consequence of such a process has been revealed since the onset of the post mid-2007 financial crisis that emanated from the meltdown in US asset-backed mortgage securities business. Policy action since then has clearly indicated a 'Too-Big-To-Be-Allowed-To Fail' policy response and indicated the significant safety net subsidies associated with large bank M&A. Having said this, however, our review of the post-2000 empirical literature reveals stronger evidence of performance improvements resulting from the consolidation process than that revealed by the mainly 1990s bank merger literature. Recent studies of European bank M&A virtually all reveal performance improvements (whether measured by returns to stockholders, efficiency gains or profits improvements). This may be explained by the fact that the European bank merger wave followed that of the US (see figure 1) and the former may be learning best-practice from the latter. (Alternatively, of course, there may have been more operational slack in European banking that allowed for greater rationalization post-merger). It is also interesting to note that there has only been a limited attempt by European researchers to estimate safety net subsidies and systemic risk issues. As we now know – safety net subsidies have been huge, and systemic risks have brought major economies to a near standstill. Areas for fruitful future work should seek to further investigate these issues – especially as post crises many banking systems will be re-organised via forced consolidation of their banks.

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4. Sizing up Performance Measures in the Financial Services Sector

Jacob A. Bikker[1]

Abstract

The adequate performance of banks, insurers and pension funds is of crucial importance to their private and business customers. The prices and quality of financial products sold by such entities are largely determined by operational efficiency and the degree of competition in the markets concerned. Since efficiency and competition cannot be observed directly, various indirect measures in the form of simple indicators or more complex models have been devised and used both in economic theory and in business practice. This paper demonstrates that measuring the performance of financial institutions is no simple matter and that indicators differ strongly in quality. It investigates which methods are to be preferred and how by combining certain indicators stronger measures may be developed. These measures are then subjected to a predictive validity test.

4.1. Introduction

This paper addresses the question how well financial institutions are performing in providing their services to consumers and businesses, and how much we know about that. Various performance aspects cannot be observed directly whereas they are economically important. While stockholders will view performance in terms of the profits made on their behalf, whether or not adjusted for risks taken, this paper focuses on performance in a broader sense, that is, the contribution financial institutions make to the common wealth, on behalf of consumers and businesses. They will be mainly interested in whether financial products are not too expensive and whether the quality is sufficient. This raises the issue of, on the one hand, the efficiency of financial institutions (*i.e.* whether unnecessary costs are made in bringing a product to market) and, on the other, the level of competition in the relevant markets (*i.e.* whether profit margins are not unnecessarily high). Since efficiency and competition cannot be observed directly, they have to be measured in an indirect way. If a cut in mortgage rates by one bank, for instance, is promptly copied by all its competitors, then this is a sign of competition – even if it does not enable us to distinguish between a little competition and strong competition. Yet the price and quality of other banking services such as

[1] The author is grateful to Laura Spierdijk for valuable comments and suggestions.

investment consultancy or payment services are much harder to determine, making competition far more difficult to measure. Difficulty in determining prices and quality levels, incidentally, is a widespread phenomenon in financial products markets. A recent example in the Netherlands is the investment-linked insurance policy, popularly known as 'robber policy' (*woekerpolis*). The fact that consumers find it hard to pick such a product on the basis of price and quality takes away the disciplinary influence of the customer and weakens competition. This problem inhabits many of the products of banks and insurers (Bikker and Spierdijk (2009a)).

There is another kind of performance that works in the interest of consumers, but does so in the long run. It is the reliability of a financial institution in terms of solvency and of whether customers can be sure to get their money back. Now that the subprime mortgage and liquidity crisis has engulfed us all, the amount of risk banks take in carrying on their business is a focal point of attention. Although this long-term performance is also affected by competition and efficiency, this paper concerns itself solely with the more palpable short-term performance exhibited in quality services and affordable prices.

Banks of course play a crucially important role in the economy because of their core products: loans to businesses and for house-purchase. Hence competition and efficiency in banking are also highly important: high quality at low cost boosts welfare. Competition is also important for adequate monetary transmission, which is the speed at which policy interest rates set by central banks pass through to bank interest rates (see Table 1).

Table 1: Importance of Competition in Banking

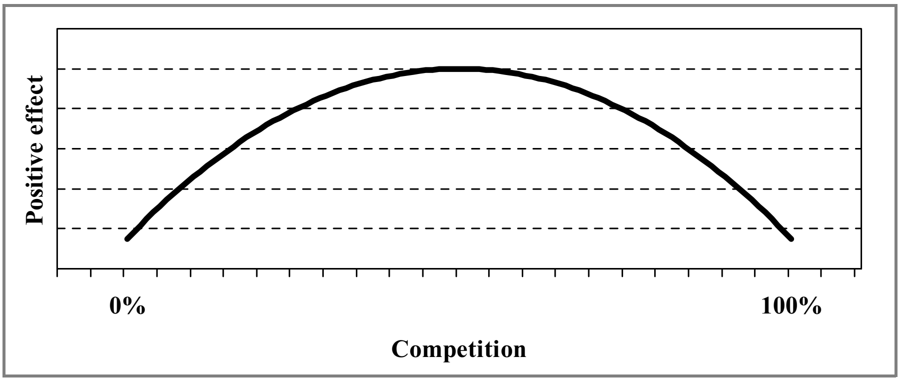
Welfare-enhancing for consumers and businesses
Reinforces monetary policy
Inverse U-shape relationship with:
– innovation
– solvency
– financial stability
– accessibility of the banking system to customers

Competition also affects financial innovations, banks' financial health, financial stability and the accessibility of banking services to customers – with accessibility meaning the extent to which small and medium-sized businesses have access to affordable financing. For all these four factors, the relation to competition is represented by a so-called inverse U-shape (see Figure 1). Promoting competition enhances these factors up to an optimum, whose position is uncertain. Stronger competition beyond the optimum has a counterproductive effect on these factors.

To give an example: when competition is very strong and excess profits dwindle, banks will find it hard to build extra buffers to protect them from adverse shocks. Healthy competition, in this sense, is better than fierce competition.

So what do banks, scientists and supervisors actually know about important variables such as competition and efficiency in the banking system? This paper will establish that, perhaps to our surprise or disappointment, we know far less than has often been taken for granted.

Figure 1: Positive Effect of Competition on Innovation, Financial Health and Accessibility of the Banking Industry and on Financial Stability



In practice, highly simplified approximations have been used to represent competition or efficiency, such as the concentration index or the cost-to-income ratio. While some indicators have been used without challenge in even the most highly-ranked scientific journals, they are in fact too primitive in nearly every case and not very reliable.

Better than such simplified proxies are theoretically founded models that attempt to estimate competition and efficiency for a particular country[2]. How well have these models been doing? This paper shows that the consensus between even the best-founded models is surprisingly weak. In other words, different methods lead to sometimes widely different results for the same country. This brings us to the central problem addressed by this paper: how far does the sounding rod of our measuring methods reach? And what can we do to reach just a little deeper?

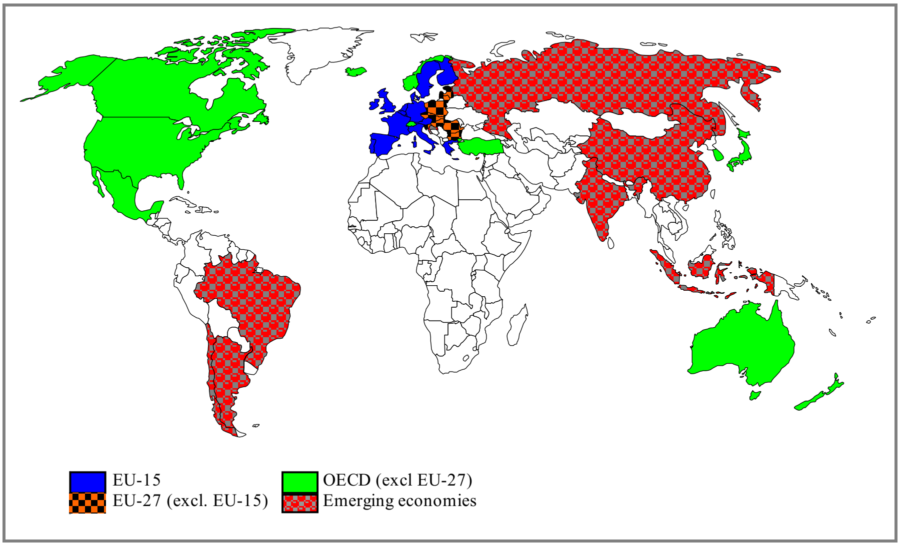
2 Or for a particular bank. This paper considers country estimates.

4.2. PERFORMANCE MEASURES FOR FINANCIAL INSTITUTIONS

As a first step toward a closer analysis, about 20 methods were used to measure banking competition and efficiency for the most important 46 countries[3]. These countries comprise the old and new EU countries (in Figure 2 these are darkly shaded and chequered, respectively), the other OECD countries (light shading) and emerging markets (polka dotted). Together, they account for 90% of global GDP.

All 20 simple approximations and model estimates of competition will from now on be referred to as indicators. Five types of performance indicators are distinguished (see Table 2). Apart from competition and efficiency, these are costs, profit (margin) and market structure.

Figure 2: Countries Examined by Category



[3] For the list of these countries, see Bikker and Bos (2008), Table 9.1. Where competition is concerned, one country, Romania, was left out due to data issues.

Table 2: Indirect Performance Indicators for Financial Institutions

Performance indicators	Correlation with competition	Indicators represented as
Efficiency	Positive	Cost X-efficiency Profit X-efficiency Scale economies Scope economies
Costs	Negative	Cost-to-income ratio Cost margin Total costs/total income
Profit	Negative (?)	Return on capital Return on assets Net interest margin
Market structure – number of banks	Positive	Number of banks Per capita number of banks
– concentration	Ambivalent	HHI, C_3, C_5, C_{10}

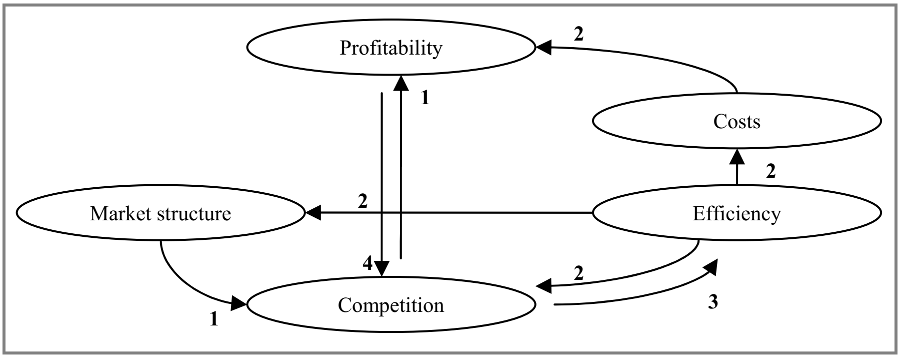
4.2.1. Mutual Relationships

Various theoretical relationships exist between the several types of performance. Figure 3 illustrates this with some examples. The classic structure-conduct-performance (SCP) theory holds that market structure determines competitive conduct and hence profits (referred to by the figure '1')[4]. For instance: high bank concentration leads to less competition and hence to higher profits. According to an alternative paradigm, the efficiency hypothesis, more efficient banks increase their market share by pushing less efficient competitors from the market (Demsetz (1973)). More efficient banks will translate lower costs into either increased profits or price reductions – the latter in order to improve their competitiveness and increase their market share (indicated by a '2' in Figure 3). Efficiency thus is not an effect but a determinant of market structure[5]. It has been generally assumed that competitive pressure forces banks to become more efficient (indicated by a '3'). Hicks (1935) assumes as much, proposing, in his 'quite life' hypothesis, that monopoly will reduce the pressure towards efficiency. Finally, excess profits enable banks to lower their prices and become more competitive in order to increase their market share (indicated by a '4').

The strong intertwinement between variables in Figure 3 explains why market structure, costs and profitability are often used as proxies for competition and efficiency. At the same time, however, the figure underlines the fact that the measures concerned reflect quite different characteristics of banks and their markets.

4 See Bos (2004) for an overview and a critical analysis.
5 Depending on the ambition of efficient firms to expand their market share.

Figure 3: Relations Between Market Structure, Competition, Profitability and Efficiency



Explanation: Relations according to the SCP paradigm are indicated by the figure 1, those according to the efficiency hypothesis by the figure 2. Relations according to the 'quiet life' hypothesis (and its reversal) are marked by the figure 3, while the relation following from a general principle is indicated by 4.

4.2.2. Correlation with Competition

Before the indicators can be used, it must be established whether the correlation (across all countries) with competition is positive or negative[6]. Figure 3 shows that efficiency is positively correlated to competition (for stronger competition leads one to expect higher efficiency) and, for the same reason, that costs are negatively correlated with competition (in other words, stronger competition leads to cost cuts; see Table 2). Also, competition is likely to reduce profits. This argument is not entirely cogent, however, because competition may also affect profit in a positive sense via cost reduction. Hence the question mark in Table 2.

Where the notion of market structure is represented by the number of banks, a positive correlation with competition is usually assumed: the presence of more banks implies more opportunity for competition. Concentration, indicating mainly the dominant position of a small number of banks, may indicate low competition, because banks may use this to collaborate. A more dynamic interpretation is that such concentration may, on the contrary, be an indication of competition because consolidation may have been enforced by circumstances. Therefore concentration is an ambivalent indicator.

4.2.3. Models and Indicators Used

Initially, five models were used to estimate competition (see Table 3). The Lerner index uses profit margin as an indicator of market power (De Lange van Bergen

6 Abstracting from causality. In some cases there are more theoretical connections, whereas different empirical results have been obtained. A final choice is made in all cases.

(2006)). The SCP model measures the influence of market structure on profits via an assumption of competitive conduct. Market structure, here, is approximated by the concentration index. The Cournot model is built along analogous lines, but instead of looking at the structure of the market as a whole, it regards the conjectural variation of individual banks[7]. Taking market share of the individual firm as a measure of market structure, the Cournot model aspires also to capture part of asymmetrical market structures, differences in cost structures and collusive behaviour. The Boone indicator measures how efficiency, through increased market shares, is rewarded by higher profits (Bikker and Van Leuvensteijn (2008); Boone (2004, 2008); Van Leuvensteijn *et al.* (2007, 2008)). The Panzar-Rosse model measures to what extent input and output prices move in step (as they would under perfect competition) or out of step (indicating monopoly or a perfect cartel)[8]. Other models in the literature (*e.g.* Bresnahan, Iwata) require data sets that for most countries are simply lacking, while estimations also present high practical barriers (Bikker (2003)). Table 3 shows how the different models simulate different aspects of competition.

Table 3: Competition Models

Model	Underlying concept
Lerner index	Profit margin indicates market power
SCP model[a]	Effect of market structure (concentration) on profit through competitive behaviour
Cournot model[b]	Effect of market structure (market share) on profit through competitive behaviour
Boone indicator	Degree in which efficiency is rewarded in the form of higher profits through increased market shares[c]
Panzar-Rosse model	Correlation of input prices and income (revenue)

a. Based on, respectively, the market shares of the largest three banks (C_3) and the Herfindahl-Hirschman concentration index (HHI) as measures of market structure.
b. Based on the market share of the individual bank as a measure of market structure, as an indicator of asymmetrical market structures, differences in cost structures and collusive behaviour.
c. Based on the efficiency hypothesis.

For the efficiency indicators, cost and profit X-efficiency as well as scale and scope economies were estimated through a model (see Table 2). Costs are represented by the cost-to-income ratio and the cost margin, while profit is proxied by return on capital or return on assets (RoA) and by net interest margin (NIM). In the case of market structure, the number of banks, the per capita number of banks and a number of concentration indices are also incorporated[9].

7 Conjectural variation is the degree to which a bank in setting its prices and total production quantity in a business area is aware of its dependency on other banks' behaviour in that area.
8 See Panzar and Rosse (1987).
9 For the exact definitions, see Table 16.1 in Bikker and Bos (2008). Concentration indicators are discussed in Bikker and Haaf (2002a).

In all cases this analysis was based on the banking market as a whole, without regard to product differences. It has been argued against this that the situation as regards competition, for instance, may vary depending on the market segment. Competition in the mortgage lending market is likely to be much stronger than in the investment counselling market. This is justified criticism: competition may vary from product to product or even from one location to another. However, for most products there are insufficient data available to perform analyses at the product or location level, with a few exceptions[10]. Where approximations for competition and efficiency are used in the economic literature, this is almost invariably done for banks as a whole, so on the highest level of aggregation.

Since all models were estimated on the basis of a single dataset, different outcomes may not be attributed to data differences. The dataset covers a ten-year period (1996-2005) and was obtained from Fitch IBCA's BankScope and from the OECD[11].

4.3. CRITICAL APPRAISAL OF THE INDICATORS

This section appraises the indicators presented above against three different criteria: first, two statistical norms – mutual correlations and the principal component analysis[12] and an economic interpretation. Finally, the variation across countries is explained from economic theory.

4.3.1. Correlations

How do the different indicators found correlate to each other? Table A.1 in the appendix shows the correlation coefficients between 14 currently used indicators for 46 countries[13]. A correlation between two variables indicates parallel move-

10 Bikker and Haaf (2002b) and Bikker *et al.* (2006b) use the Panzar-Rosse model to disaggregate by bank size, thus going some way towards a breakdown by market type (international vs. local), client type (large corporation vs. medium and small-sized businesses) and product type (wholesale vs. retail). Van Leuvensteijn *et al.* (2007) estimate competition in just the lending market.

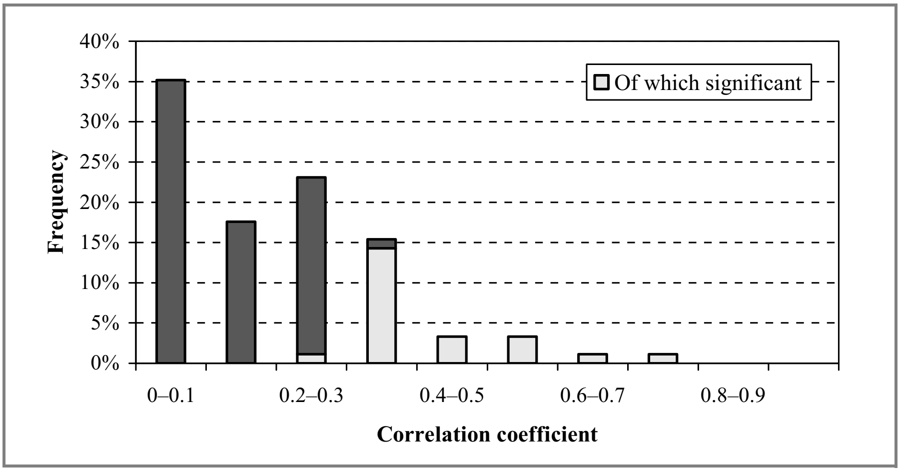
11 The data on individual banks' balance sheets and profit and loss accounts that were used by the five competition measuring models and the models to measure X-efficiency were obtained from BankScope. The dataset contains data on 13,000 private and public banks publishing more or less standardised annual accounts which permit comparison between the different accounting systems. The data underlying the profit and cost indicators for the OECD countries were obtained from the OECD (2000, 2002, 2004). Those data coincide with those used by Bikker and Bos (2008) and are discussed more fully there. The data on concentration indices for all countries and those underlying the profit and cost indicators for the sixteen non-OECD countries were calculated on the basis of the banks from those countries that figure in BankScope. Selection rules were applied to the latter set in order to eliminate banks in unusual circumstances (*e.g.* holdings and banks undergoing a start-up or winding down process). See Bikker *et al.* (2006a).

12 A third statistical method might have been regression analysis. However, the use of this is doubtful given the strongly endogenous nature of (almost) all variables used. A counterexample is Koetter *et al.* (2007).

13 All analyses for 46 countries were made without the Lerner index. Lerner index analyses were performed for 23 countries, but are not discussed here since the index turns out to be significantly correlated only with the Boone indicator. Table A.1 is part of a larger correlation matrix, because the total number of variables investigated was larger than 14.

ment, without regard to any original (causal) connection. Figure 4 summarises these findings as the frequency distribution of the correlations found.

Figure 4: Frequency Distribution of Correlation Coefficients Between Indicators



Explanation: The graph presents the 91 correlations between the 14 indicators used: the Boone, Panzar-Rosse, SCP and Cournot models, cost and profit X-efficiency, return on assets or on equity, cost-to-income ratio, total cost to total income ratio, net interest margin, cost margin, the number of banks and the top 5 banks by market share, C5 (see Table A.1). Lighter shading refers to the 22 correlations that are significant at the 5% significance level.

Evidently, most correlation coefficients are below 0.5: apparently, indicators tend to be only moderately correlated to each other. This underlines the fact that each single indicator provides at best a rough indication of competition, which is certainly not very accurate at the country level. The lighter shading indicates correlations that are significant at the 95% confidence level – the upper fourth part of all results. The number of significant correlations, at one in four, is not very high. However, they all have the right – meaning: theoretically expected – sign, except for five correlations involving ambivalent indicators whose sign depends on which of the several theoretically possible relationships is dominant. The fact that all other 17 significant correlations bear the right signs without exception is an indication that the indicators behave (roughly) in accordance with the theoretical framework and hence are not too much distorted by *e.g.* definition or measurement issues.

4.3.2. Principal Components Analysis

Another statistical technique is principal components analysis or PCA[14]. To the extent possible, this method attempts to represent the variation across the countries within a set of correlated variables using a few variables called principal components. PCA makes it possible to investigate to what extent the indicators reviewed might all be explained by just a few factors or, in other words, to what extent they overlap. The more successful the analysis, the more similar to each other the indicators would be. Even more important is the possibility to interpret the principal components (PCs) and to see whether they might represent recognisable elements of our performance measures. It would be nice, for instance, if one of the PCs represented competition, another one efficiency and the third one profitability. This way, each PC could, so to speak, filter information from the indicators and represent it in compact form.

Table 4 shows the outcome of an analysis (after the so-called varimax rotation for ease of interpretation) with twelve indicators, selected so as to minimise overlap between the indicators considered. Also, the indicators are spread as equally as possible across the categories competition, efficiency, profitability, et cetera[15]. The shading indicates for each column (*i.e.* for each principal component) the highest factor or component loading(s). Thus we may infer that the first principal component represents mainly cost and profit margins and profit inefficiency[16]. The second one has the highest factor loading at cost efficiency, while the third one has its highest factor loading at (three out of four) model-based competition measures, and again at the HHI concentration index. Apparently, this third factor comprises information on competition. Moreover, the signs of each factor loadings are correct – that is to say, in accordance with theoretical expectations[17] – so that this PC ought to present a reliable summary of the information content of these competition indicators.

[14] PCA is a multivariate statistical technique that defines, for a large number of observed variables, a smaller number of underlying series. As a statistical method, PCA is nearly identical to factor analysis. Apart from data reduction, PCA aims to provide an understanding of the dataset's structure.

[15] If the selected indicators are varied a bit, the outcome of the PCA will change as well. Typically, the first PCs may usually be interpreted as profit, efficiency and competition – though not always in that order. In some cases, costs appear in combination with profits, while in others they are coupled with efficiency.

[16] Note that competition depresses both costs and profits.

[17] As competition grows, the *H*-values of the Panzar-Rosse model will also rise, whereas the Boone indicator and the coefficients in the SCP model and the Cournot model decline.

Table 4: Factor Loadings for the First Five Principal Components (PCs)

	Factor loadings[a]					Explanation[b]
	PC1	*PC2*	*PC3*	*PC4*	*PC5*	
Panzar-Rosse model	-0.20	0.18	0.80			0.72
Boone indicator	0.20	0.30	-0.79			0.76
SCP model	-0.80	0.18				0.67
Cournot model	0.18	-0.23	-0.63	-0.42		0.66
Cost efficiency	-0.13	0.81	0.13	0.11		0.70
Profit efficiency	0.84	-0.24				0.76
Return on Assets	0.79	0.16	-0.27	-0.24		0.79
Cost to income ratio	0.26	-0.60	0.60	0.14		0.81
Net interest margin	0.84	-0.18	0.18			0.77
Number of banks	-0.20	0.13	0.12	0.85	-0.12	0.81
Cost margin	0.85	-0.23	0.12	-0.13		0.81
HHI	0.19	0.13	-0.85	-0.14		0.79
	Explanation of variance per PC					*Total*
	0.19	0.17	0.13	0.15	0.12	0.76

a. A factor loading may be regarded as the coordinate of an indicator on a PC in a coordinate system. In the case of orthogonal components (i.e. forming a right angle), the factor loading of a variable vis-à-vis a component equals the correlation between that variable and that component.

b. Explanation of the variance of the indicators based on the first five PCs (equals the sum of squared factor loadings for each variable across the five PCs).

Explanation: The shading indicates the highest factor loading for each column (that is, PC).

The last line of Table 4 shows that the first PC explains almost 20% of the variance in the indicators, falling gradually to 12% for the fifth PC, so that the first five PCs together explain 76% of the variance. Thus less than half the PCs explain three-fourths of the variance in the indicators. Apparently, the indicators do contain common elements (especially ‘competition’), but also many specific ones (profit, efficiency, concentration and further refinements such as RoA and NRM).

4.3.3. Economic Interpretation

What, now, is the economic significance of the indicators, or what are their countryspecific values? The answers to these questions are found, for the present estimates of country-level competition and efficiency, in comparing the results to available other sources of a more intuitive or anecdotal nature, or that relate to specific subsegments or to competition in other sectors. However, there is not much contrastive material around. In practice, there seems to be a degree of consensus to the effect that Anglo-Saxon countries such as the USA, the UK and Ireland are highly competitive. Another *expert view* is that competition in Southern Europe, by contrast, is very modest as a result of lagging development, exemplified by insufficient consolidation and low cost-sensitiveness in bank clients. France and Germany are also (with Italy) supposed to be less competitive owing to strong public interference and inadequate consolidation. Very recently, we have seen strong government interference with banks in many countries, in response to the financial crisis – good for solvency but bad for competitive conditions and therefore, one hopes, temporary. For Germany, stricter adherence to supervisory rules, financial conservatism and an extensive branch network are mentioned. Another universally accepted truth is that competence is stronger in developed countries than in emerging economies, with the least developed countries bringing up the rear. Table 5 presents the country ranking according to the 'expert view'.

Table 5: Competitiveness Ranking of EU Countries: Expert View vs. Empiricism

	Expert View		Empiricism (indicators)
1	UK/USA/Ireland	1	Germany/France
2	Western Europe	2	UK/USA/Ireland
3	Germany/France	3	Other EU-15 countries
4	Southern Europe	4	Central & Eastern Europe
5	Central & Eastern Europe		

Various indicators produce diverging results for the same countries, because they reflect different aspects of competition and also because estimation errors or faulty data distort the result. But there is something else, which is that the outcome suggests the above generally accepted country ranking is, in fact – or at least according to our estimates – simply wrong. Germany, which is deemed by many to be low on competition, gets good marks for all our criteria: low cost, low profit, high competition, high efficiency – and as measured by nearly all indicators. And a very similar story applies to France. Some Southern European countries live up to their underdeveloped image, yet according to many indicators, Italy – and to some extent Spain – do not. Conversely, the performance measures for the USA, the UK and Ireland are less than convincing. Although competition estimates for these countries are favourable, their cost levels (and cost inefficiencies), interest margins and profits are exceptionally high, which is hard to reconcile with a competitive climate. Table 5 shows that according to the indicators as measured across 1996-2005, Germany and France take the lead over the Anglo-Saxon countries.

Whereas the original purpose of the above comparison was to use the 'generally accepted truth' as a benchmark for the indicators, the outcome suggests the reverse, *i.e.* the urgent need to adjust the expert view.

4.3.4. Causes of Country-level Deviation Among Indicators

What is it that causes various measures to reflect somewhat different phenomena for each country? There are three main explanations. First, we are dealing with different concepts: although mutually correlated, the indicators do in fact measure different things: competition is not the same thing as efficiency, which in turn differs from profitability et cetera. Secondly, there are definition issues: each definition of (for instance) efficiency reflects a different aspect of the concept. And finally, imperfections in the data also play a role.

Definition issues also figure in the models that measure competition. Using a standard model of a profit maximising bank under a regime of oligopolistic competition, one may derive that the theoretical model of competence is as follows (Bikker and Bos (2005, 2008)).

$$\textit{Profit margin} = (1/\mu)\ \textit{HHI}\ (1 + \lambda) \quad (1)$$

Profit margin is assumed to reflect competitiveness: the more market power, or the less competition, the higher profits will be. The μ parameter indicates the price elasticity of demand: the more sensitive consumers are to changes in the prices of bank products, the stronger competition will be. *HHI*, the Herfindahl-Hirschman index of concentration, describes market structure: more banks make for more competition, while a market with few large banks weakens competition. The conjectural (or assumed) variation, λ, indicates how banks will respond to production volumes and prices of other banks. This parameter becomes higher as competition gets stronger. Equation (1) may also be derived at the firm level where, applied to bank i, it reads:

$$\textit{Profit margin}_i = (1/\mu)\ MS_i\ (1 + \lambda_i) \quad (2)$$

where MS represents market share. Bikker and Bos (2005, 2008) have demonstrated that existing competition models may be derived from these two, except that they invariably incorporate only one or two of the three components, thereby neglecting one or two others. The SCP model, for instance, assumes that μ and λ in equation (1) are constant (or that $(1 + \lambda)$ may be approximated by HHI). The same goes for Cournot, albeit at the bank instead of the country level (see equation (2)). The Boone indicator is estimated as the μ in equation (2) and assumes λ_i constant. These differences in *a priori* assumptions contribute to the variation in competition estimates. The Lerner index and the Panzar-Rosse model base themselves on the (full) profit margin at the firm level. In the case of the Lerner index, there is the problem that marginal costs have to be estimated, while with Panzar-Rosse the translation from theoretical to empirical model may have a disturbing effect.

4.4. WHAT INDICATORS CAN DO

In the preceding paragraphs it has been shown that competition indicators should not be applied indiscriminately. Time to investigate what information value the indicators do have and whether there is, in fact, a reliable way to gauge competition. In order to find this out, we will be concentrating on three aspects: economic interpretation (again), predictive validity and a bundling of all information into a single index.

4.4.1. Economic Interpretation

To see whether any clear structure lies buried inside the data, Table 6 presents the estimates of the average cost and profit X-efficiency, costs (averaged across the three cost indicators) and profitability (averaged across the three profit indicators). The table juxtaposes three types of countries (*viz.* (i) Western Europe and other highly industrialised countries, (ii) emerging economies and other OECD countries, and (iii) Eastern and Central Europe) with efficiency, broken down into five classes in descending order from high to low efficiency countries. Every cell in the table contains the number of countries in that bracket. The table shows a diagonal pattern (see shading). Apparently, the efficiency of banks in the highly developed industrial countries is clearly better than that of banks in emerging countries, while banks in the post-transitional economies of Eastern and Central Europe come out as least efficient. It follows that there is a correlation between efficiency and degree of economic development.

A similar pattern from high to low is to be found, for the same reason, when countries are classified by cost levels or profitability, but that the other way around (from low to high) as high efficiency corresponds to low costs and low profits (see the shaded diagonal in, respectively, Table 6.B and 6.C). In the developed countries, where costs are lower, profits are also lower, whereas costs and profits are higher in the transition countries. It is tempting to ascribe this phenomenon to stronger competitive pressure. However, a similar classification does not show an unequivocal pattern for competition. Other investigations have shown that competition in industrial countries is, by contrast, slightly weaker, probably owing to a higher proportion of products such as investment counselling and services and options, where competition is far less energetic than on deposit taking and lending (Bikker *et al.* (2007). In time, the share of advisory and other services continues to increase, further weakening competition (Bikker and Spierdijk (2008)).

Table 6: Distribution of X-efficiency, Costs and Profitability Across Countries

		Western Europe and other industrialised	Emerging economies and other OECD	Eastern and Central Europe
		A. X-efficiency		
High	9	8	1	
	9	7		2
Medium	9	3	3	3
	9	5	3	1
Low	9	2	2	5
	45[a]	25	9	11[a]
		B. Costs		
Low	9	9		
	8	6	1	1
Medium	10	6	2	2
	9	4	3	2
High	10		3	7
	46	25	9	12
		C. Profitability		
Low	9	7	1	1
	9	6	2	1
Medium	9	6	2	1
	10	6	1	3
High	9		3	6
	46	25	9	12

a. The X-efficiency of Romania could not be estimated due to insufficient data.

4.4.2. Average Ranking

In situations where measuring is problematic, a good solution may well be to take the average of several estimations. This is a well-known and often-used strategy in forecasting: the combination of several forecasts does better than each forecast separately. This strategy was also applied to the set of estimates and indicators discussed above. A per-country average of several competition level indicators was used. Because the units of expression of these indicators cannot be compared, instead of values, ranking orders were averaged[18]. For this exercise, eleven measures were selected in such a way that there was as little overlap between them as possible. Wherever the overlap between two measures was substantial, one vari-

[18] The third principle component 'competition' as presented in Table 4 is an alternative index, which may be viewed as a weighted (by factor loadings) average of the original normalised series.

able was left out[19]. The eleven eventually selected measures are: Boone indicator, Panzar-Rosse model, SCP model, Cournot model, cost X-efficiency, return on assets, cost-to-income ratio (C/I), total cost to total income ratio, net interest margin (NIM), cost margin (CM) and market share of the top 5 banks (C_5).

Table 7: Correlations Between the Indicators and the Index

Indicators	Correlations	Significance	Status	Index component
Boone indicator	-0.14			Yes
Panzar-Rosse model	0.33	**		Yes
SCP model	-0.05			Yes
Cournot model	-0.42	***		Yes
Profit efficiency	0.37	**	Amb.	
Cost efficiency	0.53	***		Yes
Return on capital	-0.30	**		
Return on assets (RoA)	-0.50	***		Yes
Cost-to-income ratio (C/I)	-0.42	***	Amb.	Yes
Total cost to total income ratio	-0.20		Amb.	Yes
Net interest margin (NIM)	-0.63	***		Yes
Cost margin (CM)	-0.58	***		Yes
Number of banks	0.51	***		
Concentration index C_5	-0.37	**		Yes

Note: Two (three) asterisks indicate a confidence level of 95% (99%). Shading indicates expected positive correlation instead of negative. (Only where there is ambivalence there is no a priori expectation.) Amb. stands for ambiguous.

The first column of Table 7 (*i.e.* the last column of Table A.1) presents the correlations between the 'average ranking', referred to from here on as 'Index', and the underlying variables. Remarkably, 11 of the 14 measures are significantly correlated with the Index, of which 7 at the highest confidence level of 99%[20]. Figure 5 shows, moreover, that correlations with the Index are far stronger than those between pairs of indicators.

Reassuringly, all 14 correlations have the correct (theoretically expected) signs[21], which is, of course, especially significant in the case of the nine significant and non-ambivalent variables: Panzar-Rosse model, Cournot model, cost X-efficiency, return on assets/capital, NIM, CM, number of banks and C_5. Apparently

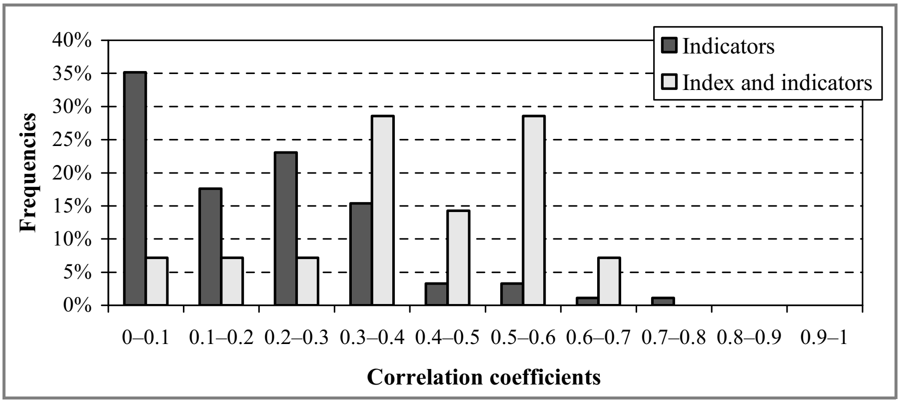
[19] Cost-based or profit-based scale economies were also disregarded because they show little variation across the countries and because of its ambivalent relation to competition.

[20] For the indicators included in the Index, a modicum of correlation with the Index is to be expected, of course. While for some indicators (Boone indicator and SCP model) this does not lead to significance, other indicators show significant correlation without being included in the Index (*e.g.* profit efficiency and number of banks).

[21] The correct sign is negative (owing to the selection made in constructing the Index, because most indicators correlate negatively with competition, see Table A.1), except in certain cases (shading).

there is, after all, an overall concept of 'competition', which is present in nearly every indicator and is reflected reliably and unequivocally in the resulting Index[22].

Figure 5: Frequency Distribution of Correlations Between Indicators and Index



Note: Dark shading: frequency distribution of 91 correlations between indicators; light shading: frequency distribution of 14 correlations between indicator and Index.

Now that an adequate measure of competition has been found in the Index, it is possible to tell which of the simple indicators, all things considered, does best. Table A.1 shows that the net interest margin and its relation, return on assets, are the most successful (overall) performance measures[23]. When the focus is entirely on competition, Panzar-Rosse or Cournot are more satisfactory.

Finally, it should be noted that this ranking-based Index is strongly and significantly (and in declining degrees) correlated with the first three principal components of Table 4, which are weighted averages of the original indicators. Both the Index and the principal components aim to present as much of the indicators' information content as possible in summary form.

22 A corollary result is that the ambivalent variables are now signed, so as to make clear which relation prevails in practice. In the case of profit efficiency the influence of cost efficiency dominates that of the use of market power. The cost-to-income ratio and the total cost to total income ratio turn out to do well as indicators of efficiency, with the enumerator (costs) dominating the denominator (income) in determining the ratio.

23 In earlier analyses across a smaller number of countries, using a differently composed set of indicators (Bikker and Bos, 2008) or covering other periods (Bikker and Bos, 2005), the net interest margin and the return on assets also came out on top.

4.4.3. Predictive Validity Test

There is another way to test the measures considered, which derives from the psychometric, sociological and marketing literature: the so-called predictive validity test[24]. The predictive validity test is based on the idea that a constructed variable – such as a survey question – must be correlated to the (subsequently) observed variable if it is to be a useful predictor. With some adjustment the indicators in the present analysis could be subjected to the following 'informative validity test'. The test is based on a model in which competition depends on economic variables or, conversely, where an economic variable depends on, among other things, competition. In such a model each of our indicators might be used as a proxy for competition to see whether it is both significant and (according to theory) correctly signed. If it is, one may conclude that the indicator's relevant information content prevails without its pattern being disfigured by the inherent noise.

Such tests occur frequently in the literature, if implicitly, because indicators are usually employed without much ado as competition measures. Examples of this are the SCP and the efficiency hypothesis literatures where concentration and market share, respectively, have been blithely cast in the role of competition. But there are many other fields of study where competition comes into play[25]. As an *ex-post* test the literature is not a reliable source, since less welcome test results are more likely to be disregarded by authors or else to be rejected by journals.

Below are three examples of such informative validity tests. A model-based measure of competition is the H-value from the Panzar-Rosse model which has been estimated for 80 countries. Next, it is explained by means of a large number of carefully selected possible determinants of competition (Bikker *et al.* (2007)). The four (out of nine) determinants that are significant (even at the 99% confidence level), all turn out to carry the right sign (see Table 8). Apparently, the H statistic contains a great deal of – competition-related – information, so that it passes the present test successfully.

24 Predictive validity is the term used if a test is observed before it can be compared to the realisation; 'concurrent validity' is applied in cases where observation is simultaneous. The latter term would be applicable if one indicator were to be validated against the other. This option is less useful in the present analysis owing to the endogenous nature of the indicators considered here.

25 Some examples of this are given further below.

Table 8: Explanation of Bank Competition in 76 Countries (2004)

Variables	Coefficients	t-value	Significance
Concentration index C5	-0.001	-0.8	
Activity restrictions	-0.000	-0.7	
Log (Market cap./GDP)	-0.016	-0.4	
Log (per capita GDP)	0.011	0.3	
Real GDP growth	-0.023	-2.8	Sign.
Foreign investment index	-0.132	-3.2	Sign.
Regulation index	0.128	2.5	Sign.
EU-15	-0.129	-1.4	
Former planned economies	-0.435	-5.6	Sign.
R^2, adjusted	0.82		

Source: Bikker et al. (2007).

Our second example concerns monetary transmission. It is assumed that as competition increases, bank interest rates will be lower and more closely aligned with market rates and the policy rates of the European Central Bank (ECB), so that competition reinforces monetary policy. Models for four types of lending in eight EMU countries[26] explain the spread between the observed four bank rates and the corresponding policy and market rates using competition in the lending market (Van Leuvensteijn *et al.* (2007, 2008))[27]. Competition was in this case measured by the Boone indicator, because it permits estimating competition in a partial market (*i.e.* the lending market). The competition measure carries the correct sign significantly for three out of the four lending rates (see Table 9). In the fourth case, the coefficient concerned is not significant. Also, a so-called 'Error Correction Model' shows that the response of all four lending rates to the market and policy rates is stronger, and hence more closely parallel, as competition increases. Again, the Boone indicator, with seven hits out of eight, seems to have passed the test[28].

26 Austria, Belgium, France, Germany, Italy, the Netherlands, Portugal and Spain (1992-2004).

27 An alternative model, the Error Correction Model, was unable to confirm decreasing spreads amid stronger competition. Apparently, this more complicated model is less capable of measuring the targeted alignment effect.

28 In addition, the spread between two deposit rates and the corresponding market and policy rates is explained by competition on the lending market. It turns out that deposit rates tend to be lower the more competition there is on the lending market. Apparently, competition on lending is not a good indicator for competition in the deposits market. On the contrary: banks compensate for their loss of income as a result of competition on lending by offering lower deposit rates.

Table 9: Effect of Competition on Spreads between Bank and Market Lending Rates

	Effect of competition on spread (t-values)	Effect of competition times market rate on bank rates (t-values)
Mortgage loans	**-2.12	***4.29
Consumer credit	***-3.03	***3.21
Short-term corporate loans	***-6.72	***3.47
Long-term corporate loans	0.15	***4.48

Note: Two (three) asterisks indicate a confidence level of 95% (99%).
Source: Van Leuvensteijn et al. (2008).

A third example is that of a model which determines the influence of competition on a banks capital buffer (Bikker and Spierdijk (2009b)). On the one hand it seems self-evident that less competition should lead to higher bank profits, so that banks may add more money to their buffer capital. There is a clear trade-off here between the short-term interest of bank customers, characterised by high competition and low prices, and the long-term interest of financial safety, in other words, the certainty that you will get your money back. An alternative theory assumes, however, that when fierce competition erodes profit margins, banks will be inclined to take more risks and hold a smaller buffer. Also, amid strong competition, banks will be less inclined to invest in inquiries regarding their clients in order to reduce information asymmetry (Marcus (1984)). This, too, increases the risk for banks. In order to determine which effect is stronger, a model was estimated – on the analogy of work by Schaeck *et al*. (2006) and Schaeck and Cihak (2007) – where the capital buffer depends on variables including competition. Competition was once more measured using the Panzar-Rosse model, so that data are available for over 100 countries.

Estimations demonstrate that competition erodes banks' capital buffers, so that apparently, the theory claiming that 'weak competition leads to high profits and hence to large buffers' wins out in actual practice. The same holds if instead of the Panzar-Rosse competition measure the third principal component derived above (which according to the factor loadings indicated competition) has been applied[29]. Again it appears that measuring competition in practice yields plausible results.

29 In fact, the Index turns out not to be significant if replacing the Panzar-Rosse measure.

4.5. WHAT DO THE VALIDATED MEASURES ACTUALLY MEASURE?

So far, this paper has been investigating how bank performance indicators do themselves perform as measures. Next, the question arises as to the banking industry's competition and inefficiency themselves. Earlier studies have tried to capture those variables. For the sake of comparison, two other financial sectors are also considered: insurers and pension funds. Little research has been done in the present area for these types of financial institution, while banking competition measurement has been underexposed in the literature.

This paper considers only estimates by methods whose results cover the same 0%-100% range, which permits the outcomes to be compared. Disregarding for now the many (almost insurmountable) problems besetting the business of measurements and comparisons[30], Table 10 presents several outcomes for scale economies, cost X-inefficiency and competition.

Unused scale economies cannot be present under strong or perfect competition. Estimated unused scale economies increase from banks (5%) via nonlife and life insurers (10% and 20%, respectively) to 36% for pension funds. Especially insurers and small pension funds could realise hefty cost savings through (further) consolidation. These outcomes reflect the degree of (overdue) consolidation per sector, and therefore in a sense a lack of competition. For under fierce competition, large-scale cost-saving opportunities would not go unexploited[31]. As has been observed many times, the inefficiency of banks and insurers is greater than their scale inefficiency. Bank competition, at 50% (world-wide), hovers halfway between monopoly and perfect competition[32]. In recent years bank competition has weakened somewhat (Bikker and Spierdijk (2008)). Among nonlife insurers, competition is considerably weaker, at 22%, than among banks (Bikker *et al.* (2008)). The conclusion is that there is a good deal of room for improvement in competition and efficiency within banks and, especially, insurance companies.

30 The measurement of scale economies, for instance, is based on the variable 'output', which presents its own measurement issues for each sector.

31 It should be noted that these scale effects also concern production structures. In all sectors, fixed costs are high and rising over time, while they are particularly high in pension funds, compared to variable costs.

32 The competence measure H of the Panzar-Rosse model, measured across 100 countries, averages 0.50, exactly halfway between monopoly ($H = 0$) and perfect competition ($H = 1$).

Table 10: Competition Among Banks, Insurers and Pension Funds (per cent)

	Banks	Insurers		Pension funds
		Nonlife	*Life*	
Scale effects[a] (Int.)	5	–	–	–
Scale effects[b] (Nld.)	–	10	20	36
Inefficiency[c] (Int.)	18	–	–	–
Inefficiency[d] (Nld.)	18	–	28	–
Competition[e] (Int.)	50	22	–	–

a. Scale effects are defined as the average percentual savings on the operating costs of any additional production realised as a result of upscaling. The greater the unused scale economies, the weaker competition will be. Source: calculations by the author and Marco Hoeberichts.
b. Sources: Bikker and Van Leuvensteijn (2008).
c. Cost X-inefficiency. Source: Bikker and Bos (2008).
d. Sources: Bikker and Bos (2008).
e. Sources: H-values by Bikker et al. (2006a) and Bikker et al. (2008).

4.6. SUMMARY

While many indicators of competition between banks commonly used in economic literature and in practice do in fact measure something, they do not contribute much to our knowledge on bank performance. At the same time it has been established that with the help of appropriate indicators – or, even better, a *combination* of appropriate indicators – we could make a good deal of headway towards a better understanding of competition. The appropriate indicators contain sufficient information on competition to be able to function reliably as explanatory variables in a model where competition plays a dominant role. Finally, the analysis also revealed that some existing expert opinions on the relative competitiveness of (especially European) countries need to be thoroughly reviewed. Application of several indicators to banks, life & nonlife insurers and pension funds has consistently shown that there is a good deal of room for improvement on competition and efficiency in banks and, especially, insurers.

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4.8. APPENDIX

Table A.1: Correlation Coefficients Between Indicators and the Index (46 Countries, 1996-2005)

	Boone	Panzar-Rosse	SCP	Cournot	Profit eff.	Cost-eff.	RoC	RoA	C/I	TC/TI	NIM	Cost-margin	No. of banks	C_5	Index
	neg[a]	*pos*	*neg*	*neg*	*amb (p)*[b]	*pos*	*neg*	*neg*	*amb (n)*	*amb (n)*	*neg*	*neg*	*pos*	*neg*	
Boone	1.00	-0.34 **	-0.20	-0.13	0.36	0.11	0.18	0.06	0.07	-0.23	-0.21	0.00	0.06	0.11	-0.14
P-R		1.00	-0.04	-0.03	-0.03	0.09	-0.17	-0.28 *	0.02	0.17	-0.02	-0.22	0.09	0.03	0.33 **
SCP			1.00	0.29 **	-0.07	-0.05	0.12	0.02	-0.27 *	-0.08	0.07	-0.09	-0.02	-0.15	-0.05
Cournot				1.00	-0.12	-0.26 *	0.25 *	0.17	-0.21	-0.06	0.20	0.21	-0.31 **	0.35 **	-0.42 ***
P. eff.					1.00	0.48 ***	0.33 **	0.10	-0.46 ***	-0.38 **	-0.23	-0.16	0.24	0.06	0.37 **
C. eff.						1.00	-0.02	-0.08	-0.36 **	-0.36 **	-0.25 *	-0.25 *	0.32 **	0.05	0.53 ***
RoC[c][1]							1.00	0.73 ***	-0.39 ***	-0.34 **	0.20	0.18	-0.28 *	0.30 **	-0.30 **
RoA								1.00	-0.03	-0.34 **	0.57 ***	0.59 ***	-0.26 *	0.21	-0.50 ***
C/I									1.00	0.37 **	0.19	0.42 ***	0.05	-0.08	-0.42 ***
TC/TI										1.00	0.11	0.06	-0.05	-0.14	-0.20
NIM											1.00	0.62 ***	-0.21	0.03	-0.63 ***
CM												1.00	-0.18	0.00	-0.58 ***
# Banks													1.00	-0.55 ***	0.51 ***
C_5														1.00	-0.37 **

a. Correlation between the Boone indicator and competition is negative, et cetera.
b. Correlation between profit X-efficiency and competition is theoretically ambivalent, but turns out positive in practice (p).
c. Return on Capital.

Explanation: Asterisks indicate significance levels: 1, 2 or 3 asterisks indicate the 90%, 95% or 99% confidence levels, respectively. Shading of the correlation coefficients indicates where negative correlation is expected, except for the right-hand column "Index" where correlations with the Index are positive instead of negative. (For the ambivalent Profit efficiency variable, this was done 'in retrospect'). The names of variables included in the Index are printed in boldface in the first column.

5. Banking on Lean – A Practitioner's View on Productivity in European Banking

Marc Niederkorn

Abstract

In a world where capital has become very costly (in particular when you need it) and where the access to liquidity is not 'free' any more, most observers agree that banks will need to fundamentally reduce their cost structure by 25 to 30% (at constant volumes) to keep generating a reasonable return on equity. In other terms, a major productivity improvement will be required from the sector in the coming years.

The trouble for banks is twofold: on the one hand, banking productivity is notoriously difficult to define and to measure and on the other hand, the track record of banks actually improving productivity is very disappointing.

Our experience as practitioners is that vast productivity improvements are possible (at current technology) as current productivity measured by standard industrial indicators such as Overall Process Effectiveness (OPE) is weak. Banks have largely failed to capture this potential in the past as their efforts have been flawed by 5 fundamental misconceptions.

Emerging evidence shows that well established industrial productivity improvement techniques can be successfully applied to financial services and can open up a new strategic playing field for early adopters.

5.1. A Practitioner's Way of Measuring Productivity in Banking

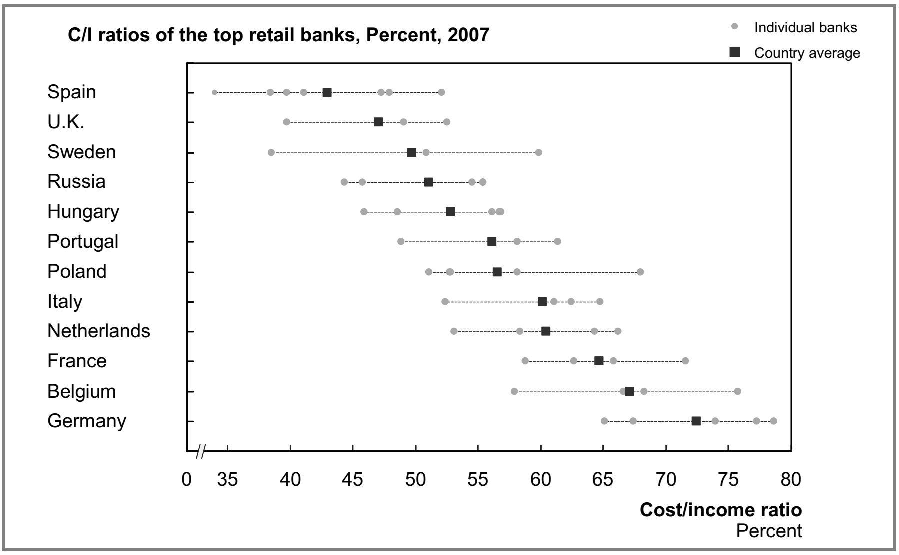
Banking productivity is notoriously difficult to define. There is abundant literature describing banking productivity indicators originating from aggregate national accounts data. Unfortunately, these analyses prove hard to use for practitioners due to their well known limitations. It has become common industry practice (by default) to compare Cost/Income or Efficiency ratios, typically defined as:

$$C/I_x = (P_x + N_x + D_x)/(I_x + C_x + T_x)^1 \qquad (1)$$

P_x	=	personnel cost of institution x
N_x	=	non- personnel cost
D_x	=	depreciation of physical assets
I_x	=	net interest margin
C_x	=	net commission revenue
T_x	=	net trading revenue

Unfortunately, C/I ratios are poor indicators to compare performance over time or between players as the revenue margins and product use patterns vary widely across geographies. A recent analysis of C/I ratios of a sample of top European and Russian retail banks suggests that the large Russian retail banks perform significantly better than banks in most other European countries and that the worst performer amongst the large Russian institution performs better than the average of the large French, Dutch or Belgian players[2]. For the reasons mentioned above, C/I ratio measures typically favor countries with a comparatively 'rich' product mix (*e.g.* strong reliance on consumer finance such as the UK) and high fee and/or float revenues (as found in many of the Mediterranean countries).

Figure 1: Cost to Income Ratios Provide a Highly Distorted View of Effective Banking Productivity



Source: McKinsey analysis.

1 The cost of risk is not taken into account in our definition of C/I or efficiency ratio.

2 In reality, the labor productivity in Russia's retail banking sector is extremely low, representing only 11 percent of US productivity levels in nominal terms and 23 percent when adjusted for the difference in income levels. Russia's productivity is low across all the services we examined, ranging from 4 percent in loans to 13 percent in payment transactions. The detailed analysis in described in McKinsey Global Institute (2009).

To compensate for these flaws, the McKinsey Global Institute (MGI) has developed and calculated a Retail Banking Productivity Index[3], which find useful for discussion with practitioners.

For a specific country, our Retail Banking Productivity Index compares the productivity in a given year to the productivity for the US in the year 2000.

$$P_{(a,t)} = A_{(a,t)}/A_{(US,2000)} \tag{1}$$

$P_{(a,t)}$ = Retail Productivity Index for country a in year t
$A_{(a,t)}$ = Absolute productivity for country a in year t
$A_{(US,2000)}$= Absolute productivity indicator for the US in 2000 (reference variable)

The absolute productivity indicator is the ratio between the Output Index (transactions or volumes) at standard margins and the Labor Input Index.

$$A_{(a,t)} = (O_{(a,t)}/L_{(a,t)}) * 1000 \tag{2}$$

$O_{(a,t)}$ = Output Index (at standard prices)
$L_{(a,t)}$ = Labor Input Index

The units of output are effectively 'normalized' whereby volumes (number of transactions or nominal amounts outstanding, deflated and converted to USD at PPP) are weighted by revenue margins at US 2000 prices.

$$O_{(a,t)} = (T_{(a,t)} * P_t) + (D_{(a,t)} * P_d) + (L_{(a,t)} * P_l) \tag{3}$$

$T_{(a,t)}$ = number of banking transactions executed (withdrawals, cheques, cards, credit transfers, debit transfers and E-Money transactions) in millions, as per ECB resp. national Central Bank statistics
$D_{(a,t)}$ = volume of bank deposits (current accounts, savings deposits and term money) deflated by the average consumer inflation index for the period 1995 to 2002 and converted into USD at 1995 Individual Consumption PPP
$L_{(a,t)}$ = volume of bank loans, whereby consumer loans are deflated by the average consumer inflation index for the period 1995 to 2002 and converted into USD at 1995 Individual Consumption PPP and mortgage loans are deflated by the average construction inflation index over the period 1995 to 2002 and converted into USD at 1995 Construction PPP
P_t = revenue per transaction in the US at 2000 US prices (total US transactions revenue divided by total US transactions volumes)
P_d = net revenue per million USD deposits (current account, term, and savings book) at 2000 US prices
P_l = net revenue per million USD loans (consumer loans, mortgages) before write-offs at 2000 US prices

[3] In this paper, we will discuss analyses and results exclusively at the level of individual countries (a discussion at the level of individual banks could equally make sense).

One of the limitations of the approach is that we are not able to take quality of output into account.

As far as input is concerned, we have focused on 'normalized' labor (taking into account outsourcing and adjusting for differences in hours worked in the different countries investigated). This approach does not take into account potentially different levels of historical and current IT and automation investments.

$$L_{(a,t)} = B_{(a,t)} * R_{(a,t)} * (1 + Q_{(a,t)}) * H_{(a,t)} \tag{4}$$

with

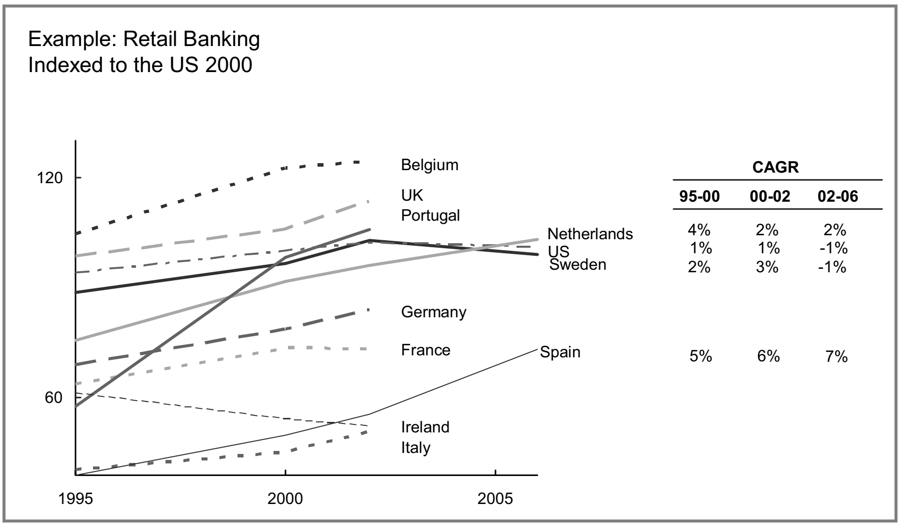
$B_{(a,t)}$ = total employment in the banking sector in terms of number of employees, as indicated by national employment statistics

$R_{(a,t)}$ = estimated percentage of employment in retail banking activities including operations and support functions (McKinsey estimate)

$Q_{(a,t)}$ = percentage of outsourced labor in retail banking (McKinsey estimate)

$H_{(a,t)}$ = conversion factor of employees to normalized full time equivalent (FTE) to take into account differences in terms of working hours, vacation times and banking holidays etc.

Figure 2: Productivity Indicator Has Historically Shown Significant Discrepancies Between European Countries



Source: National and international statistics; MGI; WMM; GPP McKinsey.

Our historical data series covering the 1995 to 2002 period had shown a number of interesting trends that the recent (partial) extension to 2006 has confirmed:

– productivity levels amongst European countries differ widely: our 2002 data had shown productivity in Belgium and the UK at over twice the level of Italy, Spain or Ireland[4];

- for the high performing countries, productivity improvement appears to be relatively slow (between 1-4% per annum) with some of the countries seemingly going into reverse (Sweden and US since 2002) potentially caused by particularly favorable market conditions that have allowed the banks to 'drop the ball' on productivity improvements;
- amongst the low performing countries, Portugal, Spain and to a lesser extend Italy have been catching up at an astonishing speed, whereas Irish productivity seems to have declined over the observation period. For the fastest improving countries, the data suggests improvements of about 5-7% per annum.

However interesting the comparison of these indicators collected at the level of individual institutions or activities may be, they remain much too aggregated to explore the very large productivity improvement opportunities that subsist, at current technology and service offering, even within the most productive European banks. To document this potential, it is necessary to turn to Overall Process Effectiveness (OPE), a methodology developed for understanding and quantifying productivity improvement potential in industrial settings[5].

The basic concept is relatively intuitive: OPE is the ratio between the productive time (roughly the time in which true value added is created and for which a demanding customer would be ready to pay) and the total time available (*i.e.* the time in which the team is available for work) measured at the level of individual processes. Conceptually, there are three sources of difference between both:

- *availability*: time spent on non-value added activities between production cycles. In banking, this corresponds typically to motion[6] and transportation[7], set-up and management time, controls or the temporal misalignment between availability of resources and demand (idle capacity);
- *performance/speed*: the speed at which individual operators execute tasks often varies widely so that there is a large gap between ideal and actual cycle time. This is partially due to lack of training (less experienced operators take a lot longer to get a task done) and/or to the absence of Standard Operating Procedures (the correct way of executing a task is insufficiently documented and shared between operators);

4 A commonly held view is that productivity is positively correlated with the degree of consolidation in banking in a particular geography. Indeed, in countries such as the Benelux and Scandinavia, the banking sector has reached a very high degree of concentration, the concentration in Spain, Portugal and particularly Italy is progressing whereas geographies such as France and Germany have made little progress in that direction over the recent years.

5 The methodology underlying the 'Lean banking transformation' approach is derived from the Toyota Production System (TPS) as originally published in Womack *et al.* (1990). Their application to banking is described in McKinsey & Company (2008).

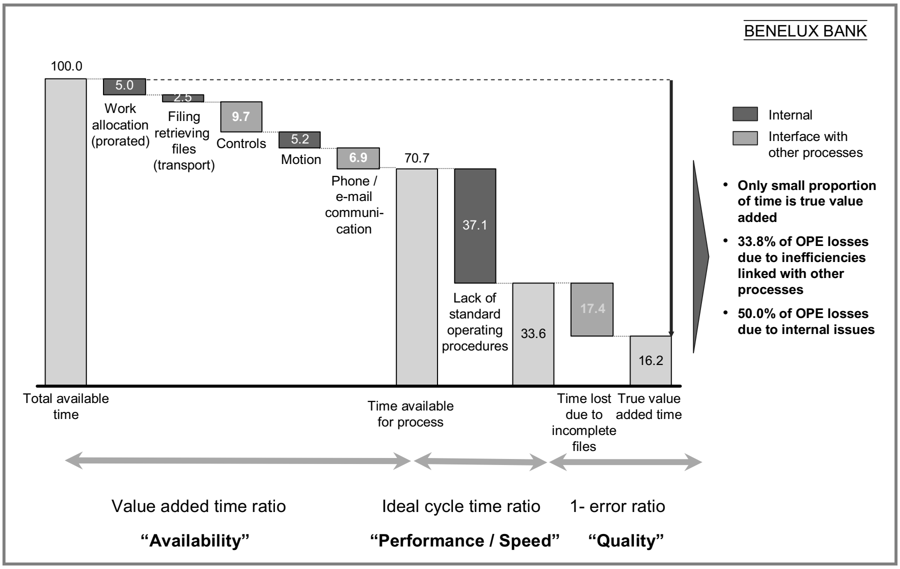
6 Motion is the time spent by operators moving around in the working area (from workpost to spare part, archive, printer, etc.).

7 Transportation is the fact that material is moved around between workposts, departments (physical inventory, paper or electronic files, etc.).

– *quality*: the percentage of procedures that are not performed right first time, leading to significant rework or that are performed to standards above what the client requests and is ready to pay for.

In optimized industrial settings, it is not exceptional to find OPE measurements between 60 and 80%[8]. Our experience in leading financial institutions in high performing geographies shows that banking OPE measurements are typically in the high tens or low twenties. So, even if there is a certain degree of methodological interpretation and therefore potentially an error margin in this approach, it is clear that substantial opportunity for improvement still remains untapped.

Figure 3: Significant Improvement Potential even for a Player from a Top Country – Example: Mortgage Origination



Source: McKinsey analysis.

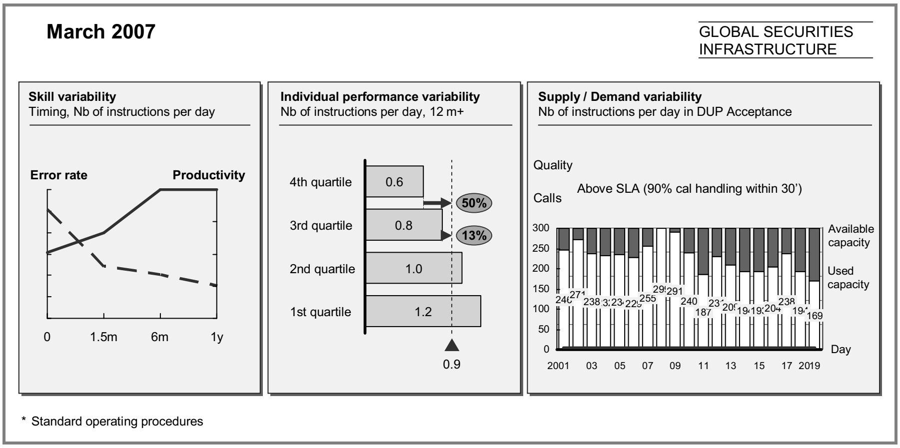
The figure above shows an example of a Benelux bank's mortgage origination process. Of the 100 units of total available time, only 71% is available for the process itself, and just 16% is true value-adding time. A third of time is lost due to inefficiencies linked to other processes, such as communications, while half is lost due to inefficiencies with the origination process itself.

The ambition is not to eliminate all coordination and control tasks and thereby increase the risk profile, nor to lower service standards for customers. Indeed, the

8 In automotive assembly, OPE measurements of 70-85% are seen as good practice, whereas Aerospace manufacturing is typically at 50-70% and the best performing high tech assembly lines (*e.g.* computer assembly) clock in at 80-90%.

figures in our example are such that, by eliminating only 15% of time loss (say by improving standardization, eliminating unnecessary motion and ensuring completeness of files), the physical output of the unit could be doubled using the current technology.

Figure 4: Variability Can Be Split between Skill and Individual Rigidity Exists because of Mismatch of Supply/Demand



Source: McKinsey analysis.

In most service industry settings, variability is the single most important productivity improvement opportunity. The example above illustrates typical findings, grouped into skill variability (*i.e.* the build-up of performance as a function of time on the job), individual performance variability (*i.e.* the difference in output between operators of a similar tenure) or supply/demand variability (loss due to the inadequate alignment of available labor to service demand).

To summarize, the 'industrialization' of banking through the application of lean approach is the key to significant productivity improvements. Our work over the last years shows that such potential is available not only in low STP rate[9] processing environments, but also in distribution networks, highly automated back-offices, IT application development, maintenance and infrastructure management environments as well as in support and overhead functions.

[9] Straight-Through Processing rate indicates the percentage of transactions that are executed without human intervention.

5.2. REASONS FOR OVERLOOKING LARGE UNTAPPED PRODUCTIVITY IMPROVEMENT OPPORTUNITIES

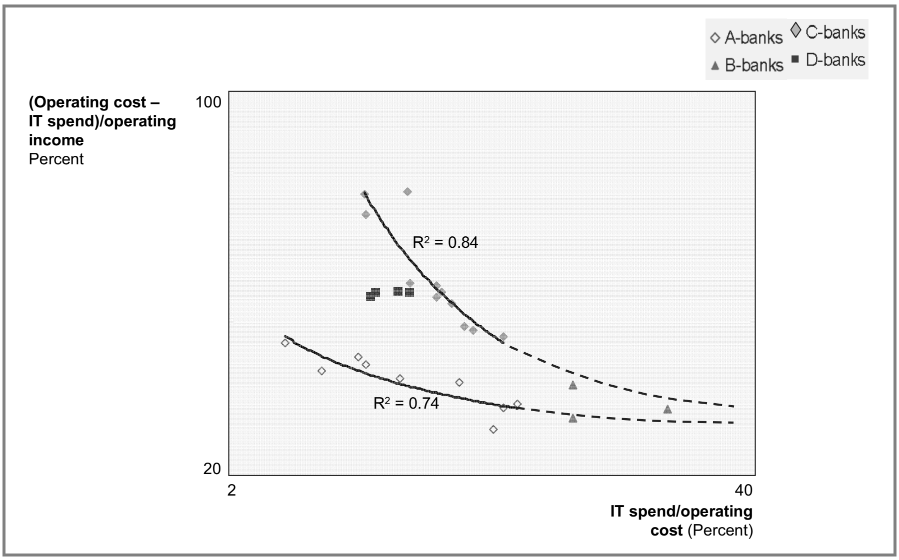
We regularly encounter five misconceptions about productivity improvement in banking that seriously hinder progress.

5.2.1. Myth #1: Productivity Can only Be Improved through Massive IT Investments

For many bankers, significant performance improvement can only be achieved through the injection of vast amounts of new (IT) technology. Our annual IT Cost Benchmarking Survey shows that financial services typically spend between 16-24% of their operating cost on IT. Although wholesale banks clearly are the highest spenders, retail and universal banks still remain at a hefty 18-19% of their operating cost.

One would hope that the cost-benefit analysis of such an enormous investment (we are talking after all about EUR 75-80 bn p.a. for European banks alone) would bear its fruits (for example by significantly lowering other operational expenses). On an aggregate level, the evidence for this being the case is far from clear.

Figure 5: Many Banks Have Reached a State of Maturity where Performance Improvement Is De-correlated from IT Spend



Source: McKinsey European Banking IT Cost Benchmark.

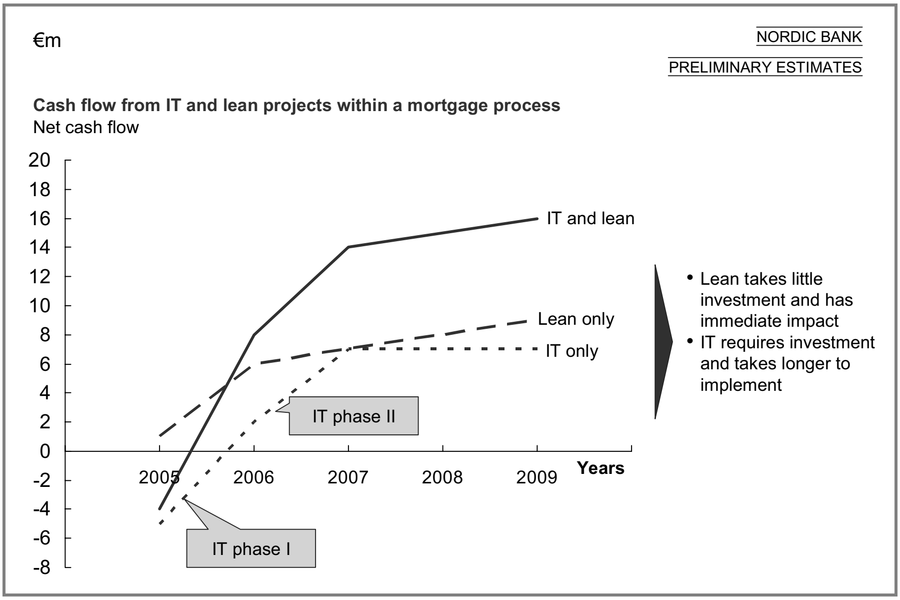
Our annual IT Cost Benchmarking survey[10] conducted amongst top European banks suggests that if for certain banks (C-Type)with particularly poor operating performance, there seems to be a positive correlation between IT spend and steep performance improvement (in our case operating cost/income corrected for IT spend) for many banks (A and B type), the improvement curve is essentially flat. One could argue that these banks have already reached a stage of maturity where any further increase in IT spend will have a limited or no effect on productivity.

Our practical work shows that in fact, most of the inefficiencies in banking are fairly low-tech: production flow is not understood and 'production lines' are inadequately balanced, customer demand patterns are not taken into account properly and capacity is not sufficiently adjusted, operational footprint is not optimized and variability is not managed. More importantly, large-scale IT investments often fail to address these issues adequately as they largely happen outside of the strict process perimeter or because the IT platform replacement is so disruptive that all the energy goes into building, testing and stabilizing the new environment rather than optimizing the way in which it is embedded into production reality. Consequently, the return on IT investment is often disappointing.

The fundamental mistake that is systematically made when discretionary IT spend is decided is that the alternative route of capturing improvement potential by addressing the operations fundamentals without significant IT investment is not explored. In the event that this is done, we systematically observe that operational improvement initiatives yield superior productivity improvement potential (often destroying the case for IT investment) and that the combination of 'lean' techniques with limited additional IT investments are almost always the right route for mature institutions.

10 See McKinsey & Company (2006) based on McKinsey's 2005 survey of IT cost in 37 European banks.

Figure 6: Understanding the Case for Lean vs. IT Investments



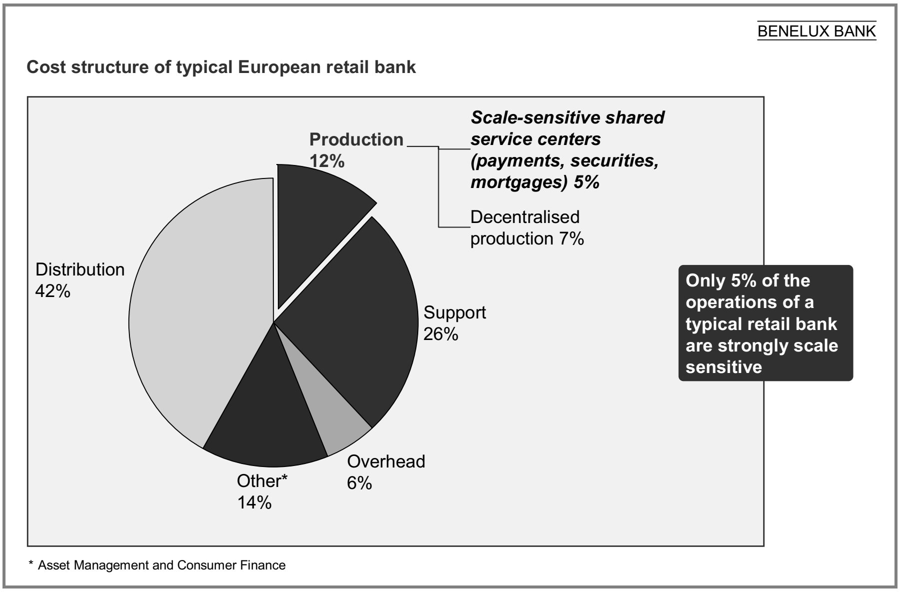
5.2.2. Myth #2: It's either Cost or Quality

A common belief is that cutting cost and streamlining processes must automatically mean that quality will drop off and that, for sure, risk will increase. The experience in manufacturing industries proves to be exactly the opposite. The elimination of waste, variability and inflexibility from a production process will not only reduce cost but, if correctly undertaken, will also improve quality simultaneously. With regard to operational/process risk, the elimination of long lead times will surface mistakes, errors as well as rogue behavior faster and the reduction of tolerance for process variability considerably strengthens the hands of those that control compliance and the respect of procedures.

5.2.3. Myth #3: Big is Beautiful – It's All About Economies of Scale

Harking back to those days of large-scale industrial production lines where size really mattered is no longer especially helpful. If we break down the cost structure of a typical European retail bank we see that only 5% of the cost base can be attributed to 'scale-sensitive' processes. The vast majority of cost is due to distribution and support cost (branches, call centers), which in the best case are sensitive to the concentration of local market share but not to scale as such.

Figure 7: In Many Instances, Scale Does not Matter All That Much



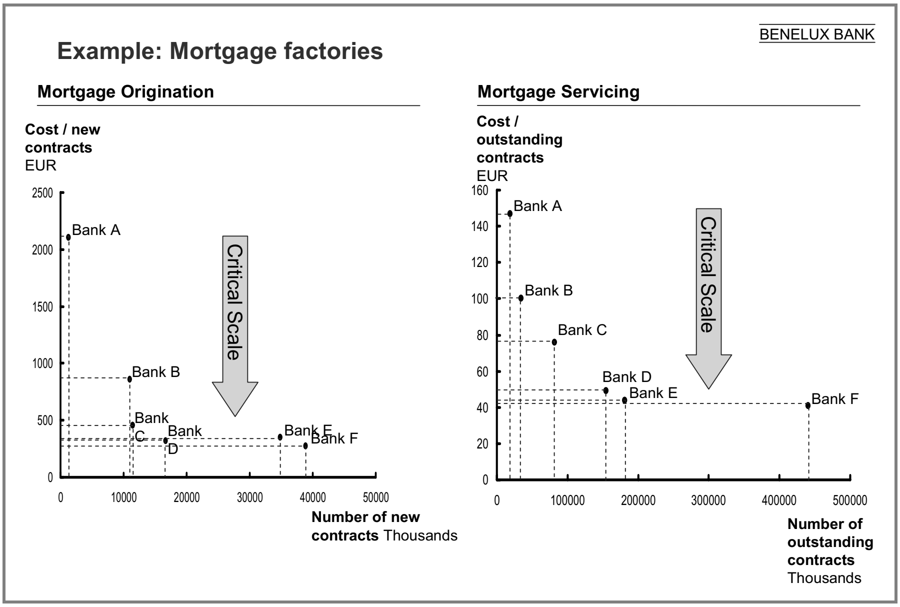
Source: McKinsey.

So, there is less room for maneuver here than might be thought. In addition, the leading European retail banks have already reached critical scale.

In mortgages for example, our analyses show that critical scale is reached at a production of about 30,000 new mortgages per year: at this level, doubling production volume would lead to less than 10% unit cost reduction (the same is true for mortgage servicing contracts above approximately 300,000 outstanding contracts). Banks with 1-2 million retail customers are highly likely to reach these production levels. In other terms, for most of Europe's leading banks, focusing on additional scale to reduce cost misses the point and proves a distraction rather than a key to success.

In general, scale is not irrelevant, but clinging on to the simple belief that building scale will be enough to deliver major savings and quality improvements will result in falling a long way short of the actual improvement potential.

Figure 8: The European Retail Banking Leaders Have Reached Critical Scale – Example: Mortgage Factories



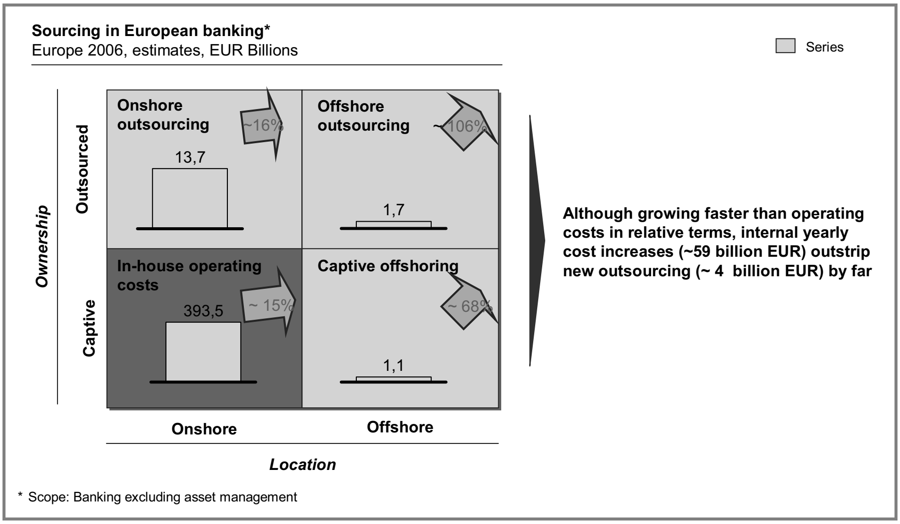
Source: Data requests; McKinsey analysis

5.2.4. Myth #4: Outsourcing & Offshoring Is Essential

By far the largest portion of the European banks' operating costs are still in-house. Captive onshore costs in 2006 were estimated to be 96% of operating costs. It is true that the share of offshore and outsourced costs is rising faster relatively than the captive onshore costs, but the volumes are still tiny in comparison.

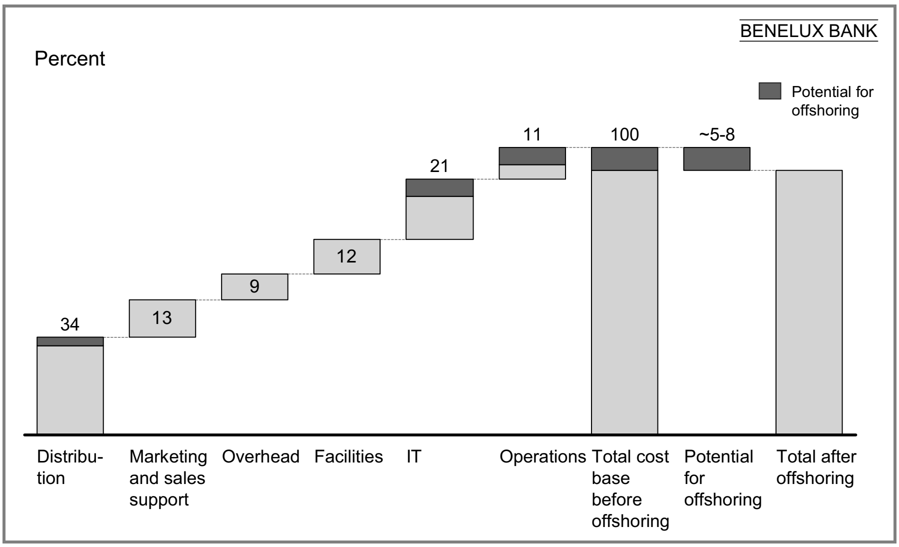
There is a reason for this: for a traditional European retail bank, only a limited part of the cost base can effectively be considered for offshoring: even if language concerns can be addressed, our experience shows that typically less than 10% of the total cost base (mostly centralized operations, IT application development and maintenance and some parts of infrastructure management) can be offshored. Even assuming that banks take a quite aggressive stance, the effective impact on the cost base would be limited, with a total impact on the C/I ratio of less than 5%. So although it is certainly a good idea to consider offshoring and outsourcing where appropriate, under no circumstances should it be seen as the only route to cost improvements.

Figure 9: Most of the Banks' Operating Cost Are Still In-house...



Source: Gartner; NASSCOM; McKinsey.

Figure 10: In European Retail Banking, Offshoring Impact Is Limited to 5-8% of Cost Base or 2-4% of C/I Ratio

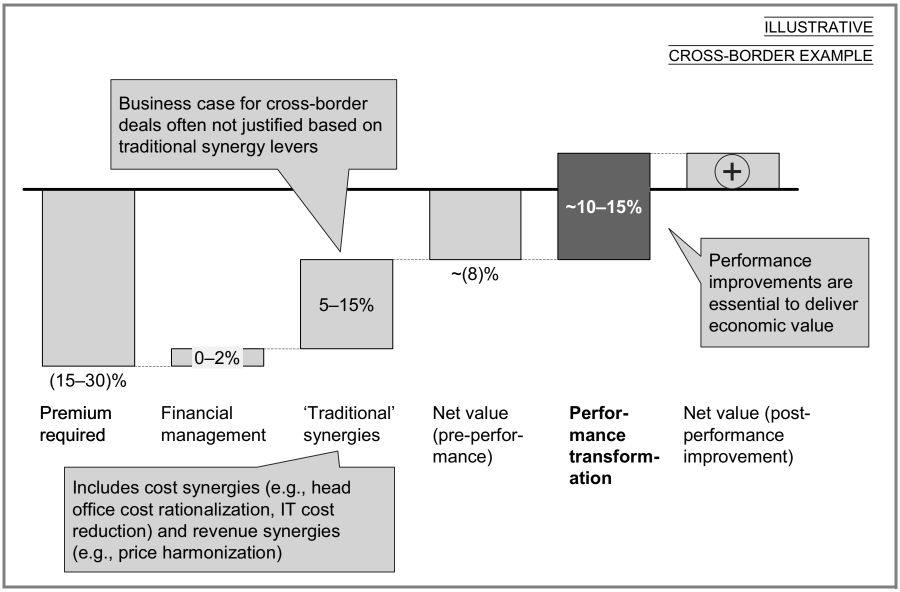


Source: McKinsey analysis.

5.2.5. Myth #5: Cross-border Consolidation Is the Key

We have already discussed the limitations of scale as a lever to improve productivity. Capturing these improvements across borders while dealing with different cultures, consumer behaviors and regulatory nuances is even more difficult.

Figure 11: Achieving Value From Cross-border M&A Requires that Acquirers Focus on Performance Transformation of the Target Banks



Source: Predator Strategies – How to Create Value From Cross-Border M&A in European Banking.

Over the last decade, cross-border acquisitions have typically required a 15-30% premium above pre-transaction market valuation of the target. Shareholders of the acquiring company should be ready to pay such an acquisition premium only if they believe that the transaction and subsequent consolidation can create more value for them (otherwise they would be better off holding both company stocks separately).

However, the numbers work typically against them: traditional cross-border (cost and revenue) synergies rarely justify a premium of more than 5-15% of the value of the target. Additional financial optimization may in some cases generate an additional 1-2%, leaving a large gap to justify such transactions. Numbers only add up if the acquirer believes that significant stand-alone process improvement can be realized in the target institution (which in theory could have been achieved by the target stand-alone or by a determined in-market buyer).

For acquiring banks that have already been through a lean transformation, transferring their expertise to the acquired entity is a powerful way of maximizing the value of the acquisition. Staff members who have lived through a lean program and seen how effective it can be are often the most effusive evangelists when taking the concept to a newly acquired bank.

The significant gaps in productivity across geographies could lead to the idea that players from higher performing countries should be well positioned to export their superior performance to players from lower performing countries. However, many of the most spectacular recent cross-border moves have been initiated by leading players from mid- to low performing geographies (Spain, Italy, France) acquiring groups in higher performing environments (Germany, Benelux or the UK). In other terms, cross-border consolidation is more often driven by a grand vision and a cost cutting determination than by the certainty to generate tangible operational improvement.

5.3. How Fast Will Banks Be Able to Tap into this Large Improvement Potential?

If the awareness of the existence of such a large improvement potential increases rapidly amongst European financial institutions, capturing it will take the industry a long time. The US car industry[11] as a sector had started to realize in the early 1980s that Japanese manufacturers were operating at a very different level of productivity. Despite intensive study and various forms of partnership, it took the 'big three' US manufacturers[12] over 15 years until they were able to reach the efficiency levels of the Japanese transplants in the US. Why is this?

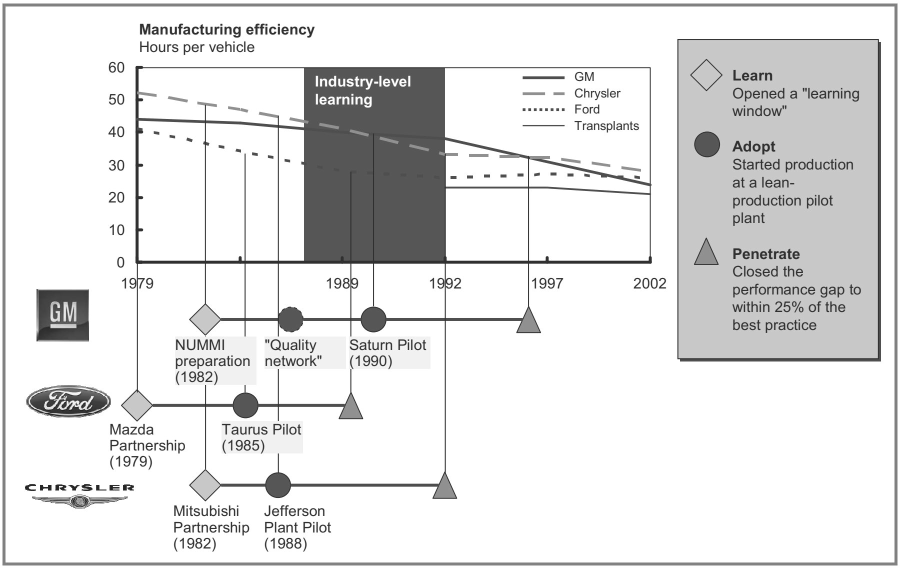
The first difficulty is the granularity of the issue. In-depth operational transformations require detailed analysis and redesign at the level of individual processes. Given the complexity of European universal banks, this often means covering teams of no more than 50 to 80 people, with limited replication potential across the organization. In other terms, to transform a large European bank, between 1000 and 2000 small (3-4 months) transformation initiatives have to be staffed, launched, coordinated and steered.

The second difficulty is the availability of skills. To successfully lead an operational transformation that captures the available potential, it is necessary to rely on transformation experts who are able to combine a deep understanding of existing banking processes, mastery of the diagnostic and redesign toolkit, strong communication, coaching and leadership skills and a hands-on pragmatic

[11] See McKinsey & Company (2005).
[12] General Motors, Ford and Chrysler.

approach. While manufacturing has invested heavily in these profiles over the last 15 years, they remain quite rare in banks. Training such experts is possible but requires approximately 6-8 months, alternating between classroom and field work. Approximately 0.5 to 1% of employees need to be trained to be able to sustain the scaling-up of such a transformation, which is equivalent to about 500 to 1,000 experts for a large institution.

Figure 12: It Took the 'Big Three' US Automotive Manufacturer 15 Years to Catch Up With the Efficiency of Japanese Transplants



Source: Harbour Report; Literature search; MGI.

The third reason is the lack of focus. In many areas of manufacturing, a price-cost squeeze of 3-5% per year has been the norm for decades. Not so in banking: periods of heavy profit pressure alternate with periods of rapid profit growth due to exogenous factors such as interest rate levels and favorable shape of the yield curve or various types of asset bubbles. Under such favorable circumstances, top management loses the focus on operational improvement and re-orients efforts towards growth and expansion, stalling operational transformation programs. The granularity of the effort and the need to build skills often result in a lead time of 2-3 years before the impact becomes material at the level of a large organization. As the boom-and-bust cycles have been rather short over the last decade, many interesting initiatives launched in 2002-2003 lost momentum before they were able to fully blossom and are hard to re-launch at short notice.

As a consequence, it is unlikely that the industry as a whole will be able to capture the benefits rapidly. On the other hand, those institutions that are able to apply these techniques and capture the benefits will have created a (rare) form of sustainable competitive advantage for themselves and will have 'earned the right' to further growth.

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6. Integration and Efficiency in EU Banking Markets

Barbara Casu and Claudia Girardone

Abstract

The creation of the single market for financial services aimed at fostering integration through the creation of a 'level playing-field' in the provision of banking and financial services across the European Union. Increased integration was in turn expected to promote both competition and efficiency in EU banking markets. In this context, evidence of financial integration and convergence are considered of importance in assessing the outcome of EU deregulation policies. This paper evaluates the recent dynamics of bank cost efficiency in the EU-15 banking markets, prior to the 2004 round of accessions (Fifth Enlargement). Further, to assess the impact of integration on bank cost efficiency, we apply the concepts of β- and σ-convergence with dynamic panel data models (GMM). Specifically, we test for convergence both towards a common EU average efficiency level and towards the best practice frontier. Results seem to provide supporting evidence of convergence of efficiency levels towards an EU average. Nevertheless, there is no evidence of an overall improvement of efficiency levels towards best practice.

6.1. Introduction

During the past two decades, the deregulation of financial services in the European Union (EU), together with the establishment of the Economic and Monetary Union and the introduction of the euro, aimed at fostering integration through the creation of a level-playing-field in the provision of banking services across the EU. The plan was to remove entry barriers and to promote both competition and efficiency in national banking markets. Indeed, in the calculation for gains from European integration in financial services, it was assumed that banks in different countries would become equally efficient with the removal of cross-border restrictions (Altunbas and Chakravarty (1998)). It was also expected that deregulation-induced competition would foster efficiency by providing incentives to managers to cut costs in order to remain profitable. EU regulators believe that a well integrated financial system is necessary to increase the efficiency of the euro area economy by reducing the cost of capital and improving the allocation of financial resources (see ECB (2005)). As a consequence, it is important to monitor and understand the process of financial market integration. In addition, as further integration is promoted at the EU level, it is also crucial to measure accurately the state of integration in various segments of the single market.

In this context, an integrated financial market is defined as a market where participants with the same relevant characteristics: (a) face a single set of rules; (b) have equal access to financial instruments and/or services; and (c) are treated equally when they are active in the market (Baele *et al.* (2004)). The above definition of financial integration is closely related to the law of one price, which states that if assets have identical risks and returns, then they should be priced identically regardless of where they are traded. Based on the law of one price it is possible to derive measures of integration. For example, the cross-sectional dispersion of relevant variables (such as interest rate spreads or asset return differentials) is often used as an indicator of integration. Recent studies of price convergence include Martín-Oliver *et al.* (2005, 2007)); De Graeve *et al.* (2007); Vajanne (2007); Gropp *et al.* (2007); Affinito and Farabullini (2006). The concepts of β-convergence and σ-convergence can also be used to assess the speed at which markets are integrating. In addition, measuring the degree of cross-border price or yield variation relative to the variability within individual countries may be informative with respect to the degree of integration in different markets[1].

The literature investigating the degree of financial integration in the EU financial markets (see, among others, Cabral *et al.* (2002); Hartmann *et al.* (2003); Baele *et al.* (2004)) has employed different indicators of integration and focused on different sectors of the markets (equity markets, bond markets, wholesale and retail banking markets, etc.).

This study aims to contribute to the current debate by investigating the impact of integration on the cost efficiency of EU banking markets. As our definition of financial integration is closely related to the law of one price, this allows us to examine the link between the dynamics of efficiency and financial integration. The concept of price convergence implies that, in case of increased integration, price differentials for the same financial asset should be either eliminated or greatly reduced overtime. This should also apply to the factors of production. Consequently, if factor input prices (*i.e.* the cost of capital, labour and deposits) are converging across the European Union, so should banks' cost structures, reflected in a convergence of cost efficiency scores. On the other hand, if country differences in observed cost efficiency levels remain (that is, if there is no evidence of increased convergence), it would imply that the regulatory removal of cross border restrictions alone was not sufficient to equalise the overall efficiency of EU banking systems and that country specific structural differences remain relevant.

[1] See Baele *et al.* (2004) for a review of different measures of financial market integration.

While measuring convergence towards a European average efficiency level is relevant in the context of the single market for financial services, measuring convergence towards the best practice frontier (that is, the maximum attainable efficiency) is even more interesting from a regulatory point of view. Increased integration is supposed to bring about improvements in cost efficiency via increased competition (Guiso *et al.* (2004)). If the process of EU integration had a positive impact on bank cost efficiency, this should result in an increased speed of convergence towards best practice (*i.e.* an overall improvement of efficiency levels over time).

In this study, we evaluate cost efficiency by means of Data Envelopment Analysis (DEA) for the EU-15 countries prior to the latest round of accessions in 2004. To assess the speed at which markets are integrating we employ the concepts of β-convergence and σ-convergence and we apply a dynamic panel data analysis. We specifically test for convergence both towards a common EU average efficiency level and towards the best practice frontier.

Results seem to provide supporting evidence of convergence of efficiency levels towards an EU average. Nevertheless, the results also indicate a decrease in performance of the best practice banks, evidenced by a decrease in the overall efficiency levels.

The remainder of the paper is structured as follows. Section 2 briefly illustrates the main milestones towards the creation of a single EU market for financial services. Section 3 reviews the main literature on integration and efficiency in banking. Section 4 discusses the results of our empirical analysis and Section 5 concludes.

6.2. INTEGRATION IN THE EU FINANCIAL SERVICES SECTOR

Since the 1985 White Paper on the completion of the internal market in Europe[2], much has been done to remove barriers to the integration of financial and banking markets. Indeed the creation of a single market for financial services has long been an objective of EU policymakers to achieve a ‘level playing field’ for banks, insurance, securities and asset management companies. The single market was expected to bring about enhanced economic and productivity growth across all sectors, better quality financial products and lower costs for consumers and businesses.

[2] The 1985 White paper set out a timetable for the measures required for the completion of the single market by 31 December 1992 at the latest.

Despite the regulatory emphasis, the process of integration of financial services has been slower than in other sectors due to national governments' reluctance to open up to foreign competition and to cede control of activities in their own national markets, particularly in relation to monetary policy. In addition, as stressed by Gual (2003) ensuring free trade and cross-border investments in a traditionally heavily regulated industry, as is banking, is especially complex.

Nonetheless, in recent years significant progress has been made towards the liberalisation, integration and harmonisation of laws and practices in the EU member states. The developments in the context of the Economic and Monetary Union (EMU) and the introduction of the single currency in 1999 have undoubtedly acted as a catalyst for integration. In a recent White Paper on Financial Services Policy (2005-2010), the European Commission (EC) has re-emphasised the need to complete the single market in financial services, to achieve a "more dynamic, innovative and attractive Europe". Table 1 reports the main steps towards the creation of a single market for financial services since the First Banking Directive in 1977.

A significant milestone was the ratification of the 1989 Second Banking Co-ordination Directive which established EU-wide recognition of single banking 'passports' issued in any Member State as well as the principle of home-country supervision with minimum standards (including capital) at the EU level. The two principles of single passport and mutual recognition (*i.e.* a system that allows licensed banks to set up branches across states while being subject to each state's rules and regulations) still constitute the basis of the EC's policies in the area of financial services where the integration of banking markets is considered a core component.

Table 1: Main Steps Towards the Creation of a Single Market for Financial Services in the EU

Year	Events and directives
1977	First Banking Directive
1979	Launch of the European Monetary System (EMS)
1988	Basle Capital Adequacy Regulation Deregulation of Capital Movements in the European Monetary System (EMS)
1989	Second Banking Directive Delors Report
1993	Investment Services Directive
1999	Financial Services Action Plan (FSAP) Launch of the single currency (EURO)
2000	Directive on e-money
2001	Directive on the Reorganisation and Winding-Up of Credit Institutions Regulation on the European Company Statute
2002	Establishment of the central banks' large- value payment system (TARGET) European Council decision to extend Lamfalussy procedure to entire financial sector Establishment of the European Payments Council (EPC)
2004	New EU Takeover Directive
2005	White Paper on Financial Services Policy
2007	Capital Requirement Directive (Basle II) Markets in Financial Instrument Directive (MiFID)

Source: Adapted from Casu et al. (2006) and Casu and Girardone (2009).

Among the more recent policies, the Financial Services Action Plan (FSAP) represented an important vehicle for working towards the goal of greater integration. The aims of the FSAP were to promote a more competitive and dynamic financial services industry by establishing a single market in wholesale financial services; making retail markets open and secure; and strengthening prudential rules. Although the FSAP has been successfully completed, in 2005 the Commission concluded that many barriers to cross-border integration and competition in Europe remained. While global competition intensified, the EU financial services industry still had "strong untapped economic and employment growth potential". The White Paper on financial services policy that followed (2005-2010) represents the EC's current financial services strategy "to effectively deliver further benefits of financial integration to industry and consumers alike".

Although the integration of wholesale financial markets in the EU has progressed relatively fast, there are still obstacles to the integration of retail financial services. These remain segmented primarily on national lines thus calling into question the competitive conditions of EU banking markets (ECB (2008); Casu and Girardone (2009)).

The local features of retail markets, compared to money and bond markets, have also been highlighted in the latest European Financial Integration Report (EC (2009)). Specifically, the report found that heterogeneity still exists on prices, available products and distribution channels; and legal and cultural factors still represent obstacles to full integration. The report highlights the key role of the successful implementation of the Markets in Financial Instruments Directive (MiFID) and the Single Euro Payments Area (SEPA) to speed up the pace of financial integration in retail markets.

6.3. LITERATURE REVIEW

Several studies investigate the existence and implications of financial convergence in Europe, especially in relation with the deregulation process, the creation of the single market for financial services and the introduction of the euro. Convergence in banking is often analysed by testing the time trends of a number of aggregate and micro level indicators. Recent empirical evidence suggests that the sustained legislative changes at the EU level have contributed towards the integration of European banking and financial markets (Goddard *et al.* (2007)). There is some evidence of integration in money, bond and equity markets (Emiris (2002); Hartmann *et al.* (2003); Baele *et al.* (2004); Manna (2004); Guiso *et al.* (2004); Cappiello *et al.* (2006)). There is also some indication of integration in wholesale banking (Cabral *et al.* (2002)). However, most empirical evidence suggests that significant barriers to the integration of retail banking markets still exist (Berger *et al.* (2001)).

There is a vast literature on the measurement of cost structure and efficiency in banking and on the determinants of efficiency (see the reviews by Goddard *et al.* (2001, 2007); Berger (2007); Hughes and Mester (2008)). Efficiency is commonly estimated by employing parametric methods (such as Stochastic Frontier Analysis, SFA) or non-parametric methods, the most popular of which is Data Envelopment Analysis (DEA). The early bank efficiency literature shows that before deregulation EU banking markets were often characterised by the presence of many institutions operating at a non-optimal scale with relatively high excess capacity. Inefficient banks could survive mainly because of the lack of competitive pressures and the fact that, in some cases, the domestic authorities, while acting as protectors of their banking sectors, were keen on maintaining a large number of banks in their systems. With deregulation and higher competition, EU bank efficiency improved, particularly over the late 1990s, as banks were under pressure to cut costs (see, among others, Amel *et al.* (2004) and Casu *et al.* (2004)). However, more recent studies show an overall decrease in bank efficiency (*e.g.* Casu and Girardone (2006); Maudos and Fernandez de Guevara (2007)).

Only a handful of studies directly address the issue of the relationship between the integration and efficiency. Tortosa-Ausina (2002) examines the convergence in efficiency of Spanish banks following deregulation through a model of distribution dynamics and find evidence of decreased dispersion of efficiency scores at the end of the deregulation period. Murinde *et al.* (2004) investigate the convergence of the banking systems in Europe following the launch of the single market programme in 1993. They find weak evidence of convergence and only for specific products. Finally, Weill (2008) attempts to provide evidence of financial integration by estimating the convergence of cost efficiency derived from the application of SFA methodology. His results indicate an on-going process of convergence at the EU level.

This study contributes to the existing literature by extending the analysis of financial sector integration to evaluate the recent dynamics of bank cost efficiency and their convergence both towards a EU-wide frontier and towards best practice.

6.4. EMPIRICAL RESULTS

The following sections present the results of the analysis of the dynamics of cost efficiency in the EU-15 banking sectors in the period 1997-2003. Our data set is primarily drawn from BankScope and includes annual information for an unbalanced panel of 11,000 observations between 1997 and 2003. The choice of an unbalanced panel is justified mainly to account for mergers and acquisitions during the period. We use data from consolidated accounts, where available, to avoid double-counting. The sample comprises commercial and savings banks operating in the EU-15 area. We focus on these two banking categories as they comprise the largest segment of depository institutions in all European banking markets. Further, the services they offer are reasonably homogeneous and comparable across countries. The time period 1997-2003 allows us to include the countries which joined in the so-called Fourth Enlargement (Austria, Finland and Sweden joined in 1995) but exclude the effects of the Fifth Enlargement in 2004[3], as there is not sufficient data availability as yet. The data were analysed for inconsistencies, reporting errors, missing values and outliers. The final sample is shown in Table 2, which lists the total and average number of banks in the sample by country and year. From Table 2 it is possible to notice that Germany is by far the country with the highest average and total number of banking institutions in our sample; whereas Finland is the country that presents the lowest number of banks over the period under study. However, as illustrated in Table 2, the average size of banks tends to be relatively high for countries where the number of banks is low and

[3] The Fifth Enlargement (Part I) occurred in May 2004, when Cyprus, the Czech Republic, Estonia, Hungary, Latvia, Lithuania, Malta, Poland, Slovakia, and Slovenia were admitted to the EU. The Fifth Enlargement (Part II) occurred in January 2007, when Romania and Bulgaria joined the EU.

vice versa. For example, the Netherlands have a relatively low average number of banks over the period but the average size of Dutch banks is the highest in the sample and more than 10 times higher than banks in Germany.

Table 2: Sample Used for the Empirical Analysis

Countries	Average number of banks 1997-2003	Total number of banks	% over total	Average size of banks (EUR m) 2003
Austria	101	706	6.4	4,509.07
Belgium	37	261	2.4	14,831.24
Denmark	84	590	5.4	40,951.35
Finland	8	53	0.5	22,431.03
France	150	1,047	9.5	24,475.70
Germany	686	4,805	43.7	6,092.81
Greece	14	98	0.9	11,675.19
Ireland	21	147	1.3	21,448.58
Italy	145	1017	9.2	10,873.20
Luxembourg	84	587	5.3	7,080.05
Netherlands	22	156	1.4	68,049.62
Portugal	17	121	1.1	16,236.84
Spain	100	703	6.4	15,036.03
Sweden	39	271	2.5	66,513.11
UK	63	438	4.0	42,280.57
EU-15	1,571	11,000	100	16,928.29

Source: Bankscope.

6.4.1. Efficiency Results

The yearly DEA results for the countries in our sample, as well as the average efficiency over the period are shown in Table 3.

Table 3: DEA Efficiency Scores by Year and Country (%)

Countries	1997	1998	1999	2000	2001	2002	2003	Average 1997-2003
Austria	71.30	85.30	81.30	84.40	78.60	73.10	76.30	78.60
Belgium	76.40	74.00	77.10	75.50	74.50	71.20	67.10	73.70
Denmark	76.40	79.40	75.90	70.30	76.90	77.40	70.90	75.30
Finland	97.80	95.30	97.80	69.70	85.40	85.30	68.60	85.70
France	55.70	68.00	55.70	71.20	67.60	78.00	75.70	67.40
Germany	67.20	63.50	67.20	67.00	69.30	68.30	71.80	67.80
Greece	91.60	85.30	91.60	89.30	91.00	88.40	76.70	87.70
Ireland	79.90	91.10	79.90	83.80	79.80	78.50	75.30	81.20
Italy	62.40	66.30	62.40	74.20	79.60	66.50	69.10	68.60
Luxembourg	66.40	66.10	66.40	72.80	54.50	62.30	61.10	64.20
Netherlands	82.40	74.50	82.40	86.30	86.90	84.90	76.20	81.90
Portugal	85.40	85.50	85.40	88.30	90.40	93.50	80.00	86.90
Spain	84.30	75.80	84.30	82.30	80.30	69.80	78.60	79.30
Sweden	91.60	87.40	91.60	57.00	51.20	77.40	59.60	73.70
UK	77.00	79.60	77.00	77.30	66.90	73.20	73.40	74.90
EU-15	77.72	78.47	78.40	76.63	75.53	76.52	72.03	76.46

The average overall efficiency score for the EU banking industry over the whole sample period is 76.5%, indicating a 23.5% average potential reduction in inputs utilisation. The results for the different EU countries in 2003, vary between 59.6% in Sweden and 80% in Portugal, with an average inefficiency score of about 20%, a result that is in line with the main literature on bank efficiency (see Berger (2007)). The yearly results seem to indicate, for most countries, an improvement in input utilisation in the first years of the analysis and an increase in input wastage from 2000-2001 onwards. This trend could be explained by the initial effort towards cutting costs fostered by deregulation and increased competition; the wave of mergers and acquisitions that followed might have imposed higher costs on banks, thereby decreasing their cost efficiency. However, it is necessary to point out that our results are static estimates obtained from yearly DEA frontiers, which allow for cross sectional comparisons, rather than considering the changes over time.

Before empirically investigating the issue of convergence, we analyse the distribution, dispersion, range and trends of efficiency levels across European countries. Figure 1 plots the standard deviation of the efficiency scores by year for all EU-15 countries included in our sample. The figure indicates that the dispersion from the average values has decreased considerably ($p = 0.085$) over the period thereby suggesting a trend towards convergence across countries.

Figure 1: Dispersion of Efficiency Scores (All Countries)

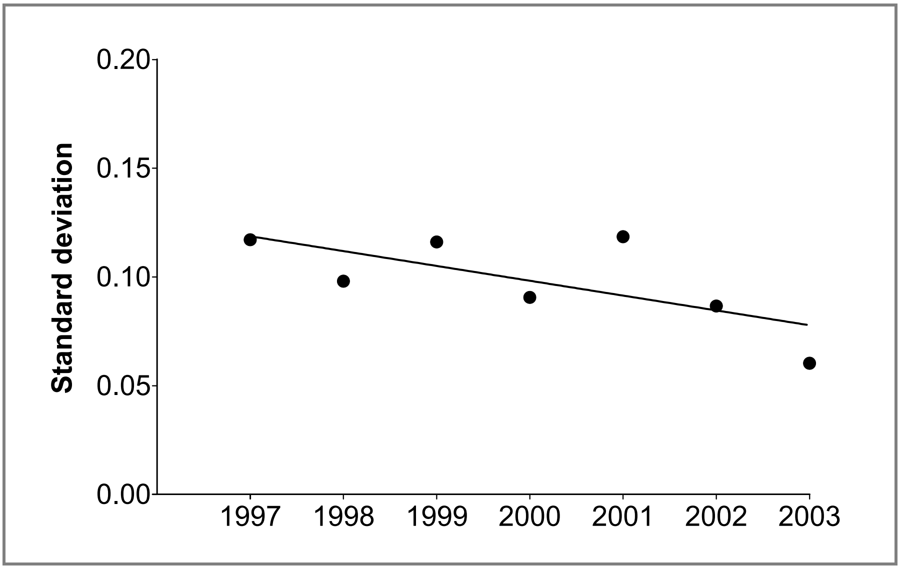
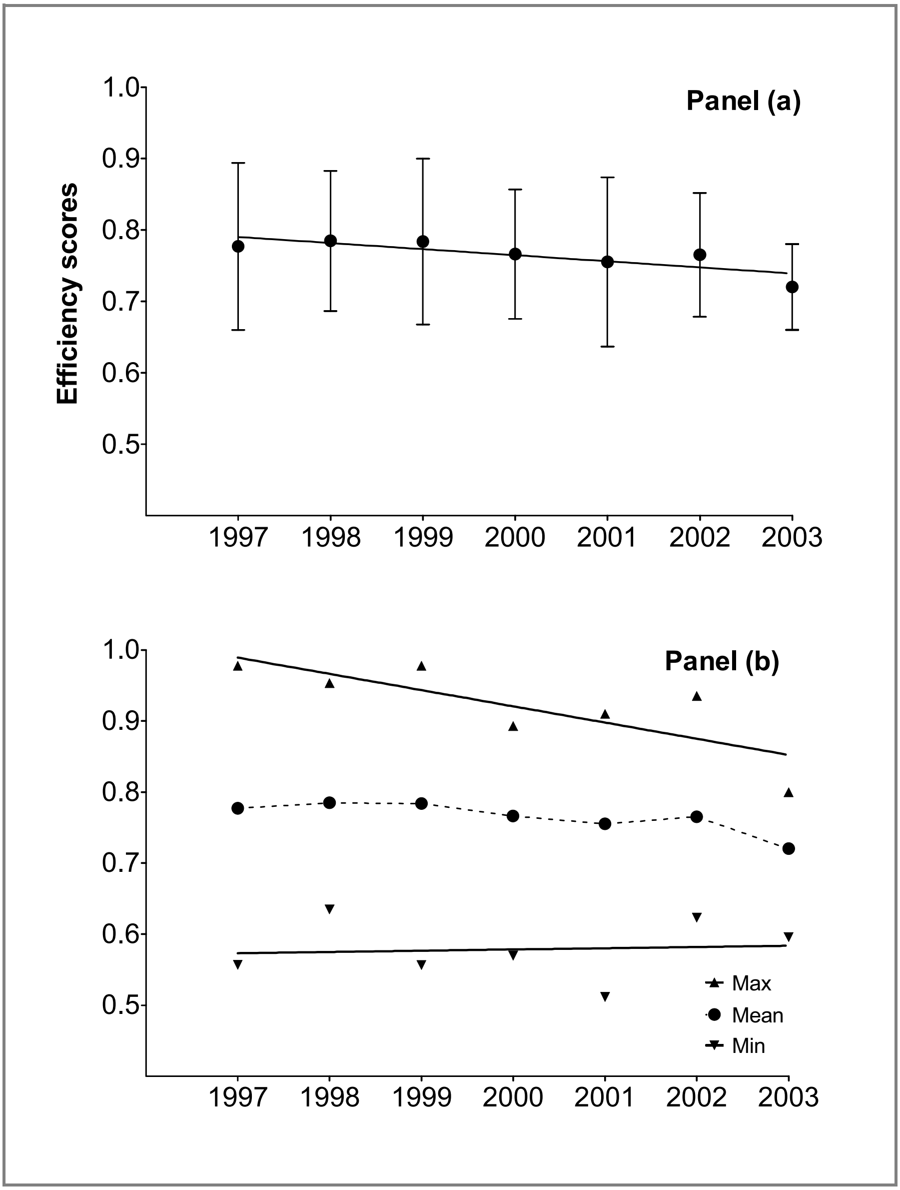


Figure 2 analyses EU banks efficiency range and trends over the period 1997-2003. Panel (a) shows that the average efficiency scores across EU-15 countries (± standard deviation) decreases over time ($p = 0.023$). Panel (b) illustrates the range (highest average efficiency score – lowest average efficiency score across EU-15 countries). It shows that while the lowest average efficiency scores each year have remained fairly constant ($p = 0.852$), the highest average scores have decreased significantly over time ($p = 0.034$). This trend is also picked up by the decline in average efficiency levels towards the end of the period. On the one hand, the findings illustrated in Figures 1 and 2 indicate that the efficiency scores for the EU-15 banking sector have tended to converge towards a common average. On the other hand, this preliminary analysis seems to suggest that the gains in increased integration have been offset by a worse performance on the part of the best practice banks as shown by the decrease of the highest average efficiency levels.

Figure 2: EU-15 Efficiency Range and Trends over 1997-2003



Panel (a): average efficiency scores across EU-15 countries (± standard deviation).
Panel (b): range of average efficiency scores across EU-15 countries.
Range = highest average efficiency score – lowest average efficiency score across EU-15 countries.

6.4.2. Evaluating Convergence of EU Banking Sector Efficiency

Convergence is a widely used concept in economic theory and, despite the fact that the meaning of the term is rather intuitive, there is neither a universally accepted definition of convergence nor a single way to model it (see Baumol, Nelson and Wolff (1994)). To investigate the convergence of bank efficiency levels across the EU-15 countries over the period of analysis, we borrow the concepts of β-convergence and σ-convergence from the growth literature (Barro and Sala-i-Martin (1991, 1992 and 1995); Quah (1996))[4]. In our study, we adapt the growth literature definition and we posit that there is β-convergence in a cross-section of countries if there is a negative relation between the growth rate in average efficiency and the initial level of efficiency. On the other hand, there is σ-convergence when the dispersion of efficiency scores across groups of countries tends to fall over time.

To examine to what extent the econometric application confirms the preliminary evidence discussed in Section 4.1, we evaluate therefore β-convergence and σ-convergence for our cross-section of EU countries for the period 1997-2003. All estimations are carried out by means of Ordinary Least Squares (OLS) and Generalised Methods of Moments (GMM)[5].

The first two columns in Table 4 report the results of the β-convergence and the last two columns illustrate the σ-convergence. The β coefficient is always negative and statistically significant, thus indicating that convergence in efficiency scores has occurred across countries in the EU-15 area.

4 In the growth literature, there is β-convergence in a cross-section of economies if there is a negative relation between the growth rate of income per capita and the initial level of income (Sala-i-Martin, 1996). 'Unconditional β-convergence' or 'mean reversion' is also often explained as the 'catch-up' effect. If poor economies grow faster than rich ones, then poor countries will catch up with the rich ones over time in terms of per capita income. 'Conditional β-convergence' instead relates to the negative relation between the growth rate of income per capita and the initial level of income after holding some country-specific variables (for example, human capital, propensity to save, etc.) constant. In other words, 'conditional β-convergence' relates to the negative partial correlation between growth and income.

5 For methodological details refer to the Appendix and Casu and Girardone (2009).

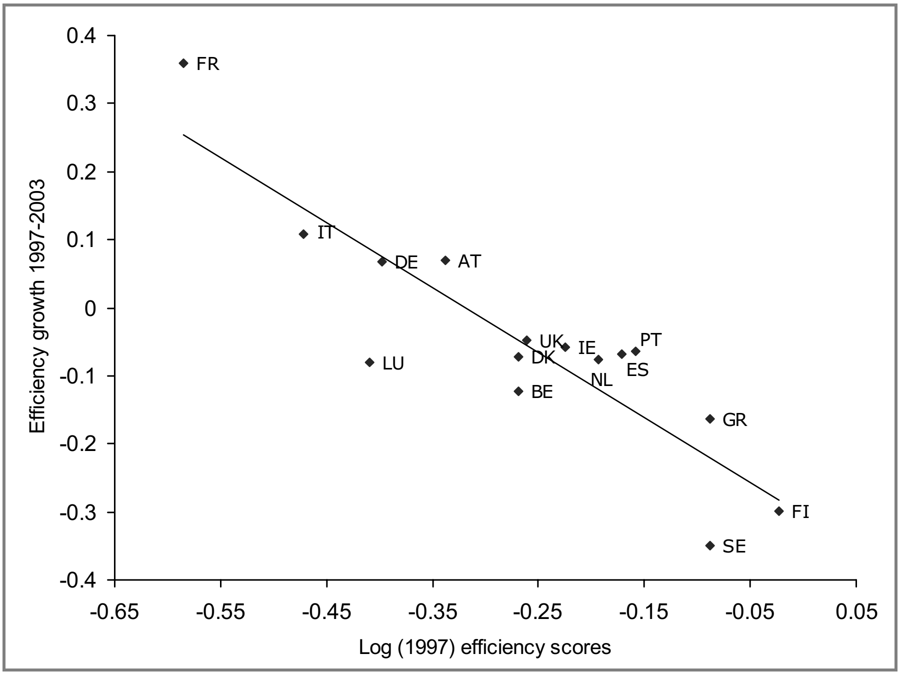
Table 4: Beta and Sigma Convergence

Coefficients	β-convergence (dependent variable Δy)		σ-convergence (dependent variable ΔE)	
	Pooled OLS robust	SYS-GMM two step robust	Pooled OLS robust	SYS-GMM two step robust
Β	-.3692*** (.1321)	-.5702*** (.2221)	–	–
Σ	–	–	-.3751*** (.1241)	-.5709*** (.2061)
Ρ	-.2816* (.1617)	-.1955 (.1388)	-.2699* (.1545)	-.1651 (.1486)
Constant	-.1162*** (.0376)	-.1676** (.0697)	-.0023 (.0121)	-.0050 (.0142)
Goodness of fit:				
R2	0.3153		0.3197	
m1 p-value		0.082		
m2 p-value		0.227		0.038
Sargan/Hansen		0.298		0.217

*Note: OLS= Ordinary Least Squares; SYS-GMM= System GMM. *,**,*** indicates significance at the 10%, 5% and 1% levels. Asymptotic standard error in parentheses. Δy is the change in the mean efficiency of country i between t and t-1; ΔE is the difference between mean efficiency of country i at time t and the average efficiency of the EU-15 countries at time t; β indicates the catch-up effect; σ indicates the speed of convergence and ρ is the coefficient on the lagged dependent variable.*
Two-step estimates are Windmeijeier corrected (Windmeijer (2005)). m1 and m2 are tests for first-order and second-order serial correlation. Sargan/Hansen is a test of the over-identifying restrictions for the GMM estimators.

Figure 3 shows the broad pattern of convergence of efficiency scores, indicating a strong negative correlation (-0.883) between the growth rate of efficiency scores over 1997-2003 to the log of the initial average efficiency in the base year (1997) for the EU-15 countries. It shows that countries that displayed the lowest efficiency values in 1997 improved faster, thereby providing preliminary evidence of efficiency catch-up among EU-15 countries.

Figure 3: Convergence of Efficiency Levels Across EU Banking Markets: 1997-2003[a]



[a] *AT = Austria; BE = Belgium; DK = Denmark; FI = Finland; FR = France; DE = Germany; GR = Greece; IE = Ireland; IT = Italy; LU = Luxembourg; NL = Netherlands; PT = Portugal; ES = Spain; SE= Sweden; UK = United Kingdom.*

The last two columns in Table 4 report the results for the sigma convergence. In our case sigma convergence indicates how quickly each country's efficiency levels ($y_{i,t}$) are converging to the EU average ($\bar{y}_t$). σ<0 represents the rate of convergence of $y_{i,t}$ towards $\bar{y}_t$; the larger is σ in absolute value, the faster the rate of convergence. Results for all the estimations suggest an increase in the speed of convergence as the σ coefficient is always negative and statistically significant.

The speed of adjustment towards the best practice frontier is evaluated by employing a partial adjustment model (PAM). The assumption behind such model is that if bank efficiency scores have improved over the period under observation, this should be reflected in a convergence towards best practice (efficiency score equal to 1). Specifically, we regress the natural logarithm of the change in efficiency levels on its lagged value, and on the interaction of the lagged value with a dummy variable *R*, controlling for the introduction of the euro. The estimated parameter on the interaction term (λ) is expected to offer information on the difference in speed of convergence after the introduction of the single currency. The partial adjustment model is estimated by pooled OLS and the results are showed in Table 5.

Table 5: Convergence Towards Best Practice (Dependent variable: Δy)

Coefficients	OLS robust
κ	.8745***
	(.0802)
λ	.07934
	(.0984)
Goodness of fit:	
R2	0.8459

*Note: *,**,*** indicates significance at the 10%, 5% and 1% levels. Asymptotic standard error in parentheses. Δy is the change in mean efficiency of country i between t and t-1; κ represents the persistence of inefficiency and λ indicates the change in the speed of convergence after the introduction of the Euro.*

In Table 5, κ represents the persistence of inefficiency and therefore a positive value of κ indicates lack of convergence towards best practice. λ indicates the change in the speed of convergence after the introduction of the Euro. A negative value of λ suggests that the introduction of the Euro failed to foster increased integration. The estimated coefficient of the one period lag of the change in efficiency is κ for the period 1997-1999 and is κ + λ for the period 2000-2003. The coefficient κ is positive and significant (at 1% level) therefore indicating a persistence of inefficiency. In other words, there is no evidence of convergence of efficiency levels towards best practice. The coefficient λ, on the other hand, although positive is not statistically significant, thus indicating that the introduction of the single currency had no effect towards increasing convergence and improving efficiency levels across EU countries. These findings support the preliminary graphical evidence reported in Section 4.1.

This latter part of the analysis has highlighted that convergence towards a common EU-15 average does not necessarily imply improvement of efficiency levels across Europe. On the contrary, while our results seem to provide supporting evidence of convergence of efficiency levels towards an EU average, they do not indicate efficiency gains. Therefore, it appears that the potential gains brought about by increased integration have been offset by a decrease in the overall efficiency levels. Whereas a well integrated and well functioning financial system is necessary to increase the integration of the euro area economy, it is important to monitor and understand the process of financial integration in various segments of the single market. While it is generally agreed that deepening financial integration is beneficial on the whole, it might also have negative effects. For example, integration in a particular market segment might lead to a high degree of consolidation which might hinder competition and efficiency.

6.5. CONCLUSION

It is a commonly held belief among EU regulators that a well integrated financial system is necessary to increase the efficiency of the euro area economy. In the overall calculation of potential gains from European integration in the financial services, it is often assumed that banks in different countries will become equally efficient with the removal of cross-border restrictions.

This paper provides evidence on the dynamics of cost efficiency in the EU-15 banking sectors in the period 1997-2003, prior to the latest round of accession. Cost efficiency is evaluated by means of Data Envelopment Analysis (DEA). The yearly results seem to indicate, for most countries, an improvement in input utilisation in the first years of the analysis and an increase in input wastage from 2000-2001 onwards. To assess the direction and speed of banking markets' integration, we apply dynamic panel data models to the concepts of β-convergence and σ-convergence. While measuring convergence towards a European average is important, measuring convergence towards best practice is even more interesting from a regulatory point of view. Indeed, convergence towards a common EU-15 average does not necessarily imply improvement of efficiency levels across Europe. Results seem to provide supporting evidence of convergence of efficiency levels towards an EU average. Nevertheless, the potential gains brought about by increased integration have been offset by a decrease in the overall efficiency levels.

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6.7. METHODOLOGICAL APPENDIX

6.7.1. Evaluating Bank Efficiency Using Data Envelopment Analysis (DEA)

DEA is a mathematical linear programming technique developed by Charnes, Cooper and Rhodes in 1978 (CCR) which identifies the efficient frontier from the linear combination of those units/observations that (in a production space) use comparatively less inputs to produce comparatively more outputs. The CCR model assumes constant returns to scale (CRS), which is the optimal scale in the long-run. Banker, Charnes and Cooper (1984) (or BCC model) include an additional convexity constraint (λ) to allow for variable returns to scale (VRS). The BCC model is used in this paper since several factors such as imperfect competition and regulatory requirements may cause a unit not to be operating at the optimal scale[6].

In particular, if at any time t there are N firms that use a vector of inputs $X = x_1, x_2, \ldots, x_k$ to produce a vector of outputs $Y = y_1, y_2, \ldots, y_m$, the input-oriented BCC measure of efficiency of a particular firm is calculated as:

$$\min_{\theta, \lambda} \theta_i$$

$$s.t. \quad \sum_{r=1}^{N} y_{mr}^t \lambda_r^t \geq y_{mi}^t$$

$$\sum_{r=1}^{N} x_{kr}^t \lambda_r^t \leq \theta_i x_{ki}^t$$

$$\lambda_r^t \geq 0$$

$$\sum_{r=1}^{N} \lambda = 1 \qquad \text{(A1)}$$

where $\theta_i \leq 1$ is the scalar efficiency score for the i-th unit. If $\theta_i = 1$ the i-th firm is efficient as it lies on the frontier, whereas if $\theta_i < 1$ the firm is inefficient and needs a $(1 - \theta_i)$ reduction in the inputs levels to reach the frontier.

In this study, we measure inefficiency with an input-minimisation orientation. The measure of input efficiency reflects the extent to which the input levels of the unit concerned can be lowered through improved performance and no output reduction, while maintaining its input mix (Thanassoulis (2001)). Loosely fol-

[6] For an introduction to DEA methodology see, among others, Thanassoulis (2001); Coelli *et al.* (2005). See Thanassoulis *et al.* (2008) for an extensive review of this literature.

lowing the *intermediation approach* (Sealey and Lindley (1977)) the input variable used in this study is total costs (*i.e.* the sum of personnel expenses, other administrative Expenses, interest paid and non-interest expenses) whereas the output variables capture both the traditional lending activity of banks (total loans) and the growing non-lending activities (other earning assets).

6.7.2. Modelling Convergence

To investigate the convergence of bank efficiency levels across the EU-15 countries over the period of analysis, we employ the concepts of β-convergence and σ-convergence (Barro and Sala-i-Martin (1991, 1992 and 1995); Quah (1996)).

To estimate unconditional β-convergence or 'catch-up effect', we employ the following equation:

$$\Delta y_{i,t} = \alpha + \beta(\ln y_{i,t-1}) + \rho\Delta y_{i,t-1} + \varepsilon_{i,t} \tag{A2}$$

where $i = 1,\ldots 15$ and $t = 1,\ldots 7$; $y_{i,t}$ = the mean efficiency of the banking sector of country i at time t;

$y_{i,t-1}$ = the mean efficiency of the banking sector of country i at time $t-1$; $\Delta y_{i,t} = \ln y_{i,t} - \ln y_{i,t-1}$; α, β and ρ are the parameters to be estimated and $\varepsilon_{i,t}$ = error term. A negative value for the parameter β implies convergence; the highest the coefficient in relative terms the greater the tendency for convergence. The β-convergence equations are estimated by pooled OLS regression and Generalised Method of Moments (GMM) to introduce dynamic behaviour in the time series and cross-sectional variation (Blundell and Bond (1998))[7].

To estimate cross sectional dispersion or σ-convergence, that is to estimate how quickly each county's efficiency levels are converging to the European average, we adopt the following autoregressive distributed lag model specification[8]:

$$E_{i,t} - E_{i,t-1} = \alpha + \sigma E_{i,t-1} + \rho\Delta E_{i,t-1} + \varepsilon_{i,t} \tag{A3}$$

where $E_{i,t} = \ln(y_{i,t}) - \ln(\bar{y}_t)$; $E_{i,t-1} = \ln(y_{i,t-1}) - \ln(\bar{y}_{t-1})$; $y_{i,t}$ = the mean efficiency of the banking sector of country i at time t; $y_{i,t-1}$ = the mean efficiency of the banking sector of country i at time $t-1$; $\bar{y}_t$ the mean efficiency of the EU-15 banking sectors at time t; y_{t-1} the mean efficiency of the EU-15 banking sectors at time $t-1$; α, σ and ρ are parameters to be calculated and $\varepsilon_{i,t}$ is the error term. $\sigma < 0$ represents the rate of convergence of $y_{i,t}$ towards $\bar{y}_t$; the larger is σ in absolute value, the faster the rate of convergence.

7 See for more details Casu and Girardone (2009).

8 Similar specifications have been estimated, among others, by Fung (2006), Parikh and Shibata (2004) and Weill (2008).

Since the 'optimal' or 'desired' level of y (*i.e.* the maximum attainable efficiency score y_{max}) is known, we evaluate the convergence of efficiency levels towards best practice by specifying a partial adjustment model as follows:

$$(\ln y_{i,t} - \ln y_{i,t-1}) = \gamma(\ln y_{\max} - \ln y_{i,t-1}) + \delta R(\ln y_{\max} - \ln y_{i,t-1}) + \varepsilon_{it} \qquad \text{(A4)}$$

where: $y_{i,t}$ = the efficiency of country i at time t; $y_{i,t-1}$ = the efficiency of country i at time $t-1$; $y_{\max}$ = maximum attainable efficiency, *i.e.* unity (and therefore zero when taking logs). ε_{it} is the error term and R is a dummy to indicate the introduction of the Euro as the single currency of 12 of the 15 countries. R takes value 0 for until 1998 and value 1 after 1999. γ = the adjustment parameter. It measures the speed of adjustment towards the best practice frontier (*i.e.* towards an efficiency score of one) with $0 < \gamma < 1$. δ_T = the interaction term between R and $\ln y_{\max} - \ln y_{i,t}$. It allows for a change in the speed of adjustment after the introduction of the Euro ($0 < \gamma + \delta_T < 1$). A significant positive δ_T would imply a faster adjustment towards best practice after 1999, when the exchange rate between member States' currencies and the euro was fixed. Rearranging equation (A4)

$$\ln y_{i,t} = (1-\gamma)(\ln y_{i,t-1}) - \delta R(\ln y_{i,t-1}) + \varepsilon_{it} \qquad \text{(A5)}$$

Let's substitute $\kappa = (1-\gamma)$ and $\lambda = -\delta$; thus we can re-write equation (A5) as:

$$\ln y_{i,t} = \kappa(\ln y_{i,t-1}) - \lambda R(\ln y_{i,t-1}) + \varepsilon_{it} \qquad \text{(A6)}$$

$\kappa = (1-\gamma)$ measures the persistence of y_{it-1} into y_{it}. In other words, it signifies lack of convergence towards best practice. A significantly negative value for λ, corresponding to a significantly positive δ, would suggest an increase in the speed of convergence of efficiency levels toward best practice after the introduction of the euro. Equation (A6) is estimated by pooled OLS.

7. Measuring the Output of the Banking Sector: Shortcomings of the Current European Methodology and New Perspectives[1]

Antonio Colangelo[2] and Robert Inklaar[3]

Abstract

Banks do not charge explicit fees for many of the services they provide. Instead, the payment for the services is usually bundled with the interest rates charged on loans and paid on deposits. To derive statistics on this 'indirectly measurable' banking sector output, European countries have implemented the methodology set up in *1995 ESA*. This methodology compares bank interest rates to a reference rate to estimate the associated service flow. In this paper we argue for a modified approach that is more consistent with economic theory. Rather than using a single short-term risk-free rate as a reference rate, we propose choosing a reference rate that more closely matches the risk characteristics of the loans and deposits and its term structure. We apply this approach to positions of euro area households and non-financial corporations; the resulting banking sector output is 31 to 47 percent lower than the output derived according to the current methodology. In terms of deliveries to final demand this implies, on the average, an overestimation between € 16.1 bn and € 20.4 bn or 0.20 to 0.25 percent of euro area GDP.

7.1. Introduction

Banks do not charge explicit fees for many of the services they provide. For instance, the payment for the services provided to the customers on loans and deposits is usually bundled with the interest rates charged or paid. In other words, when granting loans banks usually provide services to their customers throughout the duration of the contract; these services take the form of financial advice, screening credit worthiness, monitoring the performance of the loan, re-bargaining the contract conditions and are usually charged not by means of fees but implicitly by setting an interest rate which is higher than a 'fair' reference interest rate. Similarly, on deposits banks' services taking the form of bookkeeping and

[1] The views expressed in this paper are solely those of the authors and do not necessarily reflect the opinion of the European Central Bank. The work has benefited from useful comments and suggestions by Henning Ahnert, Jean-Marc Israël, Steven Keuning, Reimund Mink and Christina Wang.

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payment facilities are charged by offering the depositors interest rates which are lower than a 'fair' reference interest rate.

Any complete measure of bank output should take this into account by estimating what part of bank interest rates is a payment for services and what part is the cost of funds, reflected by the appropriate reference rate.

Under the statistical framework set up by the European system of national and regional accounts (*1995 ESA*), EU countries have implemented a common methodology to compile imputed banking sector output, which is referred to as financial intermediation services indirectly measured (FISIM)[4]. Under this approach, FISIM are compiled on all loans and deposits vis-à-vis non-financial sectors (and insurance corporations and pension funds). The estimates are derived by comparing bank interest rates to a single reference rate of interest representing *"the pure cost of borrowing funds – that is a rate from which the risk premium has been eliminated to the greatest extent possible and which does not include any intermediation service"*[5]. In practice, the inter-bank rate is used for all loans and deposits, without distinction by type and maturity of the instrument. As a result, the compensation for bearing credit default risk and the term premium is treated as a productive service and thus becomes part of financial services[6].

In this paper[7], we argue against this approach as economic theory suggests that bank interest rates should be compared to the yield on market securities with the *similar* risk and term characteristics to appropriately reflect into bank output the actual services provided to the customers[8]. This argument will be spelled out more fully, but a simple example illustrates the inconsistency of the current approach. Consider two firms with similar characteristics that need to borrow to finance their operations. The first firm borrows from the financial markets and pays the market interest rate. The second firm borrows from a bank and pays the interest rate charged by the bank. Under the current approach, the second firm is assumed to pay only the inter-bank rate, while the remainder of the payment, including the term spread and the default risk premium, is considered bank output. Under our proposed approach, both firms face the same cost of funds, and only the payments in excess of this market rate by the second firm are bank output.

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4 In particular, 1995 ESA includes other monetary financial institutions (oMFIs) and other financial intermediaries (OFIs) among the FISIM producing sectors. The results presented in this paper are limited to oMFIs' output as a fully consistent and detailed set of statistics on OFIs is currently not available at the ECB for all euro area countries. For a formal definition of financial corporations and related subclassifications, see Paragraph 2.32 to 2.67 of 1995 ESA.

5 See *1993 SNA*, par. 6.128.

6 In general, par. 1.20 of *1993 SNA* defines an activity to be part of production when *"labour and assets are used to transform inputs of goods and services into outputs of other goods and services"*.

7 This paper concentrates on estimates of output at *current prices* only. For details on the methodology for FISIM *volume measures,* see Eurostat's Handbook on price and volume measures in national accounts, (2001), and also Basu and Wang (2006) and Inklaar and Wang (2007).

8 For a formal dynamic general equilibrium model that makes this argument, see Wang *et al.* (2004).

Apart from theoretical reasons for a modified approach, there are also practical concerns about the current methodology. Including the compensation for risk-bearing as bank output can lead to changes in output that are unrelated to changes in input and technology: particularly during periods of financial distress, this leads to undesirable volatility in output estimates. More in general, banking sector output will be positively correlated with the yield premium: a steeper yield curve increases the imputed service margin even without any changes to bank inputs or technology. Euro area FISIM under the current framework has been fairly stable since 2003 (despite rising loan and deposit balances) mainly because of a flattening yield curve, less so, if at all, because (risk-adjusted) interest margins have decreased reflecting improvements in banking productivity, for example. In contrast, risk-adjusted interest margins have been rather stable over the period and FISIM has been rising broadly in line with loan and deposit balances[9]. Overall, risk-adjusted margins seem to better reflect the expected developments in imputed banking sector output for the periods under analysis. Finally, we argue that comparing current financial market rates to interest rates on outstanding amounts of loans and deposits is not appropriate. First, rates on outstanding amounts are weighted averages of rates on current and past loans and if anything, should be compared with a weighted average of current and past financial market rates. In addition, rates on outstanding amounts are not categorised according to periods of rate fixation but if a loan with long original maturity has rates which are renegotiated on an annual basis it would be more appropriate to compare the interest rate on this loan to the yield on a bond with a time to maturity of one year rather than according to the original maturity. Given these considerations, we rely on interest rates for new business.

We apply our proposed modified approach to the euro area, estimating monthly banking sector output on deposits and loans vis-à-vis euro area households and non-financial corporations for the period January 2003 to June 2008[10]. We choose this period because of the availability of detailed interest rate and balance sheet data that are consistent for all euro area banks regarding these two sectors. This allows us to distinguish between several different types of loans and deposits, further broken down by maturity and by sector of the borrower and holder respectively. In our results, we distinguish between two scenarios, one where the reference rate only takes into account the maturity of the loan and another where it also takes the default risk premium into account. Under the first scenario, euro area banking sector output vis-à-vis domestic households and non-financial corporations is on average 31 percent lower than under the current approach, while the second scenario leads to banking sector output that is 47 percent lower.

9 In particular, margins have been stable even after the financial turmoil in the second half of 2007 and until March 2008.

10 Similar research has already been done for the United States in Basu *et al.* (2009).

It is very important to have an accurate and appropriate measure for FISIM not only because it is part of overall bank output (in addition to fees and commissions) but also because it contributes to GDP insofar as banks serve households, government or foreign demand. Additionally, the interest margin is part of the price of bank output, so how this price is measured will affect producer and consumer prices. In particular, our results imply that GDP, the total value of goods and services delivered to final demand, is overestimated between € 16.1 bn and € 20.4 bn or 0.20 to 0.25 percent of euro area GDP[11]. Second, the cost of living according to the current interest margins would have increased at a slower pace than suggested by our interest margins.

The paper is organised as follows. Section two describes the current treatment of FISIM in European statistical standards and presents, also by means of numerical evidence, some of the shortcomings of this approach. Section three deals with the enhanced methodology on FISIM describing both its conceptual framework and the underlying empirical set-up; in particular, the data on interest rates and bonds that we use for the derivation of the various interest margins for households and non-financial corporations is discussed in detail. The estimates resulting from the new methodology are presented in section four for the euro area[12] as a whole and compared to FISIM derived according to the current European methodology[13]. Finally, we offer some concluding remarks[14].

7.2. FISIM AS RECOMMENDED IN EUROPEAN STATISTICAL STANDARDS

FISIM are the financial services that financial intermediaries provide to their customers but which are not directly invoiced. For depositors, these services generally include the management of the accounts, the provision of accounts statements and occasional fund transfers between the accounts. Instead of directly invoicing the services, financial institutions reduce the interest paid to depositors. Hence, this interest is typically lower than what customers could have obtained by lending their money directly on the market. For borrowers, these financial services include financial advice, screening credit worthiness, monitoring the performance of the loan, re-bargaining the contract conditions, smoothing over time

11 As this paper focuses on FISIM estimates for households and non-financial corporations only, the estimates on GDP correction do not reflect the impact of the new methodology for government and foreign demand. See Section 7.4.3. for further details.

12 All estimates in the paper refer to the moving composition of the euro area, *i.e.* data prior to January 2007 do not include Slovenia and similarly, data prior to January 2008 do not include Cyprus and Malta.

13 The FISIM estimates presented in this paper according to the methodology laid down in the Council Regulation (EC) No. 2223/93 of 25 June 1996 on the European System of National and Regional Accounts in the Community (*1995 ESA*), amended by Council Regulations (EC) 448/98 and 1889/2002, are not based on national official statistics but have been derived by the ECB simulating this methodology.

14 The Annex presents detailed results for the new methodology compared to the current framework.

of repayments and the recording of the repayments for accounting purposes. They are paid by an increase of the interest rates charged by banks.

Paragraph 3.63.J of *1995 ESA* outlines the principles underlying FISIM compilation[15]. It states that in general financial intermediation services cover two parts: (a) financial intermediation services directly charged by financial intermediaries to their clients and measured as the sum of fees and commission charged; and (b) FISIM.

Financial intermediaries provide FISIM by paying lower rates of interest to those who lend them money and charge higher rates of interest to those who borrow from them. Consequently, FISIM output is generated by financial intermediaries when managing loans and deposits whose rates they control. In contrast, there is no intermediation service for debt securities: to the extent that a bank was involved in issuing or placing these securities, they will have received an upfront fee and to the extent that they bought these in the secondary market, they have not provided services.

The *1995 ESA* identifies oMFIs and OFIs as FISIM-producer sectors[16]. Their output is valued on the basis of the difference between the actual rates of interest payable and receivable on loans and deposits vis-à-vis other sectors (including the rest of the world) and a 'reference' rate of interest. For those to whom the intermediaries lend funds, both resident and non-resident, it is measured by the difference between the effective interest charged on loans and the amount that would be paid if a reference rate were used. For those from whom the intermediaries receive funds (under the form of deposits), both resident and non-resident, it is measured by the difference between the interest they would receive if a reference rate were used and the effective interest they actually receive.

In turn, the reference rate is defined as the average interest rate at which FISIM-producer sectors lend money to each other[17]. In particular, the *1995 ESA* distinguishes between an internal reference rate, to be used for transactions among residents, and an external reference rate, to be used for the business between residents and the rest of the world, with the possibility of compiling different external reference rates according to currencies of denomination and counterpart areas.

[15] In the context of FISIM measurement *1995 ESA* is fully consistent with the general framework set up in *1993 SNA*.

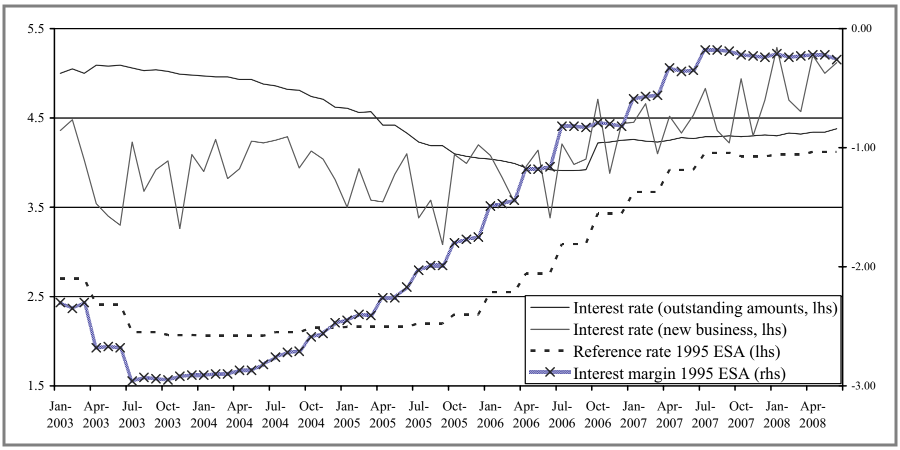
[16] Hence, under *1995 ESA* insurance corporations and pension funds are not identified as producers of FISIM. While this treatment is not questioned in this paper, it could offer interesting perspectives for future research.

[17] The positions vis-à-vis the central banks are excluded from this computation. As financial intermediaries include banks and OFIs, it can happen that the reference rate may diverge from the average inter-bank rate depending on the relative size of OFIs. It should also be stressed that when computing reference rates at national level, the average inter-bank rates may also differ due to the currency and maturity composition of the market.

The current approach has various shortcomings. Essentially, the method does not appropriately capture the differences between the various types of loans and deposits: for instance, whereas the inter-bank business is mainly short term with low default risk premium, deposits and loans from/to other sectors may have a completely different maturity structure with sometimes high default risk. In summary, within the current methodological framework compensation for term premium and default risk is treated as productive service and leads in many instances to negative FISIM, both at the sectoral level and in the rest-of-the-world account[18]. In the sequel of this paper we will show that the new proposed methodology for FISIM compilation does not suffer of these shortcomings.

To see how these drawbacks of the current methodological framework may affect FISIM estimates in practice, we now present two examples where negative margins may arise from mismatches between risk and maturity structure of specific instruments and the reference rate.

Figure 1: Deposits with an Agreed Maturity above Two Years Placed by Euro Area Non-financial Corporations with German oMFIs (p.p.), 2003:1-2008:6



Sources: ECB (MIR interest rates and internal calculations).

Notes: (Internal) reference rate for Germany obtained simulating the 1995 ESA methodology. Implied FISIM margin derived as the difference between the interest rate on outstanding amounts and the reference rate.

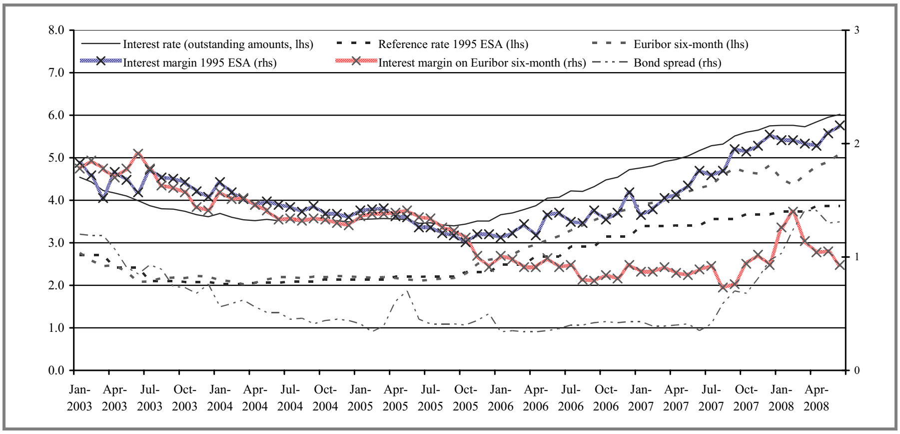
Figure 1 shows the evolution of interest rates[19] on outstanding amounts and new business volumes of deposits with an agreed maturity above two years placed by euro area non-financial corporations with German oMFIs[20] and compares them

18 For a more in depth analysis of the issue of negative FISIM on imports and exports see S. Fonte Santa (2007).
19 Interest rates compiled by the ECB in the context of MFI interest rate statistics. See Section 7.3.2. for a detailed discussion of the data available in this context.
20 Over the period between January 2003 and June 2008, these deposits have accounted, on the average, for about 24 percent of total deposits with agreed maturity placed by euro area non-financial corporations with German oMFIs.

to the estimated (internal) reference rate calculated for Germany in the ECB simulation of the *1995 ESA* methodology. Interest margins implied by the current official European FISIM methodology are negative for all periods under analysis mainly reflecting two factors. First, new business rates lay below the interest rates on outstanding amounts for periods up to mid-2006, as many outstanding deposits had more favourable rates than the new ones, perhaps because they were opened when interest rates were higher and continue to yield fixed earnings. This seems to explain the big negative margins observed over this period. Second, the term premium plays a role and its impact is especially visible in the spread between interest rates on new business over the reference rate, which is much higher in periods up to end-2005 characterised by a step yield curve and then decreases to more stable values. We will show that in this case the enhanced methodology will represent a more suitable framework for the derivation of interest margins and that the resulting estimates will be easier to interpret.

Figure 2 displays the evolution of interest rates on short term loans provided by Spanish oMFIs to euro area non-financial corporations[21] and compares it to the estimated Spanish internal reference rate.

Figure 2: Loans with Maturity Below One Year Provided by Spanish oMFIs to Euro Area Non-financial Corporations (p.p.), 2003:1-2008:6



Sources: ECB (MIR interest rates and internal calculations), Merrill Lynch (Corporate Bonds).

Notes: (Internal) reference rate for Spain obtained simulating the 1995 ESA methodology. Margins derived as the difference between the interest rate on outstanding amounts and the Spanish reference rate (Interest margin 1995 ESA) and the Euribor six-month (Interest margin on Euribor six-month) respectively. Bond spread represents the difference between the Merryl-Lynch bond index for euro area non-financial corporation bonds with a remaining maturity between 1 and 5 years and the euro area government bond index for residual maturity 3 years.

21 Over the period between January 2003 and June 2008, these loans have accounted, on the average, for about 28 percent of total Spanish oMFIs loans to euro area non-financial corporations.

FISIM margins obtained in accordance to *1995 ESA* show a decreasing path for period up to end-2005, and then increase steadily for the following periods. Two observations stand out in this case. First the maturity mismatch between the instruments in the category and the reference rate (which is mainly affected by very short term inter-bank rates) does play a role: for periods as from end 2005, the Euribor six-months started diverging from the reference rate reflecting the expectation of higher future interest rates thus suggesting that a maturity adjustment for this category of loans might be needed. In addition, it is worth reflecting on the evolution of the risk premium. In view of the lack of bond indices for Spanish non-financial corporations, the proxy used is the spread between the corporate bond index for euro area non-financial corporations and the relevant government bond index. The spread shows that the risk premium perceived by the market for euro are non-financial corporations has varied over time, with a prominent decrease between 2003 and 2005, followed by a period of stability up to July 2007 and a sharp increase after the start of the financial turmoil. In summary, the combination of these two factors explains the evolution of the margins derived under the *1995 ESA* methodology.

7.3. THE NEW METHODOLOGY

7.3.1. The Conceptual Framework

A measure of bank output cannot be estimated without a description of the financial services that customers buy. This is also the starting point of the model developed in Wang *et al* (2004) and this section is based on their arguments. For a depositor's overnight account, banks provide ready access to funds and provide payment services in the form of electronic money transfers or checks, while on other deposits the transaction services are usually fewer. Bank services to borrowers mostly consist of screening credit worthiness and monitoring the loan performance during the duration of the contract. This is a stylized description of a bank, but it covers the main features from the perspective of bank customers. We would argue that institutional risk management, ensuring that a bank can satisfy all its obligations, is part of the production process. *Ceteris paribus*, how well a bank manages risk will only be relevant insofar as more extensive risk management would increase overall costs of bank services and hence prices charged to clients, with the other side of the equation that inadequate risk management could lead to bankruptcy and resulting in losses or disruption to clients[22].

Given this set-up, we can ask the question what a bank would charge for these services. The argument for the depositor is most straightforward. Given that all European countries have a system of deposit insurance (see Gropp and Vesala (2004)), the alternative to hold money in a deposit account is (ideally) buying a risk-free security, like a (high-rated) government bond[23]. By holding money in a deposit account, the depositor foregoes the interest on another risk-free investment so the value of the services received must equal the foregone interest[24].

In an equation, this becomes:

$$Y_D = (r^F + r^T - r^D)S_D = m^D S_D \tag{1}$$

where Y_D is the value of output associated with deposit type D, r^D is the interest rate paid on that type of deposit (which could be zero), r^F is the short-term risk-free rate, r^T is the term premium, S_D is the account balance and m^D represents the corresponding interest margin applied by the bank. In particular, the term premium r^T reflects investors' assumptions about future interest rates and includes a (liquidity) premium for holding long-term instruments, compensating investors for the added risk of having their money tied up for a longer period, including the greater price and interest rate uncertainty[25].

The logic is similar for loans, except that loans are generally risky. As assets in financial markets require a rate of return that exceeds the risk-free rate, so should bank loans[26]. Imagine a firm that has the choice between borrowing from a bank and issuing bonds in the financial markets. The bank's interest rate will likely be

22 Default risk management can be viewed as an insurance contract where the lender, acting as a guarantor, charges a premium (default risk premium) to the borrower in exchange of the risk of his potential default; this premium can thus be viewed as the expected loss of the loan. See also the section on loan guarantees in chapter 17 of the *2008 SNA*. Drawing a parallel with the methodology in use to derive the output of non-life insurance corporations, or specifically, of credit insurance institutions may be of some interest in this context. In this case, output is derived as the difference between the collected premiums minus the payments or the calls under the guarantees. This would then argue in favour of the default risk correction, under the recognition that for insurance corporations the correction is done ex-post (discount of 'realised' defaults) while in the context of FISIM compilation it would be performed ex-ante (discount of 'expected' defaults). On the other hand, the risk assessment is clearly a productive activity that should be incorporated in FISIM; see also Keuning (2008).

23 It should be underlined that before the financial turmoil in August 2007 perceived risk on the interbank market, measured as the difference between unsecured and secured interbank lending rates, was rather minimal. Besides deposit insurance this may then argue in favour of limited risk premiums on banks' deposits. Since the start of the financial market turbulence the spreads between secured and unsecured interbank lending rates have widened considerably, and they have been passed through on deposits rates to a large extent. While this may justify the consideration that deposits are less secured than before, the impact on total FISIM calculation should be minimal as unsecured interbank lending rates are used as reference rates for most deposit categories (accounting, on the average, for about 90% of total deposits placed with oMFIs by households and non-financial corporations) thus guaranteeing that risk premiums are adequately reflected even in this case.

24 This is the user cost of money; see Barnett (1978).

25 The financial literature refers to the liquidity premium as the term premium and the sum of the two components as the term spread; with some abuse of terminology in this paper we will use the two expressions as synonymous.

26 Note that the Wang *et al.* (2004) theory implies that, just as in financial markets, only the systematic risk should be reflected in the required rate of return.

as high as the expected return on the bond and, in addition, the bank will charge for the services provided. In other words, to estimate the value of services provided to a borrower, the interest rate on the loan should be compared to the yield on a market security with the same risk characteristics:

$$Y_L = (r^L - r^M)S_L = (r^L - r^P - r^T - r^F)S_L = m^L S_L \tag{2}$$

where Y_L is the value of output associated with loan type L, r^L is the interest rate charged on that type of loan and r^M is the yield on the corresponding market security, which is the sum of the risk-free rate, the term premium and the default risk premium r^P, S_L is the amount of the loan and m^L represents the corresponding interest margin applied by the bank[27]. Note that in general there is no theoretical need to be specific about the factors that make up the market interest rate r^M. Financial asset pricing predicts that all systematic (non-diversifiable) risk will be reflected in r^M. In practice of course, the only way to match bank loans to market securities is to select a few key characteristics for determining the 'most comparable' market security and in this paper we have decided to focus on the default risk premium and term premium.

To illustrate the differences between the current approach and the proposed methodology, it is useful to distinguish the term premium and default risk premium. Currently, a weighted average of inter-bank interest rates is used as the single reference rate for all deposits and loans. The inter-bank market covers loans up to one year, so fairly short maturities and (fairly) default risk-free. Loans and deposits can also be for longer maturities, so the term premium is one factor we take into account. The default risk premium on loans is the other main factor. In our application to the euro area, we will propose frameworks to adjust for the term premium only and for the two factors together.

7.3.2. The Empirical Set Up[28]

The methodology developed in this paper is confined to the estimation of banking sector output on positions vis-à-vis households and non-financial corporations[29].

[27] As a simplification, the expected default rate on loans and the market security is assumed to be equal. Even then, to be precise, this equation only holds for instantaneous returns under continuous compounding.

[28] Although the paper is mainly focused on the derivation of FISIM estimates for the euro area as a whole, the empirical set-up of the methodology could easily be replicated at national level.

[29] Loans and deposits of non-financial corporations and households are the main part of bank business in the euro area representing over the period under analysis about 80 percent of total loans and deposits positions involving non financial counterparties. Loans and deposits of other domestic sectors, *i.e.* the government, insurance companies and pension funds, represent another 11 percent, while loans and deposits from the rest of the world make up the remaining 9 percent. Little is known about these loans and deposits except their overall size; especially data on corresponding interest rates is not available. For this reason we leave those sectors out of the scope of this paper although some reasonable estimates could be derived on the basis of work assumptions.

The proposed approach is mainly based on the use of MFI interest rate (MIR) statistics[30]. These statistics provide (on a monthly basis and for periods as from 2003) a harmonised and comprehensive coverage of the interest rates applied by euro area credit institutions to resident households and non-financial corporations on euro denominated loans and deposits. These data are available and consistent both at national and euro area level, and distinguish between the interest rate on new business, *i.e.* newly negotiated interest rates during the period, and rates on outstanding amounts. In addition, detailed breakdowns on deposits are provided both by maturity and by instrument, while for loans the data are broken down by maturity/period of fixation and additionally, in the case of households, by purpose of the loan, *i.e.* consumer credit, loans for house purchases and other credit. While the current approach implicitly relies on MIR rates on outstanding amounts, the methodology developed in this paper uses statistics on new business. Section 7.3.3. below will discuss some methodological aspects underlying this approach.

As described above, another feature of the current approach is the use of the interbank rate as the reference rate to evaluate interest margins. The first proposed improvement is to take into account the maturity structure of loans and deposits based on the general government bond yield curve and, for short maturities, the Euribor rates; in this paper we use the euro area government bond yield curve derived by Thomsom Financial Datastream based on AAA government bonds issued in the euro area[31]. Appendix Table A1 describes in detail which rate was applied to each category of loans and deposits for households and non-financial corporations under this approach[32]. In particular, some of the maturity and fixation period categories of these deposits and loans are straightforward to match, such as approximating the one to five year band with a three-year government bond[33]. The open-ended maturity and fixation period categories, such as more than two years or more than five years require more judgement. Overall though, the results are not very sensitive to the exact choices we make in this regard.

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30 The requirements for MIR statistics are laid down in Regulation ECB/2001/18. Most EU countries non-participating to the monetary union are also compiling MIR statistics complying with the standards required by the MIR Regulation.

31 The choice of this index also overcomes the problems related to the increased sovereign risk component in the yields of government debt securities which has affected several euro area countries starting from the third quarter of 2008.

32 An alternative approach would be to rely on the interest swap yield curve. Although this could offer interesting perspectives as swap rates reflect banks' refinancing costs, it does not fully respect the theoretical framework suggested in this paper: while reference rates should include only the term premium, risk components in swap rates (mainly counterparty risk) are rather high and if historically their spreads on government bonds (the so-called swap spreads) were about 35 bp up to August 2007, these have increased considerably after the start of the turmoil.

33 The government bond yields are based on (notional) zero-coupon bonds, so the duration of these bonds is equal to its maturity. Most bank loans will have regular interest payments, so the duration of those loans will be smaller than their maturity. For most maturities, this distortion is likely to be small. Assuming annual interest payments of a 5 percent interest rate, the duration will be on average 10% of a year shorter than the maturity for the bracket of one to five year maturity.

Secondly, while deposits can usually be considered as (relatively) risk-free investments because of deposit insurance schemes, bank loan rates are not only higher because of longer maturities but also because of higher risk. Data on the yield on bonds, specifically indices of non-financial corporate bonds and of asset-backed and residential mortgage-backed securities can be used to take this into account[34]. These indices are compiled by Merrill Lynch, which provides information on the average yield of the bonds after adjusting for option-like features of these bonds. Section 7.3.4. describes in detail the use of these data in the context of FISIM measurement. Appendix Table A2 reviews the reference rates applied to each type of loans and deposits for households and non-financial corporations under this more complex approach.

7.3.3. Interest Rates

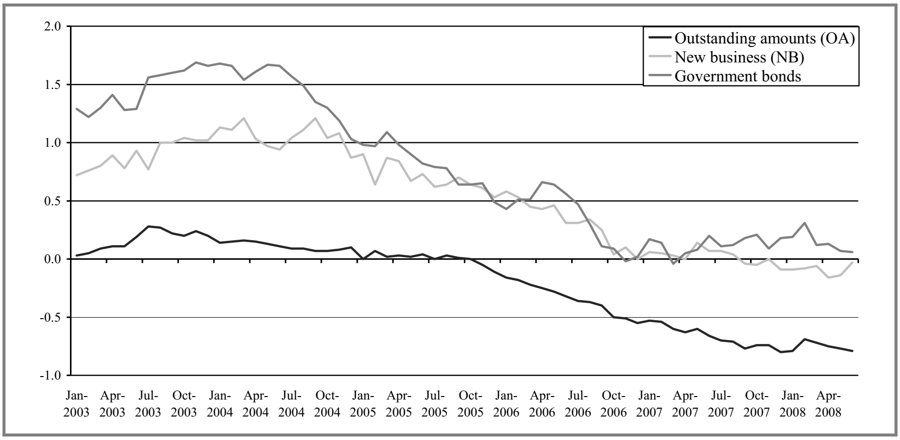
The main aim of our research is to improve the estimates of interest margins applied by banks on loans and deposits to reflect the services they provide. A first question is whether to use the 'new business' (NB) or 'outstanding amounts' (OA) rates as the basis for comparison. While the estimated margin should be relevant for the entire portfolio of bank loans in that category thus arguing for OA rates, a drawback of this approach is that the correct reference rate is difficult to define as many such loans have interest rates that were agreed some years before. Ideally, the reference rate should then be a weighted average of past bond yields, where the weights reflect the share of loans from each period in the past that are still on banks' balance sheets.

In addition, current definitions of NB and OA interest rates are not homogeneous for different maturities[35]. NB rates are categorised according to the initial period of rate fixation while OA rates are categorised according to the original time to maturity of the loan. Hence, for instance, if a loan has an original maturity of seven years, but rates are renegotiated annually, it would be more appropriate to compare the interest rate on this loan to the yield on a bond with a time to maturity of one year rather the seven years.

34 Another way of indirectly performing the correction would be to use data on loan provisions which may be collected for financial stability purposes by national authorities; in practice this approach may lead to incomparable results due to the lack of harmonisation of statistics on loan provisions across countries.

35 In the context of the update of Regulation ECB/2001/18 on the requirements for MIR statistics new data could become available to overcome this limitation.

Figure 3: Interest Rate Spread of Government Bonds and Business Loans: Long-term minus Short-term (p.p.), 2003:1-2008:6



Sources: ECB (MIR interest rates), Thomson Financial Datastream (Government Bonds).

Notes: All series for the euro area. MIR rates on loans to non-financial corporations: more than 5 years minus less than 1 year. Government bonds: 7 year minus 1 year yield.

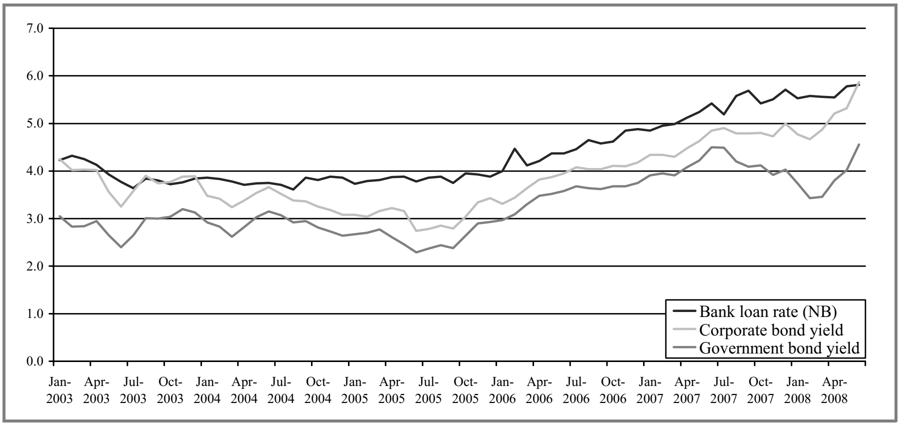
Given these considerations, we will rely on the NB rates to calculate the interest margins. Figure 3 illustrates the impact of the problems discussed above in the case of loans to NFCs, thus giving empirical justification to the choice of NB rates over OA rates. The figure shows the yield spreads of long-term loans to non-financial corporations (more than five years) over short-term loans (less than one year). In comparison, a similar spread on government bonds is also shown (seven years minus one year yield). The spread for OA turns negative at the end of 2005, while the NB spread stays positive (or very close to zero), just like the government bond spread. The negative OA spread is caused by a slower rise in the rates of loans with long original maturity compared to loans with short original maturity. This could reflect favourable rates on loans that were agreed in earlier years. It could also reflect a difference between original maturity and the repricing period: in fact, the volume data on NB suggest that most business loans have interest rates which are renegotiated within a year, while the volume data on OA suggest a long average time to maturity.

7.3.4. Reference Rates on Loans: Discussion of the Data in Case of Full Adjustment

The proposed method requires data on the current market yield of different types of debt securities with a broad coverage of the euro area market. Therefore, bond indices are preferred over individual bonds. The bond indices compiled by Merrill Lynch satisfy these criteria[36].

Merrill Lynch publishes a range of bond indices for non-financial corporations, but only their overall non-financial corporations bond index, which has an average rating between BBB and A, is available broken down by maturity band. Although there is no information available on the credit quality of bank loan portfolios, it may be assumed that most borrowers (by number, but not by volume) are not investment-grade. However, this may be less of an issue when considering the bank loan volumes. Besides, using the overall Merrill Lynch bond index is the most practical approach in view of the availability of maturity breakdowns[37].

Figure 4: Interest Rate on Business Loans Compared to Corporate and Government Bonds (%), 2003:1-2008:6



Sources: ECB (MIR interest rates), Thomson Financial Datastream (Government bonds), Merrill Lynch (Corporate bonds).

Notes: All series for the euro area. Bank loan rates refers to loans to non-financial corporations with an initial rate fixation between 1 and 5 years. Corporate bond yield is the yield on the Merill-Lynch bond index for non-financial corporation bonds with a remaining maturity between 1 and 5 years. Government bond yield is the 3 year constant maturity bond yield.

36 See www.mlindex.ml.com for these data as well as the bond index rules and definitions. ML does not produce country-specific bond indices as most national debt markets within the euro area do not have the characteristics for the derivation of reliable and meaningful bond indices.

37 A sensitivity analysis has shown that the advantages related to the use of bond yield indices broken down by maturity largely overcome these shortcomings, at least at the euro area level.

Figure 4 compares the interest rate of loans to non-financial corporations with the corresponding corporate bond and government bond yields[38]. As expected, the loan rate is higher than the corporate bond yield, which in turn is higher than the government bond yield. At the end of 2003 as well as in June 2008, there were a few instances when the spread was slightly negative, but otherwise the picture is consistent. As the more complete analysis below will demonstrate, negative spreads occur in some other instances as well. There we will discuss possible reasons why margins may become negative in theory and in practice. Overall, the Merrill Lynch bond index for loans to non-financial corporations in the corresponding maturity bands does capture the main developments that also affect loan rates. This may be seen as the financial market indicator with the most similar characteristics. It is also worth noting that from the summer of 2007 to (at least) end-2008, due to the financial market turmoil the spread of the corporate yield over the government bond yield has widened[39]. The spread has peaked at the end of the first quarter of 2008 when a substantial 'flight to security' effect pushed down government bond yields. Interest rates on bank loans to non-financial corporations have also risen though the risk-adjusted interest margins have been broadly stable, although in the course of the second quarter of 2008 the worsening of the economic outlook and the consequent lack of liquidity on euro area bond markets resulted in a sharp increase of NFC bond yields which have converged to interest rates on business loans.

This illustrates the unappealing choice in troubled financial times: one could either rely on government bond yields and see a sharp widening of interest margins or use corporate bond yields and see a contracting interest margin. Using government bonds probably overstates margins by more in the recent period: why would loans that used to require only about 0.7 percentage points of service margin now require up to 2.5 percentage points? On the other hand, a disappearing margin is likewise implausible.

For loans to households, it is more challenging to compute interest-rate margins since households do not generally raise funds directly from financial markets. Here the most comparable security is securitized debt. Securitization is a means for banks to fund further credits as, in its traditional form, it enables to remove loans from balance sheet and thus frees up capital to make new loans. The main advantage of securitization is to enable banks to specialize in what they do best, namely originating and monitoring debt. However, an important reason for banks to originate a loan for a household in the first place is that the fixed cost of gathering and processing credit information on households is too burdensome

[38] The interest rate for non-financial corporations refers to loans with an initial interest rate fixation period between one and five years and is the rate on new business. The corporate bond and government bond yields are defined to match this maturity band.

[39] The spreads of bonds of financial corporations have widened even more.

for decentralized financial markets. To allow these loans to be sold in secondary markets in form of asset backed securities (ABS) or residential mortgage backed securities (RMBS), a group of similar loans is pooled and usually divided into tranches. Defaults in this loan pool will first be borne by the junior tranches and the senior tranches will be affected last. As a result, the senior tranches commonly receive an AAA credit rating from rating agencies. The current financial market turmoil has raised questions about whether these ratings are a good reflection of risk, in particular in the face of high default rates on mortgages of subprime borrowers in the US. However, for our proposed method, what is relevant in principle is the perceived risk by banks at the time the loan is originated[40,41].

The limited size of the ABS and RMBS market in Europe compared to the corporate bond market also deserves some considerations. While the overall Merrill Lynch bond index for non-financial corporations covers around 700 corporate bonds, their index for ABS and RMBS covers only some 30 bonds[42]. This means that for Europe we only have a single index that covers all maturities and credit ratings, with most securities AAA-rated[43]. Despite the small number of securities, the yield spread over government bonds is quite stable, highly correlated with the yield spread of AAA corporate bonds (0.85) and almost the same size on average[44,45].

40 Recent literature has elaborated on various agency problems raised by securitisation and resulting in misalignments between perceived risks by banks and on the market. For instance asymmetric information may lead to downward biases in credit ABS/RMBS spreads when the loan quality deterioration is not fully recognised by investors and rating agencies. In addition, once the default risk is transferred the bank may have a little incentive to monitor the borrowers and to restructure the underlying loan portfolios. For a comprehensive review of these and other agency problems related to securitisation, see Franke and Kranen (2008) and references therein.

41 Another way in which RMBS can receive an investment-grade rating is if a government agency guarantees the underlying mortgages. As a result of either financial engineering or government backing, the default risk on the most liquid RMBS and ABS is supposed to be minimal and the main reason for the positive spread over risk-free government bonds is prepayment risk; see *e.g.* Rothberg *et al.* (1989). If most loans on bank balance sheets are government-backed, prepayment risk is all that matters for a correct reference rate, but otherwise, the yield from these RMBS and ABS will be too low compared to the risk associated with the bank loans. However, if the risk is higher, banks will presumably also go to greater lengths to gauge the credit worthiness of borrowers, so the service margin for those types of loans is also likely to be higher. One concern in the current climate is that the opacity and heterogeneity of RMBS and ABS leads to illiquidity. Also, there is an ongoing reassessment of the value of credit ratings and the default risk of these securities. As a result, in current periods yields on these securities are possibly higher than warranted by the underlying default risk or the composition may have changed to include more lower-rated securities.

42 By comparison, similar indices for the US cover around 3000 corporate bonds and 1500 residential MBS or collateralized mortgage obligations (CMOs).

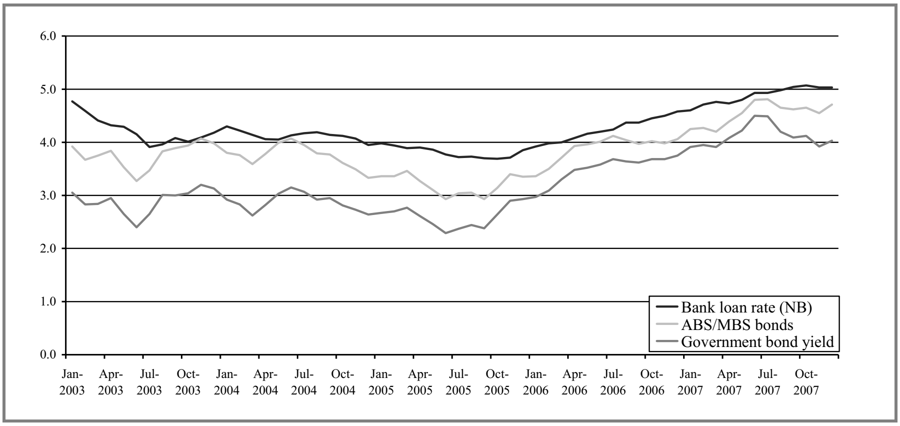
43 Merrill Lynch only provides occasional snapshots of the composition of the index and these suggest limited differences between the components. Given the scarcity of information, this is a tentative finding.

44 The average spread for AAA corporate bonds was 0.33 percentage points over the period 2003-2007 and for the MBS/ABS bonds it was 0.35 points.

45 While sensitivity analysis has shown the overall reliability of the approach described above, further research is being performed aimed at improving this framework. The development of new statistics on short-term European paper (STEP), which also cover asset-backed commercial paper, might offer some interesting prospects. For further information on STEP, see www.ecb.eu/stats/money/step/html/index.en.html). More in the medium to long term horizon, the enhancement of the collection of securities statistics on a security by security basis and the related development of the so-called Centralised Security Database (CSDB) in the euro area could also allow the derivation of more refined yield curves to be used in the framework of FISIM measurement as described in this paper.

A final issue is how to deal with loans with maturities for which there are no directly matching bond indices. In Figure 4, we could match loans with an initial fixation period between one and five years to the yield on corporate bonds with a remaining maturity of one to five years. However, there is no bond index covering bonds with a remaining maturity of less than one year, so for loans with an initial fixation period of less than a year there is no appropriate bond index. In this example, we use the spread of the corporate bond index over the three-year government bond index and add this to the one-year government bond index. Similarly, the Merrill Lynch ABS/RMBS index has a duration of around five years, so the spread over the five-year government bond index for each fixation period band is applied for the matching.

Figure 5: Interest Rate on Housing Loans Compared to ABS/MBS and Government Bonds (%), 2003:1-2008:6



Sources: ECB (MIR interest rates), Thomson Financial Datastream (Government bonds), Merrill Lynch (ABS/MBS).

Notes: All series for the euro area. Bank loan rates refers to loans to household for house purchases with an initial rate fixation between 1 and 5 years. ABS/MBS bonds is the yield on the Merrill Lynch bond index for asset-back and mortgage backed bonds, adjusted using government bond yields to a 3-year maturity. Government bond yield is the 3 year constant maturity bond yield.

Figure 5 shows the interest rate on household loans for housing purposes compared to the ABS/RMBS series and the corresponding government bond yield. The interest margin for this type of loans varies more than the corporate margins as the inertia of bank interest rates seems greater. On the other hand, the interest margin stays positive throughout the period, with the exception of June 2008. As for NFCs, periods following the financial turmoil are strongly influenced by the developments on the financial markets. While the implicit risk premium measured by the government bond spread of ABS/RMBS securities index has widened, seemingly in line with the underlying causes of the credit crisis, this market has become almost fully illiquid and cannot, in the context prevailing as from the second quarter of 2008, represent a good proxy for the household loans on banks' balance sheets. For instance, this may be the reason underlying the negative margin in June 2008.

7.4. ESTIMATES

7.4.1. Interest Margins

So far we have discussed what data we use on loan and deposit rates for households and non-financial corporations, namely interest rates on new business from the MIR statistics. We also described our approach to matching these interest rates to comparable securities traded in the financial markets. We can now move to a discussion of the interest margins as estimated in our framework. In the case of loans, the interest margin we calculate is the excess a borrower has to pay compared to the market rate to compensate the bank for the information services provided. For deposits, it is the opposite: how much less a depositor is willing to accept than the market rate in return for the transaction services the bank provides.

Table 1 gives the broadest set of results on interest margins by comparing the estimates on the different financial asset categories for the euro area as a whole in the case of households and non-financial corporations. Our analysis uses monthly data from January 2003 to June 2008, thus covering 66 months (the entire span of the MFI survey on interest rates). We compare three sets of interest margins. The first set is calculated by simulating the current approach where implicit interest margins can be obtained by comparing MIR rates on outstanding amounts to the internal reference rate. The second set takes into account that for longer-term financial assets a term premium is paid, estimated by the yield spread of long-term over short-term government bonds. For loans, we also calculate a third set, where the default risk is taken into account by using data on corporate bonds and asset and mortgage-backed securities. Under the new proposed framework, MIR statistics on new business are used and for all instruments a weighted average margin is compiled across maturities in the case of deposits and across bands of initial interest rate fixation periods in the case of loans using the shares in new business volumes as weights. For each set of margins, we compare three statistics, namely the average over the period, the standard deviation and the number of negative margins. For a more complete overview, the interested reader is referred to the Annex which, for each sector and type of loan and deposits, presents in form of time series the three sets of estimated margins, together with the corresponding interest and reference rates.

Table 1: Euro Area Interest Margins on Loans and Deposits Using Different Reference Rates (Weighted Average Across Maturities, January 2003-June 2008, %)

	Average			Standard deviation			Number of negatives		
	I	II	III	I	II	III	I	II	III
Loans									
Loans to non-financial corporations	1.74	0.97	0.40	0.46	0.21	0.18	0	0	1
Loans for house purchases	1.92	0.96	0.59	0.85	0.28	0.27	0	0	1
Consumer credit	3.76	3.95	3.59	0.73	0.48	0.48	0	0	0
Other household loans	3.76	1.54	1.20	0.73	0.35	0.29	0	0	0
Business deposits									
Overnight	1.71	1.49		0.37	0.39		0	0	
With agreed maturity	-0.07	0.28		0.23	0.19		39	4	
Redeemable at notice	0.34	0.25		0.32	0.39		8	31	
Repurchase agreements	0.30	0.07		0.13	0.05		0	5	
Households deposits									
Overnight	2.11	1.90		0.60	0.62		0	0	
With agreed maturity	0.04	0.40		0.50	0.17		36	0	
Redeemable at notice	0.75	0.66		0.54	0.62		0	2	
Repurchase agreements	0.30	0.07		0.13	0.05		0	5	

Notes: Interest margins are calculated as the difference between the relevant interest rate minus a reference rate.
Reference rates:
***I** (current approach): euro area internal reference rate*
***II** (term premium correction): the government bond yield for that rate fixation period is used*
***III** (default risk and term premium correction): in addition to II, an adjustment is made for the higher risk of bank loans using bond index yield spreads*
Interest rates:
***I:** interest rates on outstanding amounts*
***II and III:** interest rates on new business*
Interest margins shown are weighted averages of the margins derived for the different maturities and periods of initial interest rate fixation. The weights used reflect the outstanding amounts (case I) or the volumes of new business (cases II and III).
See Appendix Tables A1 and A2 for further details.

In the case of loans, the effect of accounting for the term premium and default risk on the average margin is as expected: margins decrease. Note that when comparing columns I to II and III, the reference rates change to reflect the risk of the loans and the interest rates change from those on outstanding amounts to interest rates on new business. In general, the changes in methodology have the largest effect on loans, where margins decrease by up to 2.5 percentage points. Actually many loans, in particular those for housing purposes, have fixed rates for longer periods of time and default is an important risk factor as well. In addition, the standard deviation of the margins also decreases. This is partly related to lower average margins, but not entirely. Finally, despite the large reductions in average margins, the margins on loans remain positive in (almost) all months. The adjustments to the average margins are smaller for deposits than for loans as most deposits are short-term while loans cover a wide range of (longer) maturities. The effect on standard deviation is also less pronounced. On the deposit side, interest margins are negative in many months regardless of whether using the current approach or our suggested alternative. Margins for the most sizeable deposit categories (overnight and with agreed maturity) are less prone to being negative[46].

There are both conceptual and practical reasons that may explain temporarily negative interest margins. First, banks may accept small or even negative margins if a borrower or depositor brings in income from deposits or fees for other services. The analogy with a supermarket is useful here: they often price visible brand-name products at or below cost to draw in customers, who then spend on other goods. Second, long-term business relationships may also play a role: in times of rising market interest rates, banks may not raise their loan interest rates by as much or ration credit in return for more favourable margins in periods of lower market rates[47]. There may be some support for this in the data as many of the loan interest rates are less volatile than the corresponding reference bonds[48]. This is in general indicative of imperfect pass-through of market interest rates to retail bank interest rates. Our finding of more negative interest margins for deposits than for loans is also consistent with the pass-through literature, where deposit rates are generally found to be more inelastic[49].

A more practical reason for some of the negative margins may be shortcomings in the available data, such as mismatches between interest rates and bond indices in terms of maturities and risk profiles. For example, the two negative values on loans refer to June 2008 and in both cases the bond indices used as reference rates show sharp increase which are not matched in the interest rate data (see also the

46 In particular, it should be outlined that most of our negative margins refer to deposits redeemable at notice by NFCs, which only account for about 3% of the total NFCs deposits.
47 See *e.g.* Boot (2000) for a review of relationship banking.
48 See Berlin and Mester (1999) on interest smoothing as a feature of relationship banking.
49 See *e.g.* De Bondt (2005) and De Graeve *et al.* (2007).

Annex)[50]. Similarly, for deposits with an agreed maturity of more than two years we have selected five-year government bonds as the reference rate. However, in Germany deposits are on offer with much longer maturities so that a ten-year government bond might have been a more representative security. In some countries bank loans to creditworthy firms may also be more prevalent, making a corporate bond with a high credit rating a better choice. Another reason for the observed negative margins may be sampling error in the MIR survey. The evidence for this is somewhat circumstantial, but the interest rates of relatively uncommon loans and deposits tend to be more volatile[51].

In short, negative margins for certain instrument and years can be explained and do not invalidate the basic approach. Negative margins for long periods of time though, can imply that a different security is needed to reflect country-specific circumstances.

When comparing margins on the different financial instruments, a few observations stand out. First, the estimated margins for consumer credit are very high compared to the other instruments, regardless of the approach taken. This could reflect high information and processing costs, but could indicate that a more effective method to account for the higher risk associated with these loans should be developed. The frequent absence of collateral for such loans can be used to argue either ways: the lack of collateral makes the loan riskier but might also induce more screening and monitoring activities by banks. Without further information on the risk of bank portfolios, it is hard to make a more definitive assessment. In addition, the average margin on consumer credit is lower under the current approach than with the term premium correction; this is due to the different evolution of the interest rates for consumer credit NB and OA.

[50] As described above, the margins shown in Table 1 are compiled as weighted averages across maturities in the case of deposits and across bands of initial interest rate fixation periods in the case of loans. Hence while Figure 4 shows some negative margins for loans to NFCs with a fixation period between one and five years in the course of 2003, no negative margins are derived for total NFCs loans over that period.

[51] Volatility is measured as the standard deviation of the interest rates and we get an indication of how common an instrument is in the country by calculating the average volume of new business for the instrument over the entire period and normalizing by the average across all instruments.

Figure 6: Euro Area Interest Margins on Loans by Period of Initial Rate Fixation, Average 2003:1-2008:6 (%)

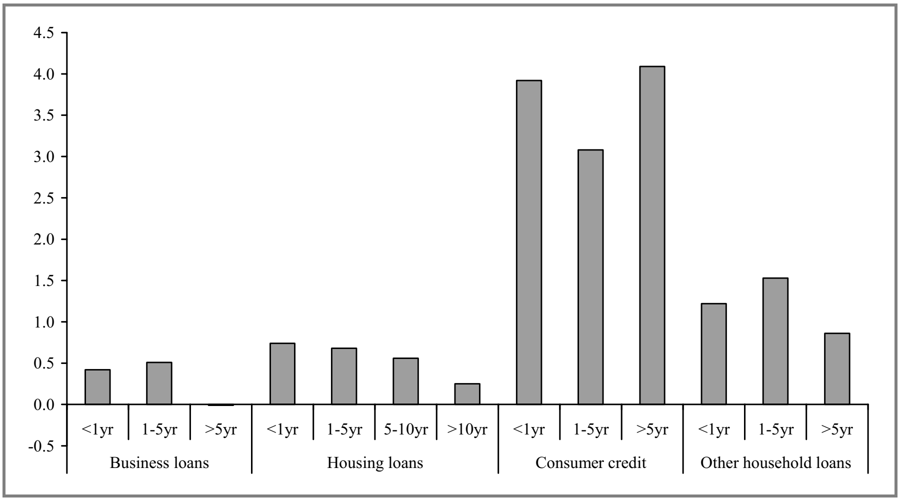


Figure 6 shows how the average margin varies by band of initial fixation periods for the different types of loans for the euro area, calculated using reference rates that account for both the term premium and default risk, i.e. case III in Table 1 above. In general, margins are lower on loans with a longer period of initial rate fixation. This holds not only for the euro area as a whole but also for many of the individual countries. The main exception is consumer credit with a fixed interest rate for more than five years. The pattern is clearer for housing loans, where the margin on loans with a fixation period of less than a year is 0.74 percent while loans with a fixation period of more than ten years have a margin of only 0.25 percent. One possible reason for this pattern is that the screening of new borrowers is an important part of the financial services provided to borrowers. As this screening process only takes place before the loan is agreed upon, the associated costs are spread over the life of the loan. Alternatively, it could reflect higher administration costs for loans with variable interest rates. This is likely to be a factor for loans to non-financial corporations: only 13 percent of new loans have a fixed rate for more than one year, but 69 percent on the outstanding loans have an (original) maturity of more than one year. This implies that most loans to non-financial corporations have (fairly) flexible rates and a long maturity. Another possible reason is that only low-risk borrowers receive a fixed rate for longer periods of time. In contrast, our reference rates are based on bonds with a constant default risk profile across maturities. This would imply that our default risk adjustment is overdone for loans with long-term fixed rates. We would need firmer evidence though before changing the adjustment.

A further observation is that the margins on loans granted to non-financial corporations are noticeably lower than those on (consumption and other purposes) loans to households; only the margins on loans for housing purposes are close to the former. An explanation could be that amounts lent to households are generally smaller so that banks provide more services per euro lent and need to charge a higher relative price to cover their fixed costs. Also, the risk associated with corporate loans may be easier to gauge than that of loans to households. This would be the case if non-financial corporations tended to have standardized financial reports compared to less standardized or less detailed financial information provided by households. Non-financial corporations (in particular large ones) may also be better informed and have more bargaining power than households. In addition, large corporate loans are often collateralized. Finally, loans to non-financial corporations with a fixation period of more than 5 years show slightly negative average margins (-0.01 percent), but these loans account, on the average, for about 7 percent only of the total new business volume of loans to non-financial corporations.

Figure 7: Euro Area Interest Margins on Deposits by Maturity, Average 2003:1-2008:6 (%)

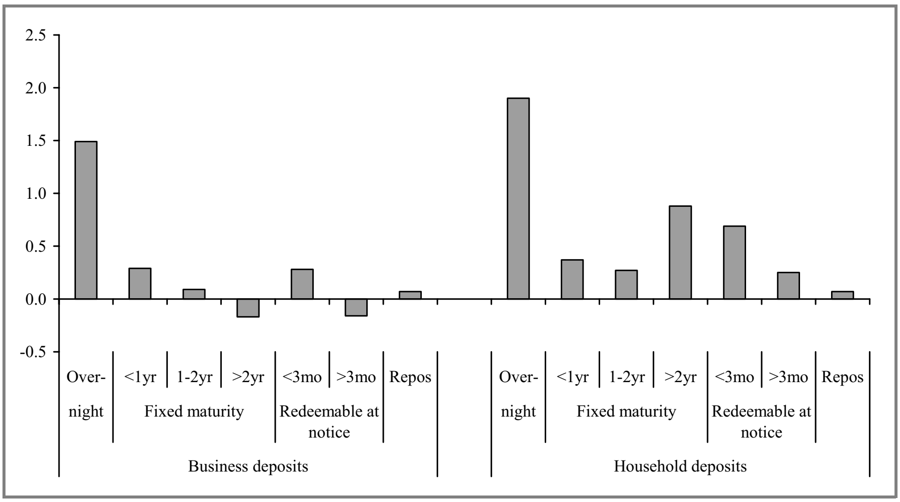
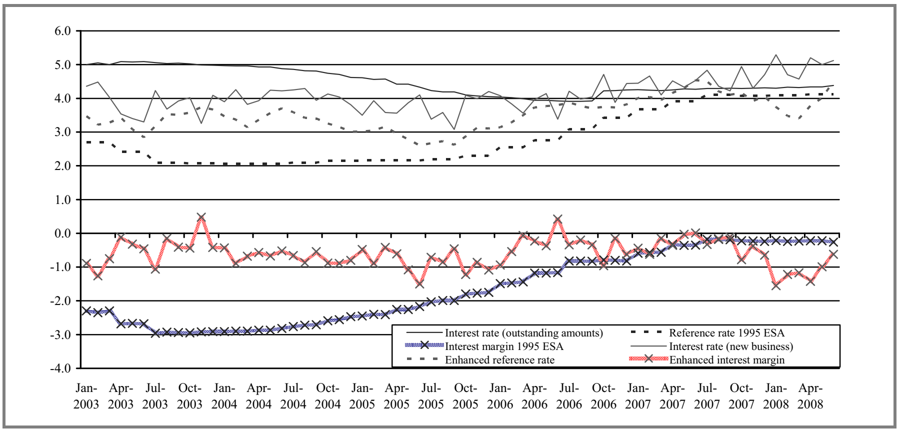


Figure 7 shows the average interest margin in the euro area in the case of deposits; this corresponds to case II in Table 1 above. Margins for deposits held by non-financial corporations tend to be lower than for household deposits, which could be explained by the same reasons as for loans. Furthermore, overnight deposits (current accounts) command the highest margins: banks may charge a high interest margin on these deposits because they provide most transaction services to their customers on this type of accounts. Another observation from Figure 7 is that for two categories of deposits, interest margins are negative when averaged over the entire period.

7.4.2. Two Examples under the Proposed Approach

How does the proposed enhanced methodology deal with the two examples presented in section 7.2. above? The first example regarded long-term deposits with agreed maturity placed by euro area non-financial corporations with German oMFIs; there we concluded that negative margins would be obtained under the *1995 ESA* approach as a result of the comparison between rates on outstanding amounts, which mainly reflect interest rates bargained in past periods, and forward-looking interbank rates, and to a maturity mismatch. Interest margins obtained under the proposed methodology are obtained in this case comparing new business interest rates for this category of deposits with the five-year German government bond.

Figure 8: Deposits with an Agreed Maturity above Two Years Placed by Euro Area Non-financial Corporations with German oMFIs (p.p.), 2003:1-2008:6



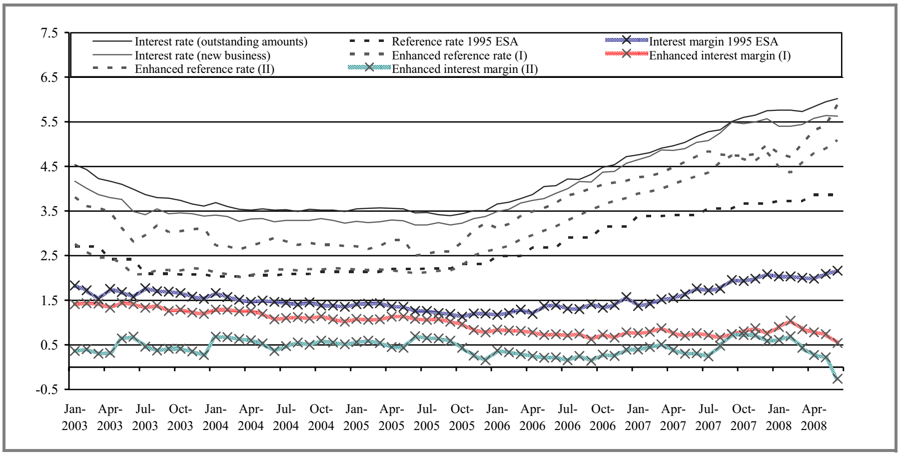
Sources: ECB (MIR interest rates and internal calculations), Thomson Financial Datastream (Government Bonds).

Notes: Reference rates obtained simulating the 1995 ESA methodology and considering the 5-year German government bond yield respectively. Interest margins derived as the difference between the interest rates (outstanding amounts or new business) and the relevant reference rates.

As it is shown in Figure 8, interest margins obtained under the modified approach are much more stable (and easy to interpret) than those obtained under the current framework. On the other side, they stay negative for most of the periods, while the jump observed in Q1 2008 seems to be determined by the 'flight to quality effect outlined above'. Although there is no theoretical justification arguing against negative margins (as outlined above), it is likely that in this case the choice of the five-year government bond may not have been appropriate: in Germany these deposits are also on offer with very long maturities so that a ten-year government bond might be a more representative security[52].

We now turn to the example on loans provided by Spanish oMFIs to euro area non-financial corporations.

Figure 9: Loans Provided by Spanish oMFIs to Euro Area Non-financial Corporations (p.p.), 2003:1-2008-6



Sources: ECB (MIR interest rates and internal calculations), Merrill Lynch (Corporate Bonds).

Notes: MIR rates on loans to non-financial corporations: original maturity below one-year (outstanding amounts) and fixation period below one-year (new business). Reference rates for Spain obtained simulating the current framework (1995 ESA) and in accordance to the enhanced methodology, i.e. Euribor six-month (I) and the Merrill-Lynch corporate bond index for euro area non-financial corporations one to five-years corrected by a maturity spread (II). Margins derived as the difference between the interest rates (outstanding amounts or new business) and the relevant reference rates.

In this case the two methodologies are not directly comparable as the *1995 ESA* framework is based on interest rates on outstanding amounts broken down by original maturity of the loan while the new approach is based on new business rates broken down by periods of fixation. Nonetheless, we compare margins obtained for the maturity band below one year (*1995 ESA*) and fixation period below one year (new approach) respectively, and are able to show that the new framework would solve the issues related to the maturity mismatch and the relevance of the risk premium. In particular, interest margins according to the proposed methodology are calculated in case of maturity adjustment (Euribor six-

52 Using the German ten-year government bond as a reference rate the interest margins is on the average -16 bp against an average of -60 bp using the five-year government bond. While there is no information available at the ECB on the average maturity of the newly offered deposits in this category so to better calibrate reference rates, data might be available at national level.

month is used as the reference rate) and in case of full adjustment (the he Merrill-Lynch corporate bond index for euro area non-financial corporations and for residual maturities between one and five years corrected by a maturity spread). The results are shown in Figure 9 above. First adjusting for the maturity mismatch (method I) allows obtaining more stable interest margins for periods when the Euribor six-months diverges from the *1995 ESA* reference rate, *i.e.* after the beginning of 2006. In addition, when adjusting also for the risk premium (method 2) the overall picture improves even further with interest margins rather stable around 50bp. It should be underlined that under this approach interest margins are negative on this type of loans in June 2008, reflecting what was already discussed above at euro area level in section 7.4.1.

7.4.3. FISIM Results for the Euro Area

With a complete set of interest margins, the implications for FISIM (imputed bank output) can be shown. For each institutional sector, imputed bank output can be calculated as:

$$Y_i = m^i S_i \tag{3}$$

where Y_i is the output associated with financial asset i (loan or deposit), m^i is the interest margin and S_i is the outstanding amount of the corresponding financial asset or liability on the bank balance sheet[53]. As discussed above, our margins are calculated using interest rates on new business for each maturity band in the case of deposits and for each band of initial interest rate fixation periods in the case of loans, and then averaged according to the shares of new business volumes, but these are then applied to outstanding amounts.

The top panel of Table 2 below shows three estimates of FISIM by sector: (i) as required in the current FISIM regulation, (ii) when the term premium is removed from the interest margins and (iii) when the default risk premium for loans is additionally removed. The bottom panel shows the weighted average interest margin for each sector, based on the underlying margins for deposits and loans. Note that the differences between FISIM under current framework and the two alternatives is not only due to different references rates, but also due to the use of

53 A critical point has been recently raised that only on-balance sheet activities of oMFIs are taken into account. Once a bank loan is securitised, the bank is assumed to be no longer providing services to the borrower. Calculations of the Federal Reserve Bank of New York have shown that treating off-balance sheet lending originated by banks in the same manner as on-balance sheet loans would boost bank output by more than 10% for the US. This should be taken into account to avoid implausible growth rates: the subprime crisis has resulted in a substantive enlargement of bank balance sheets as the sponsors of many structured vehicles have returned back to bank financing. This shift will have, ceteris paribus, the effect of artificially boosting financial sector output. See *e.g.* Ashcraft and Steindel (2008). No detailed simulations have been carried out in the case of the euro area, but a very preliminary assessment has led to the conclusion that the impact would be much lower in this case.

interest rates on new business as compared to interest rates on outstanding amounts under the current FISIM methodology.

Table 2: Imputed Banking Sector Output (FISIM) and Interest Margins in the Euro Area by Sector, Current Regulation and Modified Approaches (Average Q1 2003 – Q2 2008)

	Current regulation	Adjusted for term premium	Adjusted for term and default risk premium
FISIM (€ bln)			
Non-financial corporations	72.2	45.9	26.2
Households	145.0	103.7	89.0
Total	217.1	149.6	115.2
***Interest margin** (%)*			
Non-financial corporations	1.5	1.0	0.5
Households	1.7	1.2	1.0

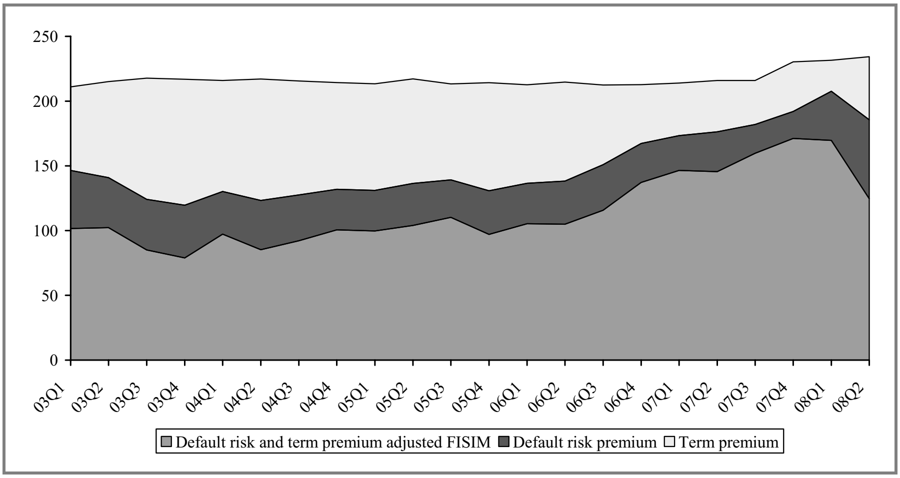
Notes: FISIM is calculated as the interest margin of each type of loan and deposit times the outstanding balance. The interest margins in the bottom panel are weighted averages of loan and deposit margins. Current regulation FISIM uses interest rates on outstanding amounts and reference rates which mainly represent weighted averages of inter-bank interest rates. The two alternatives use interest rates on new business. When adjusting for the term premium, the government bond yield with the most closely matching maturity is used as reference rate. When also adjusting for the default risk premium, yields on corporate bonds and mortgage- and asset-backed securities are used. See Appendix Tables A1 and A2 for details.

Overall, the differences are substantial. Both alternatives show lower FISIM than the current approach: under the two approaches described above the average annual banking sector output on positions vis-à-vis households and non-financial corporations is € 149.6 bn and € 115.2 bn respectively. The adjustments yield figures that are 31 and 47 percent lower, respectively, than the data on FISIM under the current framework. While the current regulation implies estimated average interest margins of 1.5 percent for non-financial corporations and 1.7 percent for households, these fall to 1 and 1.2 percent in case of term premium adjustment and to 0.5 and 1 percent when adjusting both for therm spread and for the risk premium. Table 1 illustrates why the impact of the two alternatives is larger for non-financial corporations than households. For nearly all types of loans and deposits the margins paid by corporations are lower than for households, even when a short-term interest rate is used. Any downward adjustment will therefore represent a relatively larger part of the margin. A more complete overview on sectoral FISIM results and time series is given in the Annex[54].

[54] In particular, the Annex presents detailed results for the new methodology in its two variants compared to the framework of *1995 ESA*. The different approaches are referred to using the syntax of Table 1, *i.e.* method I refers to the current approach, method II performs a term premium correction on the reference rate(s) and method III also takes into account the default risk premium in case of loans; in addition, methods II and III use interest rates on new business.

Figure 10 provides a summary overview on aggregated euro area FISIM for households and non-financial corporations. The bottom area shows FISIM calculated using interest margins from which both the term premium and default risk have been eliminated. The middle area can be interpreted as the default risk premium adjustment. The three areas together correspond to the current statistical practice of measuring FISIM, and therefore the top area shows the (bias resulting from the inclusion of the) term premium. As might be expected based on the data in Table 1, the impact of removing risk from the banking sector output is substantial. Risk-adjusted FISIM is on average only 53 percent of current-practice FISIM, with default risk accounting on the average for 16 percent of the current measure and the term premium for 31 percent. In terms of deliveries to final demand this implies, on the average, an overestimation between € 16.1 bn and € 20.4 bn or 0.20 to 0.25 of euro area GDP[55].

Figure 10: Euro Area Imputed Banking Sector Output (FISIM) and the Value of the Risk Premiums (billions of euros), Q1 2003 – Q2 2008



55 Assessing the impact on GDP (at current prices) of the new methodology is not straightforward as it would require FISIM calculation for all domestic sectors as well as FISIM exports and imports. In addition, FISIM affects both intermediate and final consumption and requires their bridging with the different types of loans recorded in the context of MFI balance sheet statistics. Services provided to corporations (as non-FISIM producers) are intermediate consumption, and do not affect GDP. However, services provided to households (as well as to general government and to non-residents) are final consumption and add to GDP. An important exception, though, is lending to households for housing purposes, which is an intermediate consumption input into the production of these services. Preliminary simplified estimates show that for the period January 2003 to June 2008 the total value of bank services to households delivered to final demand would be reduced, on the average, by € 20.4 bn in case of default risk and term premium adjustment, and by € 16.1 bn in case of adjustment for the term premium only. The adjustments respectively represent 0.25 and 0.20 percent of euro area GDP. It should be outlined that this estimate depends on the specific implementation of both current-regulation FISIM and our adjusted FISIM. Current FISIM statistics as compiled by statistical agencies will in general be different leading to different estimates of this overstatement, although it seems plausible that the order of the correction would not change.

The impact of removing the remuneration for credit default risk and term premium from the banking sector output is substantial. A first important remark regards the sizeable impact of the term premium correction over the period from Q3 2003 to Q2 2006 which was characterized by a steep yield curve; conversely, this adjustment drops in the course of 2007 because of a flattening yield curve. Secondly, while over this period the total default risk correction seems to be broadly stable, in an environment with high growth rates on outstanding loans and deposits this mainly reflects a decreasing (average) risk premium; see also section 7.3.4. In addition, the default risk premium correction also appears to decrease in the last two quarters of 2007 and to then increase rather sharply in the course of 2008. This phenomenon is related to the peculiarity of the financial turmoil observed over this period, which led to an increase of the general financial market risks while the borrowers' credit default risk remained broadly unchanged at first to then increase considerably in 2008[56].

Risk-adjusted FISIM is more volatile than current-practice FISIM[57]; this mainly reflects the evolution of the outstanding amounts on loans and deposits which have shown sharp growth rates over the period under analysis. In turn, all interest margins are less volatile than under the current framework (see the Annex for further details); the reason is that most of the volatility of the current margins originates from the volatility of the term premium and the default risk premium components. By removing these common drivers of the interest margins, idiosyncratic movements make up a more substantial part.

7.5. CONCLUDING REMARKS

Banks do not charge explicit fees for much of the services they provide, so that the value of those services needs to be imputed by comparing bank loan and deposit rates to reference rates that serve as a measure of opportunity costs of funds. This paper has shown how the euro area banking sector output (FISIM) would change if the compensation for bearing risk would be removed from output. Recent theoretic work has demonstrated that bearing risk is in general not a productive service as such. Instead, determining credit-worthiness of borrowers and pricing the risk is production as it requires labour, capital and intermediate inputs. If banks bear risk by holding corporate bonds or equity, this is not considered a productive service and, likewise, the systematic risk on bank loans (and deposits) should also be excluded from the banking sector output.

56 In other words, while market interest rates on loans increased reflecting the sharp increase in inter-bank rates with a maturity between one month and one year, the bond yields did not completely mirror this change at the beginning of the turmoil to then increase in the course of 2008 reflecting the deterioration of the general economic situation.

57 The coefficient of variation of FISIM under the current framework is 0.03, compared to 0.16 and 0.24 under the two proposed alternatives.

Our empirical application of the risk-adjusted bank output model covers deposits and loans vis-à-vis euro area households and non-financial corporations from the first quarter of 2003 to the second quarter of 2008. The results show that if we only remove the term premium, the banking sector output is on average 31 percent lower than under the current methodology. If we also remove the default risk premium, this output is on average 47 percent lower. In other words, the choice of reference rate is crucial and the empirical impact of this choice is substantial. This also has an effect on GDP, the size of the economy, to the extent that bank services are part of final demand. For example, banking sector output to households falls from an average over the period of € 145 bn to € 89 bn, implying a fall in services delivered to final demand of about € 20.4 bn. Comparable work for the United States by Basu *et al.* (2009) has shown an adjustment to banking sector output of a similar magnitude, so our findings for the euro area do not depend on specific data or assumptions.

Beneath these headline results, a number of data issues remain. The current financial crisis in particular illustrates problems of matching bank loans and financial market securities. Risk premiums have widened since the summer of 2007, but bank loans rates have changed by much less. Does this mean bank loan rates are slow to adjust? Have service margins decreased? Is there a mismatch between the type of bank loans and the debt included in these securities? These questions would need further research to be answered, but these questions also arise under the old methodology. There excessive service margins lead to avoid negative interest margins in these times but the changes in margins are as hard or harder to gauge. Since our service margins are closer to what economic theory requires for all periods under study, and also because they are less volatile we would argue for our modified, risk-adjusted bank output measure.

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7.7. APPENDIX 1

Table A1: Bank Loan and Deposit Instruments and Reference Rates: Term Premium Adjustment

	Reference rate
Loans	
(breakdowns by periods of initial interest rate fixation)	
Non-financial corporations	
Up to 1 year	6-month EURIBOR
Over 1 year and up to 5 years	3Y government bond yield
Over 5 years	7Y government bond yield
Households	
For house purchases	
Up to 1 year	6-month EURIBOR
Over 1 year and up to 5 years	3Y government bond yield
Over 5 years and up to 10 years	7Y government bond yield
Over 10 years	10Y government bond yield
Consumer credit	
Up to 1 year	6-month EURIBOR
Over 1 year and up to 5 years	3Y government bond yield
Over 5 years	7Y government bond yield
Other purposes	
Up to 1 year	6-month EURIBOR
Over 1 year and up to 5 years	3Y government bond yield
Over 5 years	7Y government bond yield
Deposits	
(breakdowns by maturity; same treatment for households and non-financial corporations)	
Overnight deposits	EONIA
Deposits with agreed maturity	
Up to 1 year	6-month EURIBOR
Over 1 year and up to 2 years	2Y government bond yield
Over 2 years	5Y government bond yield
Deposits redeemable at notice	
Up to 3 months	1-month EURIBOR
Over 3 months	2Y government bond yield
Repurchase agreements	EONIA

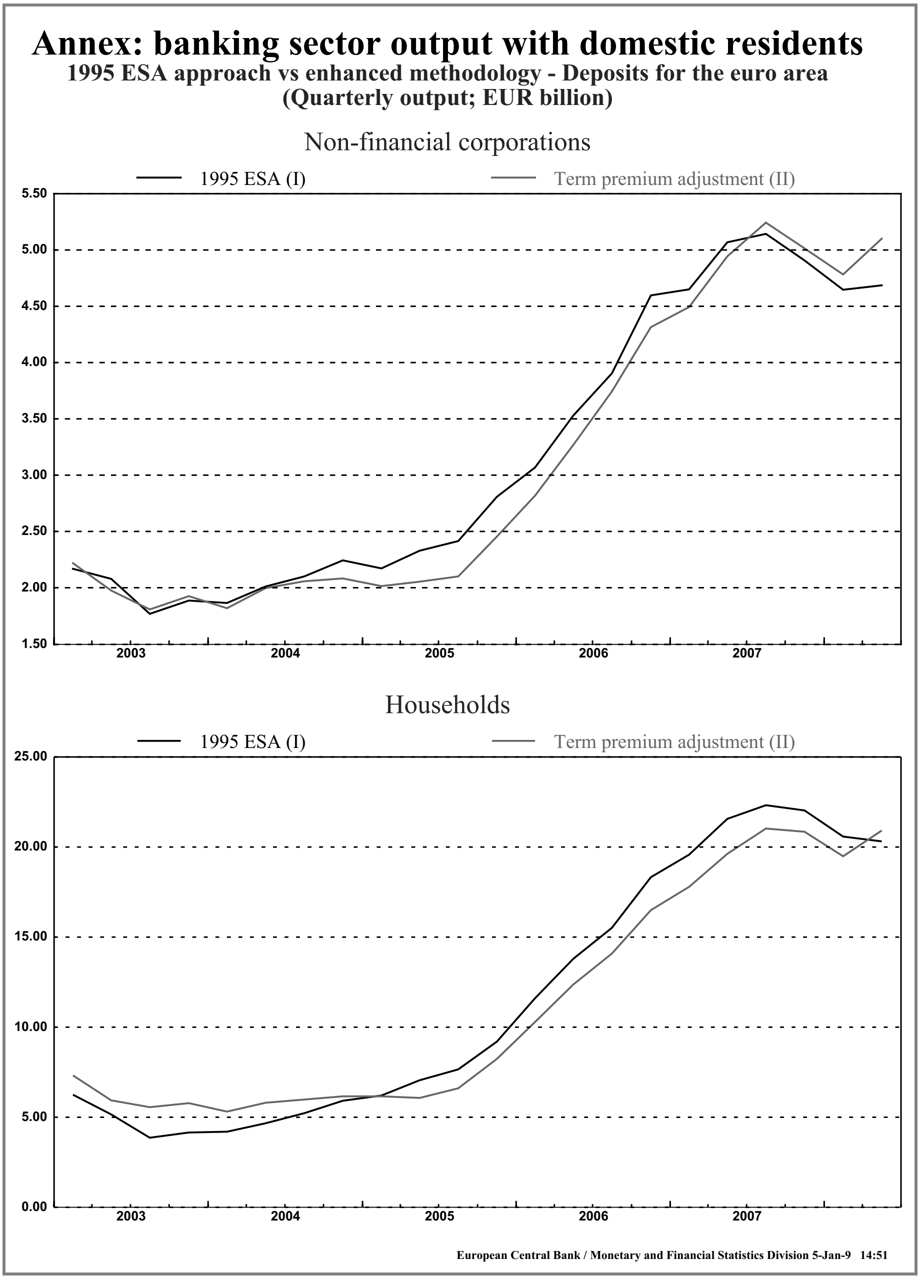
Acronyms:
NFC: non-financial corporations.
EONIA: Euro overnight index average.
EURIBOR: Euro interbank offered rate.

Table 2: Bank Loan and Deposit Instruments and Reference Rates: Default Risk and Term Premium Adjustments

Reference rate	
Loans	
Non-financial corporations	
Up to 1 year	ML NFC bond index, 1-5Y minus 3Y government bond yield plus 1Y government bond yield
Over 1 year and up to 5 years	ML NFC bond index, 1-5Y
Over 5 years	ML NFC bond index, 5-10Y
Households	
For house purchases	
Up to 1 year	ML ABS/MBS index minus 5Y government bond yield plus 1Y government bond yield
Over 1 year and up to 5 years	ML ABS/MBS index minus 5Y government bond yield plus 3Y government bond yield
Over 5 years and up to 10 years	ML ABS/MBS index minus 5Y government bond yield plus 7Y government bond yield
Over 10 years	ML ABS/MBS index minus 5Y government bond yield plus 10Y government bond yield
Consumer credit	
Up to 1 year	ML ABS/MBS index minus 5Y government bond yield plus 1Y government bond yield
Over 1 year and up to 5 years	ML ABS/MBS index minus 5Y government bond yield plus 3Y government bond yield
Over 5 years	ML ABS/MBS index minus 5Y government bond yield plus 7Y government bond yield
Other purposes	
Up to 1 year	ML ABS/MBS index minus 5Y government bond yield plus 1Y government bond yield
Over 1 year and up to 5 years	ML ABS/MBS index minus 5Y government bond yield plus 3Y government bond yield
Over 5 years	ML ABS/MBS index minus 5Y government bond yield plus 7Y government bond yield
Deposits (same treatment for households and non-financial corporations)	
Overnight deposits	EONIA
Deposits with agreed maturity	
Up to 1 year	6-month EURIBOR
Over 1 year and up to 2 years	2Y government bond yield
Over 2 years	5Y government bond yield
Deposits redeemable at notice	
Up to 3 months	1-month EURIBOR
Over 3 months	2Y government bond yield
Repurchase agreements	EONIA

Acronyms:
ML: Merrill Lynch
NFC: non-financial corporations
ABS/MBS: Asset-backed security/Mortgage-backed security
EURIBOR: Euro interbank offered rate
EONIA: Euro overnight index average

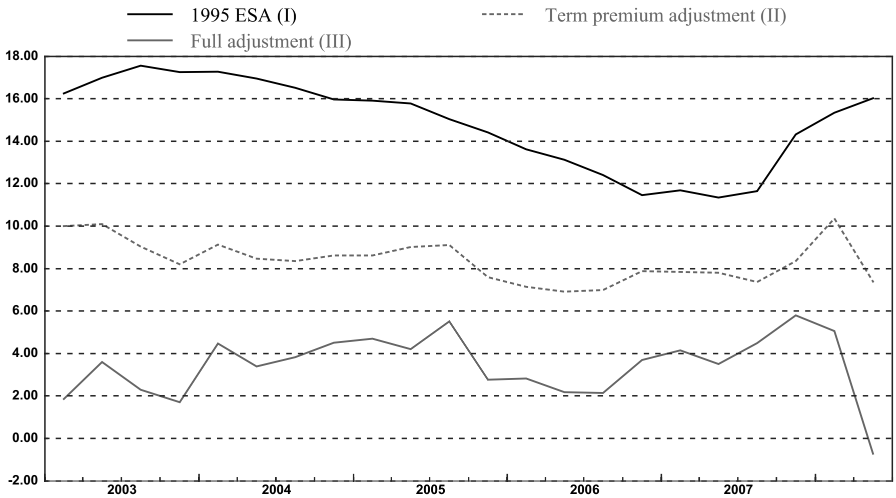
7.8. APPENDIX 2



Annex: banking sector output with domestic residents

1995 ESA approach vs enhanced methodology - Loans for the euro area
(Quarterly output; EUR billion)

Non-financial corporations



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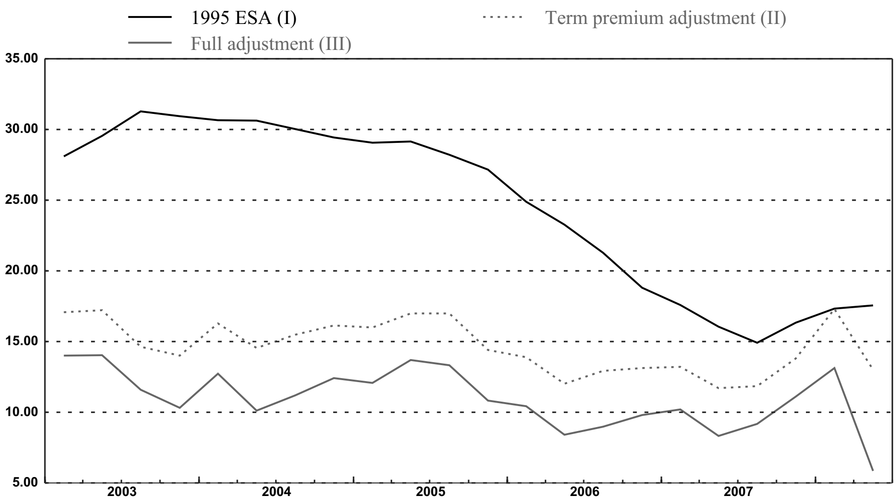

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Annex: banking sector output with domestic residents

1995 ESA approach vs enhanced methodology - Deposits and loans for the euro area
(Quarterly output; EUR billion)

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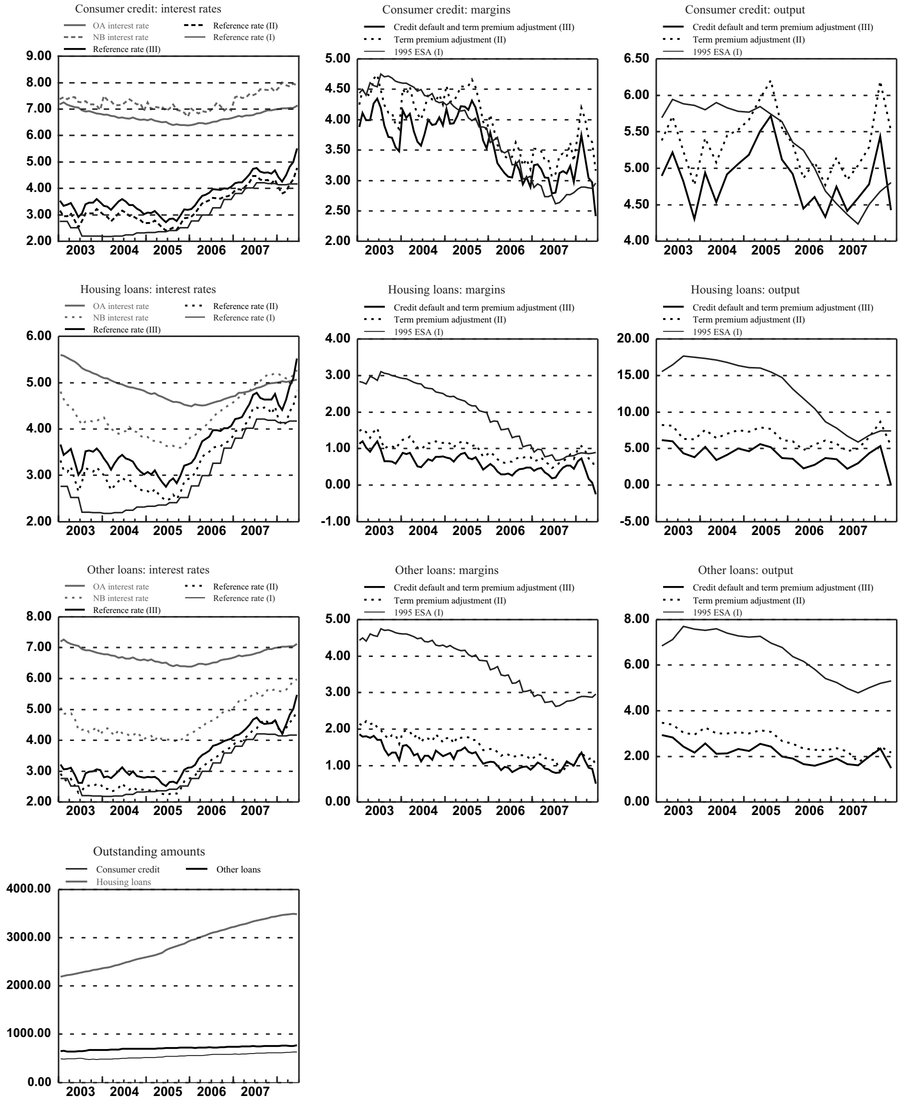
Annex: banking sector output with domestic residents

1995 ESA approach vs enhanced methodology - Loans to households for the euro area
(percentage points for interest rates and margins; EUR billion for stocks)



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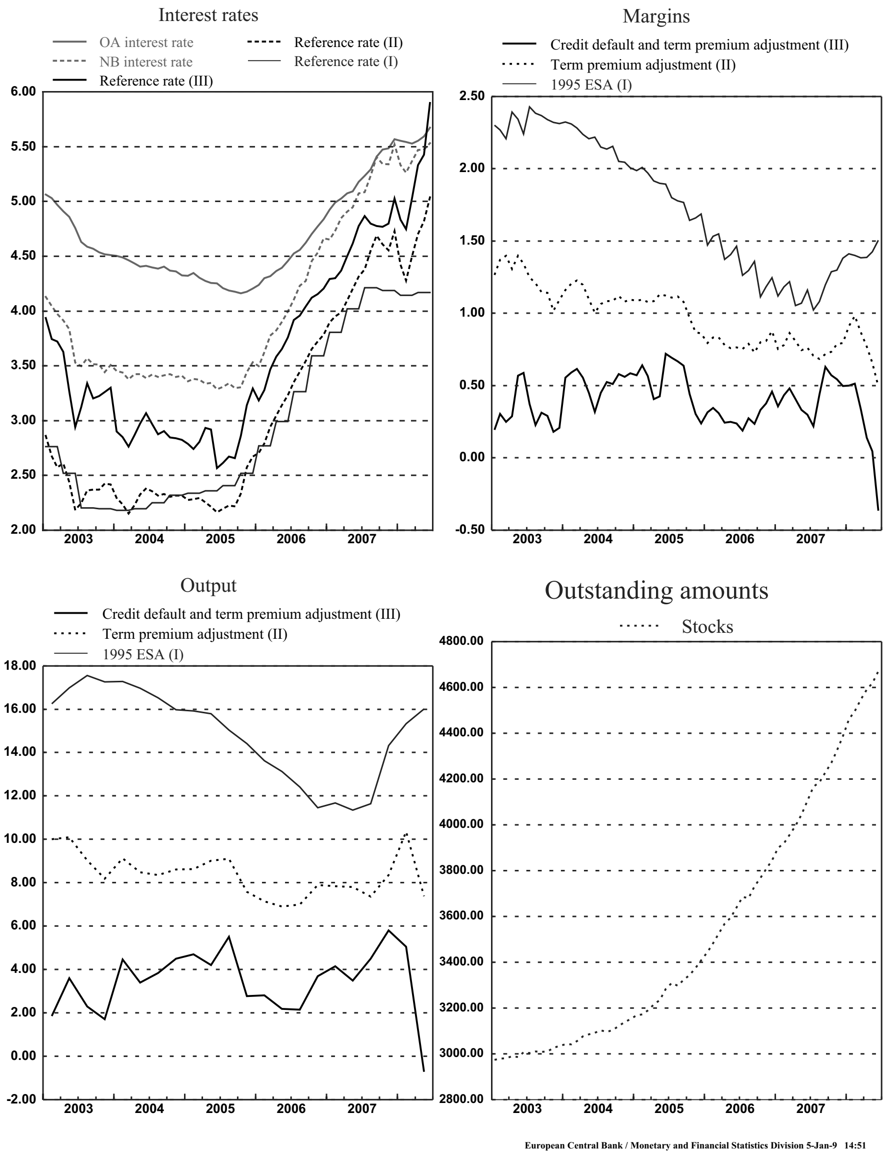
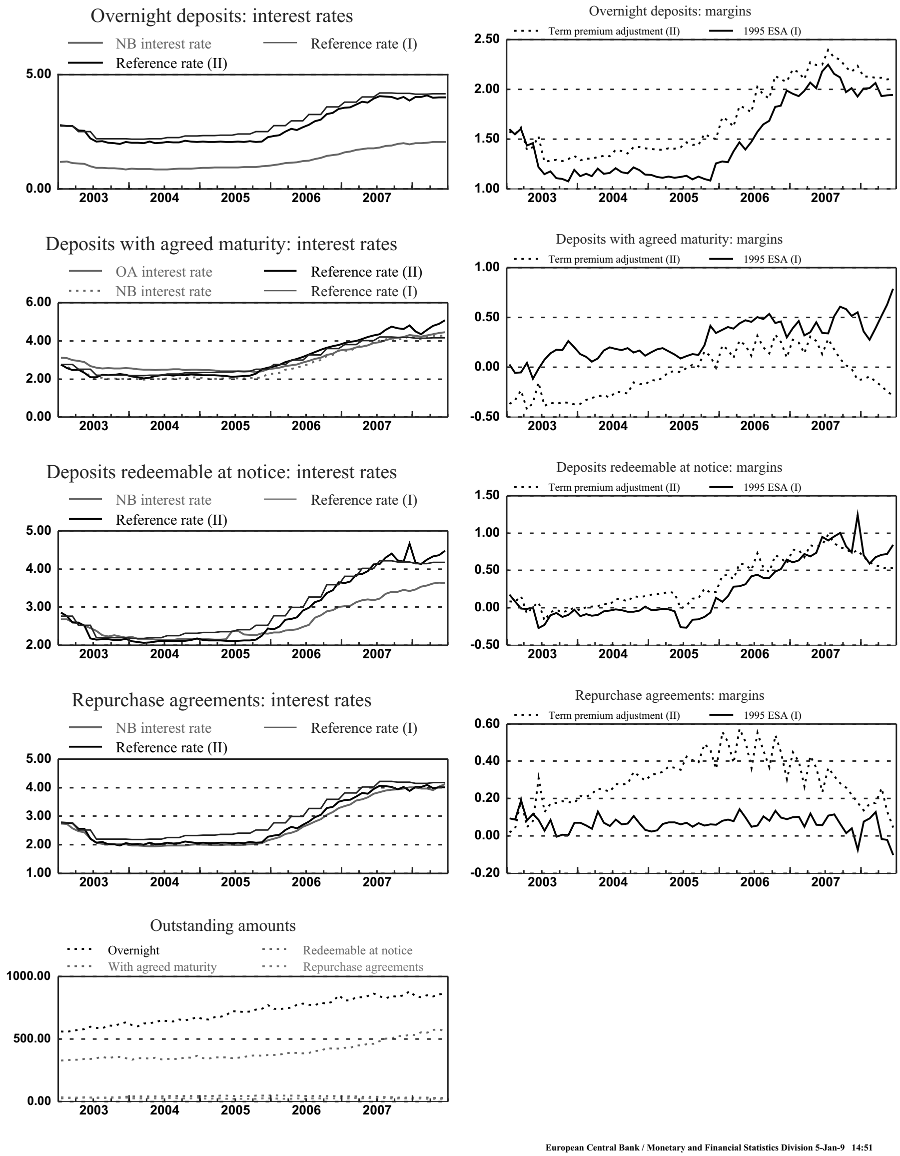
Annex: banking sector output with domestic residents

1995 ESA approach vs enhanced methodology - Loans to non-financial corporations for the euro area
(percentage points for interest rates and margins; EUR billion for stocks)



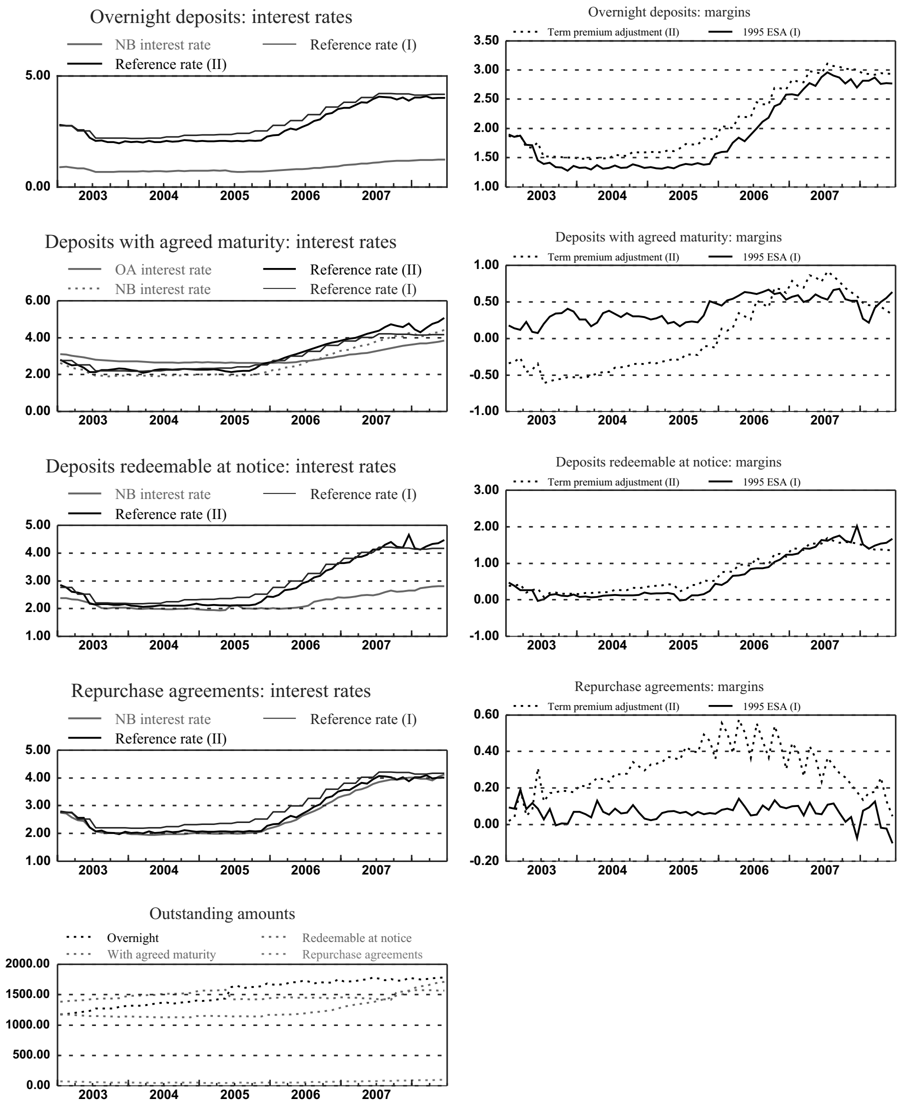
Annex: banking sector output with domestic residents

1995 ESA approach vs enhanced methodology - Deposits by non-financial corporations in the euro area (percentage points for interest rates and margins; EUR billion for stocks)



Annex: banking sector output with domestic residents

1995 ESA approach vs enhanced methodology - Deposits by households in the euro area (percentage points for interest rates and margins; EUR billion for stocks)



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8. Bank Productivity and Efficiency in Luxembourg: Malmquist Indices from a Parametric Output Distance Function

Paolo Guarda and Abdelaziz Rouabah[1]

Abstract

Productivity change reflects both technical change (shift in the best-practice frontier) and efficiency change (how far the average firm is from the best practice frontier). This article analyses these two sources of productivity change using quarterly reporting data from Luxembourg's banking sector. Bank output is defined using the user cost approach as already applied to this dataset in Guarda and Rouabah (2006, 2007). Malmquist productivity indices are calculated from an output distance function estimated parametrically using a translog system of equations. Results suggest that productivity in Luxembourg's banks grew by about 1% per quarter over the sample 1994Q1-2007Q4. Productivity growth was somewhat higher when averaged only over larger banks (in terms of total assets). The standard decomposition of the Malmquist productivity index suggests that most of the productivity growth is from efficiency change rather than technical change. This means that few individual banks occasionally shift the efficient frontier and that most of the other banks in the sample are catching up, improving their productivity by reducing their inefficiency.

8.1. Introduction

Conceptually, productivity change is broadly understood as the change in the level of output produced for a given change in the level of input. Measuring this ratio becomes more challenging in a setting with multiple outputs and multiple inputs (such as the banking industry). Caves, Christensen and Diewert (1982) introduced Malmquist indices for productivity analysis and showed that they correspond to the ratio of two distance functions. The advantages of the Malmquist productivity index are that it is appropriate for production technologies with arbitrary returns to scale, substitution possibilities and biases in productivity change. However, Caves and al. noted that the Malmquist cannot be computed without knowledge of the underlying technology. Instead, these authors showed that Törnqvist productivity indices can be expressed as the mean of two

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Malmquist productivity indices if the production technology is translogarithmic. Törnqvist indices have the advantage that they can be calculated even without knowledge of the parameters of the underlying technology.

Färe, Grosskopf, Norris and Zhang (1994) showed how Malmquist indices can be calculated using nonparametric techniques which do not require specifying the functional form of the production technology. These authors also provided a decomposition of productivity change (PC) into technical change (TC) (shifts in the best-practice frontier) and efficiency change (EC) (individual observations shifting relative to the best-practice frontier). This decomposition into two separate sources of productivity change proved very popular and encouraged the widespread application of non-parametric techniques such as Data Envelopment Analysis (DEA). Prominent studies of productivity change in banking using non-parametric methods include Berg, Førsund and Jansen (1992), Grifell-Tatjé and Lovell (1997), Wheelock and Wilson (1999), and Alam (2001).

Parametric techniques continued to be applied, but usually in the context of stochastic cost frontiers (see Altunbas, Goddard, Molyneux (1999); Altunbas, Gardener, Molyneux and Moore (2001), as well as Casu, Girardone and Molyneux (2004)) or stochastic profit frontiers (see Kumbhakar, Lozano-Vivas, Knox Lovell and Hasan (2001)). These models generally included a deterministic time trend in the stochastic frontier to capture the impact of technical change. This involves the strong assumption that (on average across banks) technical progress occurs at a constant rate. The Malmquist index, instead, involves a series of period-to-period comparisons, which allows technical progress to speed up, slow down and even reverse within the sample period. Fuentes, Grifell-Tatjé and Perelman (2001) showed that Malmquist indexes could be obtained within the parametric approach by estimating output distance functions directly. They included a deterministic time trend in their translog output distance function and used its estimated coefficients to isolate the technical change component. Instead of a deterministic time trend, Atkinson, Cornwell and Honerkamp (2003) used period-specific dummies in their translog input distance function to obtain Malmquist indices. In this paper, we choose yet another method to capture technological change by estimating period-by-period parametric frontiers as proposed by Coelli, Rao and Battese (1998, pp. 233-234). Previous parametric studies of productivity avoid this alternative because of its high cost in terms of degrees of freedom. We solve this problem by estimating the distance function within a simultaneous system of cost share equations (increasing the number of degrees of freedom each period) and imposing the necessary cross-equation restrictions (reducing the number of parameters to estimate). Since we are in a system of equations context, it is difficult to maximise the highly nonlinear log-likelihood of a composed error model, so we prefer estimation by 'corrected' ordinary least squares (COLS) as implemented in Coelli and Perelman (2000). For the translog functional form, Coelli (2000) established the consistency of this simple method for directly estimating the output distance function under the assumption of revenue maximising behaviour.

Section 8.2 outlines the methods used in more detail, describing the Malmquist index and its standard decomposition, as well as the particular form of the output distance function estimated and its associated system of equations. Section 8.3 describes the data and discusses some trend behaviour. Section 8.4 presents the resulting productivity indices and their decomposition. The final section presents some conclusions.

8.2. METHODS

To introduce the Malmquist index, we must first define the production technology and its associated distance function. Let $x^t = (x_1^t, \ldots, x_K^t) \in R^K$ and $y^t = (y_1^t, \ldots, y_M^t) \in R^M$ represent the input and output vectors at time t = 1,…, T. Then the feasible production technology can be represented as a correspondence between the output set $P^t(x^t)$ which can be produced and the input vector x^t:

$$P^t(x^t) = \{y^t \text{ is obtainable from } x^t\}, \qquad t = 1, \ldots, T \tag{1}$$

The output set $P^t(x^t)$ is assumed to be consistent with a set of axioms including convexity and strong disposability of outputs. Following Shephard (1970), the output distance functions can be defined as follows:

$$D_O^t(x^t, y^t) = \inf\{\theta: (y^t/\theta) \in P^t(x^t)\}, \qquad \mathrm{t} = 1, \ldots, \mathrm{T} \tag{2}$$

By assumption, $D_O^t(x^t, y^t) \leq 1$, with the distance function taking the value unity $D_O^t(x^t, y^t) = 1$ only if y^t is located on the outer limit of the feasible production set. Thus the value of the output distance function indicates the potential radial expansion of production (increase of all outputs y^t in the same proportion θ) that is feasible for a given vector of inputs x^t. By definition, the distance function is linearly homogenous in outputs.

The Malmquist index is defined as the ratio between two distance functions corresponding to the input and output vectors of the i^{th} firm at two different periods (t and $t + 1$ in what follows).

$$M_O^t(x^{i,t}, y^{i,t}, x^{i,t+1}, y^{i,t+1}) = \frac{D_O^t(x^{i,t+1}, y^{i,t+1})}{D_O^t(x^{i,t}, y^{i,t})} \qquad \mathrm{t} = 1, \ldots, \mathrm{T}$$

Note that the distance function in the numerator and the denominator are both defined with respect to the technology in period t. However, the input and output vectors in the numerator are those of period $t + 1$, so the numerator may take a value greater or equal to one. The Malmquist index will be greater than one if productivity grows between period t and $t + 1$ and will be less than one if productivity falls. However, these changes in productivity can be further decomposed by introducing the output distance function $D_O^{t+1}(x^{i,t+1}, y^{i,t+1})$ based on the technology in period $t + 1$. This makes it possible to write the Malmquist index as the product of two ratios:

$$M_O^t(x^{i,t}, y^{i,t}, x^{i,t+1}, y^{i,t+1}) = \frac{D_O^{t+1}(x^{i,t+1}, y^{i,t+1})}{D_O^t(x^{i,t}, y^{i,t})} \cdot \frac{D_O^t(x^{i,t+1}, y^{i,t+1})}{D_O^{t+1}(x^{i,t+1}, y^{i,t+1})} = EC \cdot TC \tag{4}$$

Where the first ratio represents Efficiency Change (EC) and the second ratio represents Technical Change (TC). Efficiency change above unity means that the ith firm has moved closer to the efficient (best-practice) frontier and thus measures 'catching up' (or 'falling behind' if it is less than unity). Technical change above unity indicates technological progress, meaning that the efficient frontier has shifted out compared to the previous period, and a value below unity suggests technical regress. Note that the decomposition in (4) requires evaluating the distance function from period t with the input and output vectors of period $t + 1$ and vice versa.

Fixler and Zieschang (1992) econometrically estimate an output distance function for banks with a system of simultaneous share equations. They note that Shephard's classic duality result demonstrates that if D_O^t is convex and increasing in y^t then it is dual to the revenue function $\pi(x^t, p^t)$ that can be defined

$$\pi(x^t, p^t) = \{p^t \cdot y^t : y^t \in P^t(x^t)\} \qquad t = 1, \ldots, T \tag{5}$$

where p^t is a vector of known nonzero, nonnegative output prices. If one of the outputs in the vector $\boldsymbol{y}$ is actually an input (meaning that the functions D and π have negative derivatives with respect to this element of the vector $\boldsymbol{y}$) then the profit function π can be re-interpreted as the general restricted profit function. McFadden (1978, p.66) proposed the latter as a unified approach encompassing the cost-minimising, revenue-maximising and profit-maximising solutions. In fact, the general restricted profit function can represent (as special cases) the revenue, profit or cost functions (the latter with a negative sign).

In the context of the general restricted profit function, McFadden distinguished the *fixed* from the *variable* outputs and/or (negative) inputs. Fixler and Zieschang (1992) took the level of deposits as the fixed variable on which the function is conditioned. The Shephard-Hotelling lemma is generally used to yield the vector of revenue-maximising outputs as $y^{t*} = \nabla_p \pi(x^t, p^t)$. Instead, Fixler and Zieschange appealed to its obverse to estimate the vector of shadow prices $p^{t*} = \nabla_y D^t(x^t, y^t)$. To do this, they estimated the conditional distance function D_c^t, which is conditioned on the level of deposits. This is appropriate in the banking context as deposits and other liabilities represent accounting inputs (a use of funds) even though they may be a source of financial services output. Since the output distance function is conditional on deposits and liabilities, it generates a system of gross revenue share equations, relating asset receipts to total asset income. Instead, an unconditional distance function would generate a system of net revenue share equations, relating (positive) asset income and (negative) deposit payments to net asset income. From an econometric point of view, this would be problematic because net asset income shares would not be bounded between zero and one, so the results would be more sensitive to random variation in the interest rates that are effectively endogenous variables in the system.

For each asset class, the gross revenue shares can be calculated as follows

$$\omega_i = \frac{(h_i - \rho)y_i}{R_A - \rho A} \tag{6}$$

Where h_i = the holding revenue rate on the i^{th} asset; ρ = the opportunity cost of funds (rate); R_A total income (asset holding revenue plus income from directly charged services not associated with asset/liability products); $A = \Sigma_i y_i$ = total assets; and $\omega_i = \nabla_{\ln yi} D_c(x^t, y_v^t y_f^t)$. Fixler and Zieschang (1992, p. 230) assume that the opportunity cost rate ρ is a constant fraction ϕ of the total return on assets r_{TA} such that $\phi = \rho/r_{TA}$ and restate these equations with a change of variables as

$$\omega_i = \phi \cdot s_i + (1 - \phi) \cdot \omega_i \tag{7}$$

Where $\omega_i = h_i y_i / R_A$ = the holding revenue share of the i^{th} product in overall asset income; $s_i = y_i/A$ = the asset portfolio share of the i^{th} product; $r_{TA} = R_A/A$ = the total rate of return on assets including service charge income.

Assuming the conditional distance function is translog, the economic shares w_i can be written:

$$\omega_i = \alpha_i + \sum_{\delta = 1}^{M} \gamma_{yy,\,ij} \ln y_j + \sum_{k = 1}^{K} \gamma_{yx,\,ik} \ln x_k \tag{8}$$

The familiar restrictions $\sum_{i=1}^{M} \alpha_i = 1$, $\sum_{i=1}^{K} \gamma_{yy,\,ij} = 0$, $j = 1,\ldots,M$; and $\sum_{i=1}^{M} \gamma_{yx,\,ik} = 0$, $k = 1,\ldots,K$ follow from homogeneity of the distance function. Substituting (8) into (7) and appending an error term:

$$\omega_i = \phi s_i + \mu_i + \sum_{j=1}^{M} \psi_{yy,ij} \ln y_j + \sum_{k=1}^{K} \psi_{yx,ik} \ln x_k + \varepsilon_i \tag{9}$$

$$\omega_s = \mu_s + \sum_{j=1}^{M} \psi_{yy,sj} \ln y_j + \sum_{k=1}^{K} \psi_{yx,sk} \ln x_k + \varepsilon_s \tag{10}$$

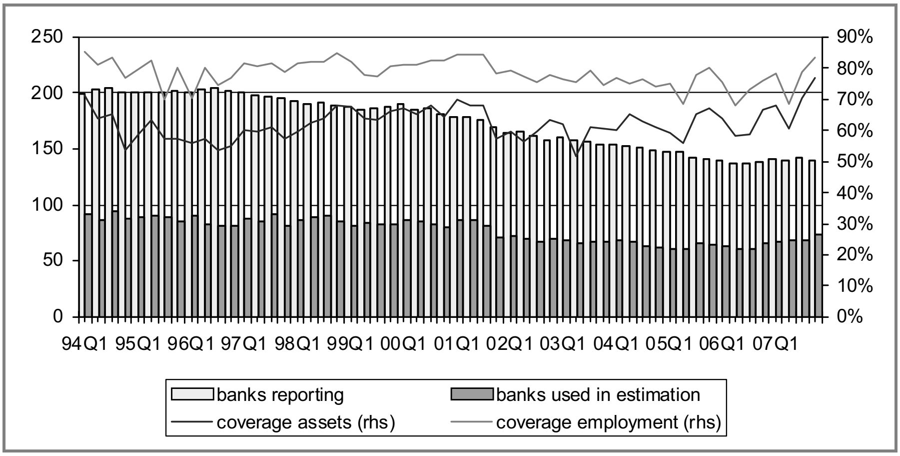
where $\mu_i = (1-\phi)\alpha_i$; $\psi_{yy,ij} = (1-\phi)\gamma_{yy,ij}$; $\psi_{yx,ik} = (1-\phi)\gamma_{yx,ik}$ and the earlier homogeneity restrictions can be restated using this new parameterization. Equation (10) is the share equation for income from directly charged services, which are not associated with any particular balance sheet items.

Note that since the shares must add up to unity, there is a restriction on the stochastic error terms added to equations (9) and (10): $\varepsilon_s + \Sigma_i \varepsilon_i = 0$. The covariance matrix of the disturbance terms across the equations is singular because these error terms are restricted to add up to zero. Therefore one of the share equations in the system can be dropped arbitrarily and its parameters recovered via the homogeneity restrictions. Below we estimate a system of simultaneous equations including the translog output distance function as well as the share equations of form (9) and (10).

8.3. DATA

The dataset includes observations from all banks reporting over the sample 1994Q1-2007Q4. On average, 176 banks reported each quarter; however the exact number of banks per period varies as some banks enter, leave or merge each quarter. Unfortunately, many of the banks reporting do not provide all the data required for our analysis. This is often because branches of banks established in other EU member states are subject to lower reporting requirements. In addition, some banks are specialised in some very restricted line of business so they report zeros in many asset/liability positions, which is problematic for our assumed translog functional form. To ensure a more homogenous sample, we restricted our analysis to banks that reported all four of the asset categories and both of the liability categories presented in Table 1 below. This reduces the number of banks to only 78 per quarter on average. However, the banks that were removed from the sample were predominantly smaller banks, often both in terms of balance sheet and in terms of the number of employees. In fact, the sub-sample of banks considered covered 52% to 71% of the aggregate balance sheet for the sector, with the coverage rate for total assets averaging 62%. In terms of employment, the sub-sample of banks considered represented 68% to 85% of all jobs in the banking sector, averaging 79% over the whole sample period.

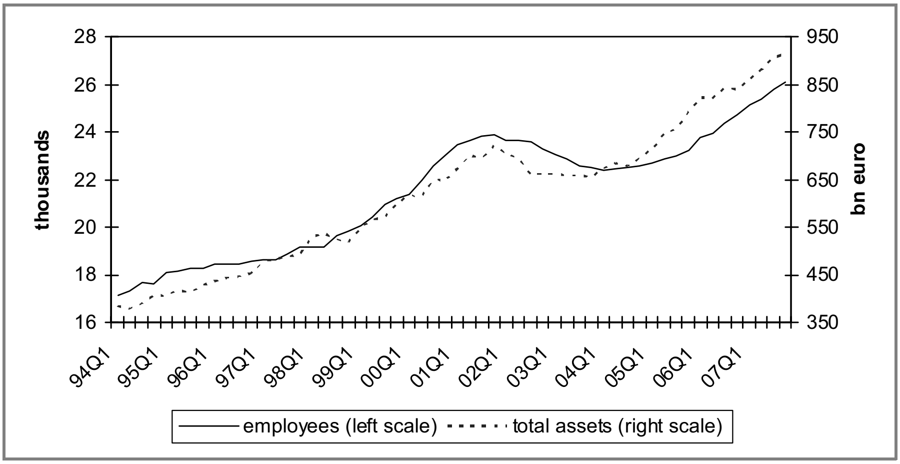
Figure 1: Number of Banks and Coverage Rates



Source: BCL.

The observable decline in the number of banks from over 200 to about 140 reflects the move towards consolidation in the European banking sector, as mergers between parent banks in Germany, France, Belgium or other EU countries lead to mergers in their Luxembourg subsidiaries. In fact, despite this decline in the number of banks, the Luxembourg financial sector has continued to grow both in terms of total assets and in terms of employment. This is confirmed by the following figure plotting the evolution of total assets and employees summed over all banks for each individual quarter in the sample. Both employment and total assets grew strongly until the beginning of 2001Q4, when the financial sector started to contract. Both series have recovered since, with the expansion beginning earlier in total assets than in employment.

Figure 2: Employment and Total Assets in Luxembourg's Banks



Source: BCL.

There is no generally accepted definition of bank outputs and inputs and many studies select them on the basis of the detail available from banks' balance sheets, along with an occasional reference to a conceptual framework (see Berger and Humphrey (1992)). In previous work (Guarda and Rouabah (2006, 2007)), we followed Fixler and Zieschang (1992) in implementing the user cost approach. This involved aggregating assets and liabilities drawn from the balance sheet into different product classes, with each class potentially either an input or an output. The input/output status of these different financial product classes was then determined by the sign of their associated user cost. This was calculated as the difference between a reference rate (the 'opportunity cost of funds' denoted ρ above) and the holding revenue rate for assets or the holding cost rate for liabilities. Therefore, the definition of the different classes of assets and liabilities has to be chosen as a function of the available detail in the profit-and-loss account, since the corresponding holding revenues or costs for the given asset or liability need to be identified. The following is our version of Table 6.1 in Fixler and Zieschang (1992):

Table 1: Components of Financial Product Aggregates

Aggregate financial product	BCL code	Description
Loans & leases:		
Y1	B1-04.000	Loans to customers
Y2	B1-05.000	Leases
	B1-03.000	Loans to depository institutions
Securities:		
Y3	B1-02.000	Government securities
	B1-06.000	Fixed income securities
Y4	B1-07.000	Shares
	B1-08.000	Participations
	B1-09.000	other variable income securities
Directly charged services:		
Y5	P4-04.000	Commission income
	P4-01.600	Gains on foreign exchange trades
	P4-01.700	Gains from financial instruments
	P4-06.000	Gains from financial operations
	P4-07.000	Other non-interest income
Deposits & other liabilities:		
Y6	B2-01.000	Deposits by banks
	B2-03.000	Securities issued
	B2-07.000	Subordinated debt
Y7	B2-02.000	Deposits by customers

Source: BCL.

For asset classes Y1, Y2, Y3 and Y4, the holding revenue rate was constructed from respective interest or other income but was also adjusted for any write-downs in value and any transfers to/from provisions to reflect foreign exchange or credit risk. The holding revenue rate for each asset was constructed for each bank in each quarter.

Financial product Y5, directly charged services, was classified as an output on an a priori basis. In fact, Y5 represents the sum of several series in the profit-and-loss account that cannot be associated with any particular asset or liability class in the balance sheet. For liability classes Y6 and Y7, the holding cost rate was constructed from interest and other costs. Here also, the holding cost rate of each liability class was calculated for each bank in every quarter. In our data set, some implausible rates (in excess of 100%) were observed for the holding costs/revenue rates on some assets/liabilities. To avoid the influence of these outliers, we dropped the observations associated with the top 0.5% of the distribution (across all periods) of each holding cost/revenue rate for which implausible values appeared.

We follow Fixler and Zieschang (1992) in identifying three additional inputs on an a priori basis: labour (X1), capital (X2, including both tangible and intangible fixed assets) and purchased materials and services (X3, including non-wage administrative costs and commissions paid). Note that 'commissions paid' represents the counterpart of 'commissions received', which was integrated in financial product Y5, directly charged services. In our sample of Luxembourg banks, net commission income generated by these two flows is of the same order of magnitude as income from the interest rate margin. It is therefore crucial to integrate these commission flows correctly into the analysis to measure productivity in our sample.

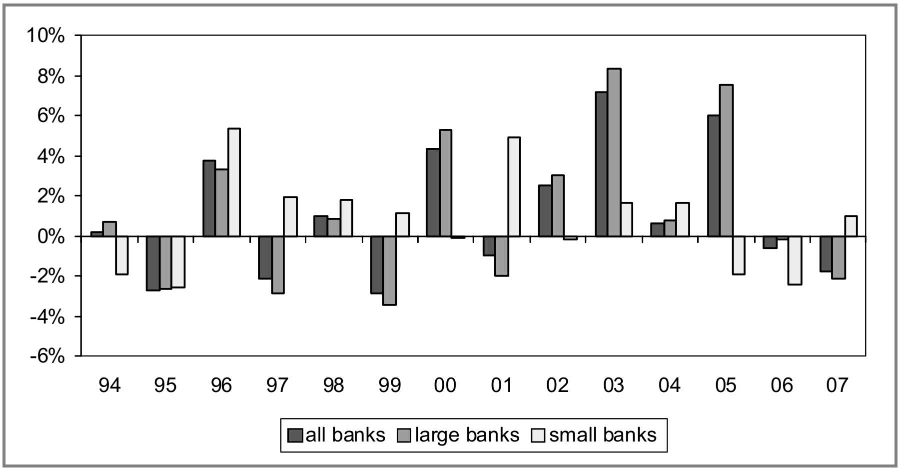
On the basis of bank-specific user costs, Guarda and Rouabah (2007) found that all asset classes Y1 to Y4 were outputs and that 'deposits by banks' Y6 was an input, consistent with the intermediation approach. However, 'deposits by customers' Y5 was an output, which is more consistent with the production view of the banking firm. We maintain this data-driven classification of inputs and outputs in the analysis below.

8.4. EMPIRICAL RESULTS

The simultaneous system of equations described in section 3 was estimated separately by SUR (Seemingly Unrelated Regression) for each of the quarters in the sample. Following Coelli (2000) and Coelli and Perelman (2000), the intercept of the output distance function was 'corrected' by adding the largest negative residual to impose the constraint that the most efficient firms lay directly on the frontier (the distance function is bounded by unity). Since the Malquist index decomposition requires evaluating the distance function representing the technology in period t at input and output vectors observed in period $t + 1$, this actually required estimating the system of equations twice for each period. Once it was estimated over the set of banks that were present both in period t and in the preceding period, and the other time it was estimated over the set of banks that were present both in period t and in the following period. This allowed a comparison of period t-1 with period t and a comparison of period t with period $t + 1$. Note that this comparison was possible for every individual firm present in two contiguous periods. Thus we constructed Malmquist indices (and their decomposition) for every individual bank and then aggregated them as described in the following paragraph to obtain an indication of productivity developments for the industry as a whole.

Figure 3 plots the Malmquist productivity index aggregated across banks and averaged across quarters for each year in the sample. Individual banks' Malmquist indices were aggregated using a weighted geometric mean with weights equal to each bank's share in total assets summed across all banks in that particular period. Separate Malmquist indices were also constructed for large and small banks, with these defined as those above and below the median value of total assets for each period. Note that large and small banks were assumed to share the same technology, as the distance function was estimated over all banks in the given period; however, since we calculated the Malmquist index for each individual bank, these sub-aggregates allow us to analyse productivity developments separately according to size classes.

Figure 3: Malmquist Productivity Growth in Luxembourg's Banks

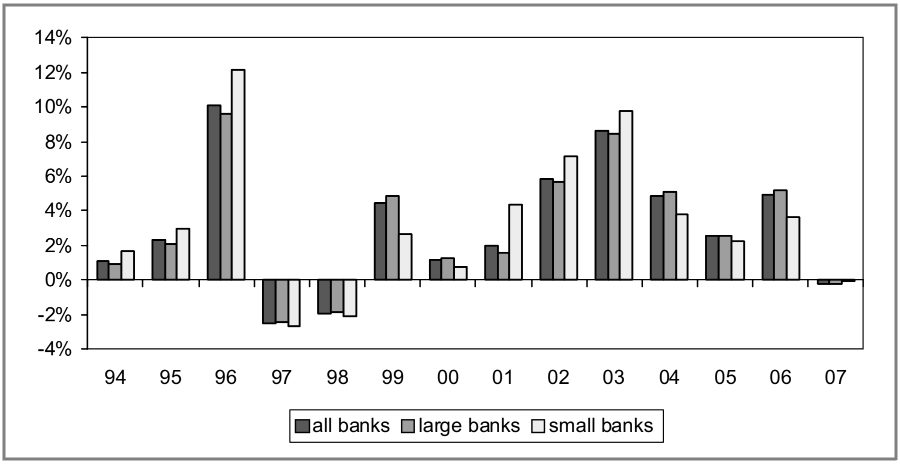


Source: BCL.

The first observation one can draw is that productivity developments in large banks dominate the 'all banks' index. For example, in 1994 and 1997 productivity developments in small and large banks had opposite signs but the index for all banks has the same sign as the index for large banks. This is a logical result given that the 'all banks' index is a weighted average with weights equal to individual banks' share in total assets of the industry as a whole.

A second observation one can draw from Figure 3 is that productivity developments were generally different for large and small banks. Only in 1995 were they similar. On average, productivity increased by 1% per quarter over all banks. Over large banks only, the average increase was nearly 1.2% per quarter and for small banks it was only 0.7% per quarter. Large banks saw especially strong productivity growth in 2000, 2003 and 2004. Small banks experienced strong productivity growth in 1996 and 2001 only.

Figure 4: Efficiency Change in Luxembourg's Banks

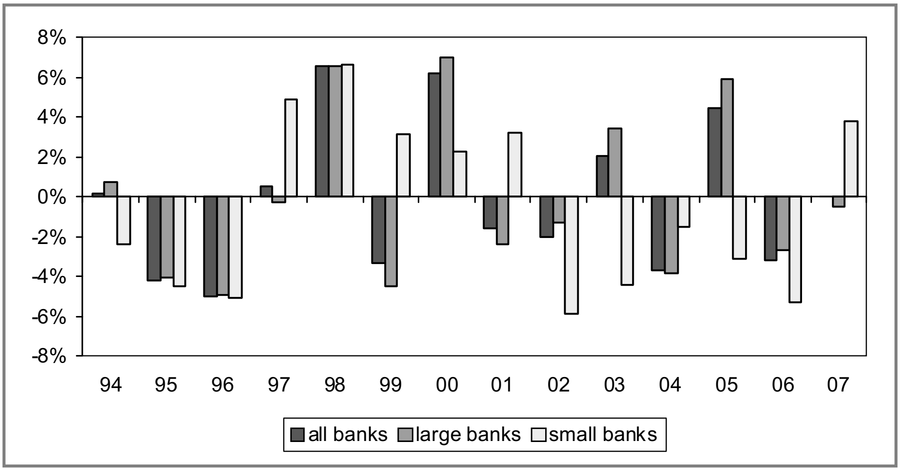


Source: BCL.

The discrepancies between productivity growth in large and small banks presumably reflect different developments in the underlying Malmquist index components (efficiency change and technical change). This conjecture is confirmed in the following two figures. Figure 4 plots efficiency change calculated from the estimated output distance functions. It is interesting to note that the relative performance of large and small banks is more similar at level of Efficiency Change component than at level of overall Malmquist productivity index. In contrast to the preceding figure, the average direction of efficiency change was the same for large and small banks in every year in our sample. This means that the overall index of efficiency change is not dominated by developments in large banks, which receive a greater weighting in the aggregation.

According to Figure 4, efficiency change had a substantial positive contribution in 1996. This could either be indicative of a general 'catching up' or of an inward shift in the efficient frontier, improving the relative position of poor performers. In fact, the following figure will show this was a year of technical regress so improved efficiency comes from the frontier moving closer to poor performers rather than individual banks moving closer to the efficient frontier. In 1997 and 1998 efficiency change was negative. This could be explained by evidence in the following figure that small banks made strong technical progress in 1997 and that both large and small banks made progress in 1998. Thus as some banks moved the efficient frontier outwards, the other banks' efficiency deteriorated and this shows up in the weighted average of efficiency change.

Figure 5: Technical Change in Luxembourg's Banks



Source: BCL.

Overall, one can observe a gradual increase in efficiency over 2001-2003 and a slower increase in 2004-2005. At the end of the sample, efficiency change is marginally negative in 2007. On average, efficiency change was 3.1% for all banks, 3.1% for large banks and 3.3% for small banks. This suggests rather rapid movement towards the frontier (which may itself be moving). The differences between the average for large and small banks may not be statistically significant, but it does suggest that small banks have been better at eliminating waste.

Figure 5 reports the technical change component of the Malmquist productivity index, measuring shifts in the (best-practice) efficient frontier. This reveals somewhat more disparity between large and small banks than there was in efficiency change. In particular, average technical change of large and small banks was in opposite directions in the years 1999, 2001, 2003 and 2005. However, there is more concordance than was observed in Figure 3 for the aggregate Malmquist productivity index. Technical regress is observed in 1995 and 1996 (for both large and small banks). After that, small banks saw technical progress in 1997 through 2001 and then regress until 2007. Instead, large banks saw more irregular development, with technical progress only in the years 2000, 2003 and 2005.

On average, technical change was marginally negative (-0.22% for all banks, -0.05% for large banks and -0.59% for small banks), however, this masks some significant positive developments in isolated periods. Apparently technical change is more often positive for small banks, suggesting they have a significant role in expanding the efficient frontier. In addition, technical change in large banks was also positive on average in several years. Overall, technical change seems to be less decisive than efficiency change in determining the evolution of the Malmquist productivity index.

8.5. CONCLUSIONS AND DIRECTIONS FOR FURTHER RESEARCH

This paper uses parametric estimates of an output distance function to calculate the Malmquist productivity index and its standard decomposition into efficiency change and technical change. Bank outputs and inputs are defined using the user cost approach and the technology is modelled using a translog specification for the output distance function. The distance function is estimated separately each quarter, avoiding the use of a deterministic time trend or period-specific dummies to capture technical change.

Results suggest that productivity in Luxembourg's bank grew by about 1% per quarter on average over the sample 1994Q1-2007Q4. Productivity growth was somewhat higher when averaged only over larger banks (in terms of total assets). The standard decomposition of the Malmquist productivity index suggests that most of the productivity growth came from efficiency change rather than technical change. This means that few individual banks occasionally shift the efficient frontier and that most of the other banks in the sample are catching up, improving their productivity by reducing their inefficiency.

A major issue that we have not addressed here is the nature of returns to scale. With estimated translog functions, it is common to check the plausibility of the constant returns to scale hypothesis by simply summing the first-order parameters on the outputs and comparing to unity. However, this is not an appropriate test as it only refers to the average observation. The translog function is non-homothetic so it actually displays variable returns to scale across the sample space. For a given set of parameter values, returns to scale may be increasing, constant or decreasing at different observations. Therefore the returns to scale should be calculated for each bank-period observation and then aggregated across the sample. The Malmquist index decomposition used here is only valid where the constant returns to scale hypothesis is approximately satisfied. In the presence of increasing or decreasing returns to scale the technical change component needs to be further decomposed to isolate the effect of changing scale. Färe, Grifell-Tatjé, Grosskopf and Lovell (1997) propose an alternative decomposition of the technical change component into the product of an output bias index and an input bias index. This alternative decomposition, which is implemented in Fuentes, Grifell-Tatjé and Perelman (2001), could help shed light on the volatility of the technical change component found in this paper.

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9. Internal Wage Structure and Bank Performance

Charles-Henri Di Maria[1] *and Sandy Metzler*[2]

Abstract

The aim of this document is to assess to what extent wage dispersion inside banks may affect their efficiency through a possible wage incentive scheme. Efficiency is measured by data envelopment analysis considering multiple inputs and outputs. At a second stage efficiency scores are regressed on various measures of wage dispersion and on a set of contextual variables. A Gini index will measure hierarchical differential and standard errors of wage equations will proxy wage compression. The main results indicate that some wage dispersion is needed to increase efficiency among workers who have similar characteristics and a strong unequal wage structure between workers having different job positions will adversely affect efficiency in the bank.

9.1. Introduction

What impact does intra-bank wage dispersion has on bank performance? The theoretical and empirical literature on this issue can be split into two contradictory answers to this question. According to Lazear and Rosen (1981) granting people with different level of wages provides an incentive to work harder and more efficiently. The worker will then see an opportunity to increase his wage whenever his effort will be noticed by the human resources. Moreover a relatively dispersed wage structure will attract more talented employees. This is the so called tournament model. Similarly for Jirjahn and Kraft (2007), wage dispersion can be seen as the reflection of an underlying firm policy to highly reward ability and effort. Therefore it is assumed that individual efforts will aggregate up to enhance organizational performance (Bloom (1999)). Since the seminal work of Lazear and Rosen (1981) several authors have found a positive link between firm performance (often measured as labor productivity) and wage dispersion. Among them: Finkelstein and Hambrick (1989), Fisher and Govindarajan (1992), Galbraith and Merrill (1991), Gomez-Mejia (1992) and Conyon, Peck, and Sadler (2001).

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However, some authors quote several adverse effects that lead to losses due to wage dispersion. Lazear (1989) explains that wage inequality provides an incentive for counterproductive sabotage activities. It will damage co-operation and any sense of common purpose across the work force as a whole (Beaumont and Harris (2003)). Hicks (1963) states that *"there should not be strong feelings of injustice about the relative treatment of different employees, since these would diminish the efficiency of the team"*. For Levine (1991) narrowing the wage dispersion can increase cohesiveness and increase productivity. This is also the case in Akerlof and Yallen (1990). For Beaumont and Harris (2003), the theoretical foundation for these perspectives lie in the role of relative deprivation theory, and to a lesser extent in equity theory, in shaping the notion of distributive justice as found in Cowherd and Levine (1999).

The aim of this document is to examine the link between wage dispersion and bank performance in Luxembourg. Departing from previous studies the performance of firms is not measured by labor productivity whose concept is hardly tractable in studies relating to banks but by efficiency. Basically efficiency can be thought as the ability to maximize production for a given bundle of inputs. In order to compute efficiency of banks, data envelopment analysis (DEA) will be used. DEA is now a popular framework to assess efficiency of banks. Among the many advantages of the DEA method is the possibility to deal with multiple inputs and outputs. Few studies have tried to define what the outputs and inputs for banks in Luxembourg are (DiMaria (2001) and Guarda and Rouabah (2007)). For the sake of simplicity the choice of outputs have been decided a priori given previous studies on the subject. Then inputs are mainly labor and borrowed funds. Outputs are customer loans and deposits. This choice gives a mixed approach combining the production and the intermediation approaches. To measure wage dispersion two proxies will be used. The Gini coefficient will proxy the hierarchical structure of wage considering the wage dispersion among employees regardless of their job duty and personal characteristics. And, following Lallemand *et al.* (2007), wages equations are estimated bank by bank, standard errors will proxy compression of wages. The first section presents the data, the second section introduces the framework and results while the last section concludes.

9.2. DATA SOURCES

The data are taken from two main sources. Inputs and outputs come from the financial statements of Luxemburgish banks for 2002, compiled by the Luxemburgish Financial Supervisory Service (Conseil de Surveillance du Secteur Financier) while data regarding wages are derived from the Structure of Earnings Survey (2002) conducted by the Luxemburgish National Statistical Institute

STATEC. See Frising and Haag (2004) for a presentation of the survey. The sample includes 69 banks and covers in 2002 about 77 percent of total assets of the banking sector.

9.2.1. Inputs and Outputs

Despite numerous studies in various countries there is no agreement on the definition of outputs and inputs in the banking sector. Basically for Berger and Humphrey (1992, 1997) most studies can be divided into two main approaches. The asset approach defines loans and other assets as outputs, while deposits, other liabilities, labor, and physical capital are treated as inputs. On the other hand, the value-added approach defines outputs as those assets and liabilities that add substantial value to the bank and includes labor, the value of premises and fixed assets (physical capital) as inputs. DiMaria (2001) and Guarda and Rouabah (2007), have tried to define outputs and inputs for banks in Luxembourg following the user cost approach defined by Fixler and Zieschang (1992). However given the lack of consensus concerning the appropriate production model to be employed for banks, this study proposes an agnostic – mixed approach.

Table 1: Outputs and Inputs

	Asset approach	Value added approach	This study
Outputs	Loans Other assets	Deposits Assets	Deposits Loans Shares and other assets
Inputs	Deposits Other liabilities Physical capital Labor	Labor Fixed assets	Labor Physical capital Borrowed funds

Table 2: Descriptive Statistics of Inputs and Outputs

	Deposits	Loans (assets)	Shares (assets)	Loans (liabilities)	Securities (liabilities)	Capital	Labor
Mean	1249.53	1775.31	186.40	4512.77	869.26	245.88	306.20
Maximum	13953.98	13518.72	2631.49	34274.69	12114.89	2904.94	2846.00
Minimum	0.89	0.00	0.00	3.28	0.00	1.82	12.00
Std. Dev.	2313.58	3172.17	453.65	6893.20	2098.01	441.50	529.48
Sum	86217.43	122496.50	12861.54	311380.90	59978.82	16965.39	21128
N. Obs.	69	69	69	69	69	69	69

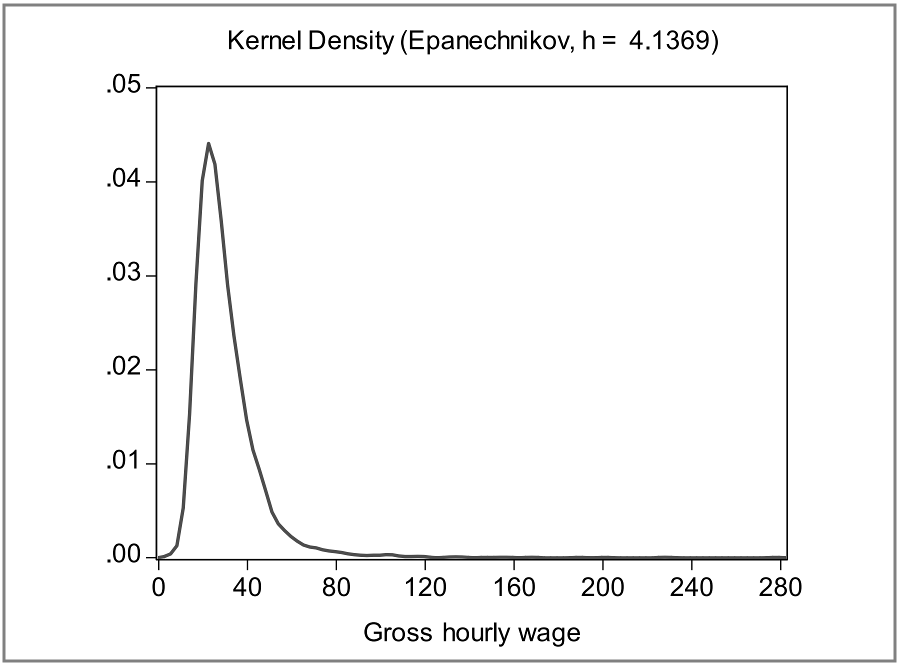
Units million of Euros.

One drawback in this study but shared by most studies is the difficulty to measure fixed/tangible capital. It is likely that capital is under estimated.

9.2.2. Wages and Wage Dispersion

Conducting surveys at establishment level is difficult regarding representativeness. Guidelines were given by STATEC and the sample of workers inside banks is supposed to be representative then no weights are used. In addition results concern the sample of banks and do not aim at representing the banking sector as a whole then again no weights are used. In this sample of banks the average gross hourly wage is of about 30 euros with a minimum value of 3.7 euros (note that the sample includes some trainees) and a maximum of 270 euros. In this study wage also includes yearly performance bonuses[3]. The distribution of wages is likely to be log-normal:

Graph 1: Kernel Density Estimates Gross Hourly Wage

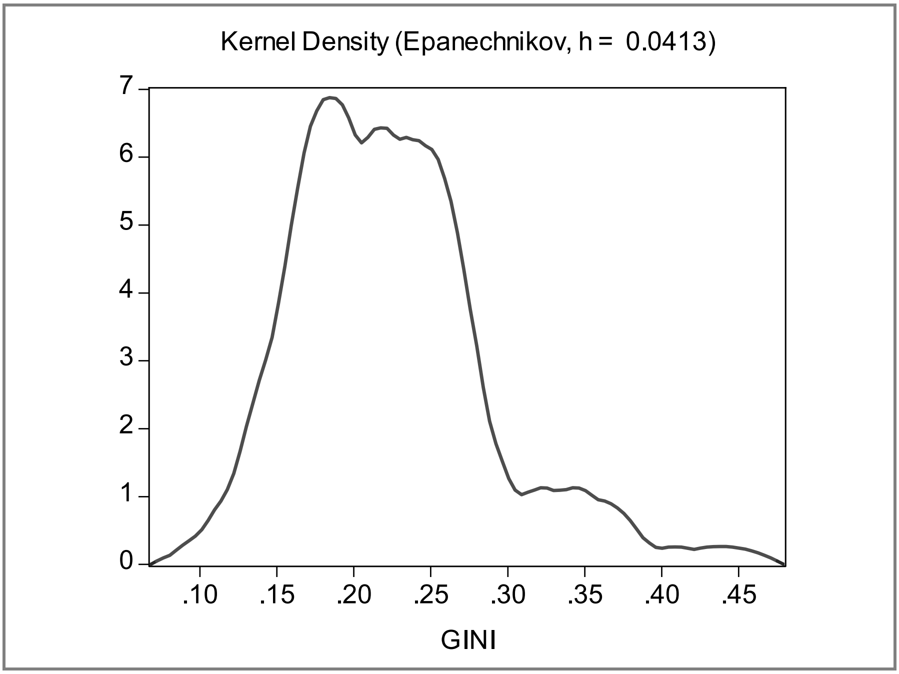


First of all wage dispersion has been measured by the Gini index. This index takes values in a unit interval. The closer the value is to one the higher inequality is. If

3 One may note that important indirect rewards are missing such as mortgages, insurances, pension funds, stock options, car, etc.

the Gini index is close to one then a great proportion of wages is concentrated into a relatively few individuals near to the top of the distribution of wages and the paid distribution is said to be hierarchical. In average banks show a relatively low wage dispersion with a mean value of the Gini index of 0.22, the maximum value being 0.44 and the minimum value being 0.11. Noting that a Gini coefficient of 0.26 in 2000 for the total Luxembourgish economy has been computed by EUSILC. Frising and Haag (2004) indicate that the Gini index computed for the economy from the Structure of Earning Survey is 0.29. The distribution of the Gini index exhibits some dissymmetry:

Graph 2: Kernel Density Estimates Gini Coefficient



The main a priori disadvantage by using the Gini index is that it is an unconditional measure of inequality. It does not take into account possible elements that may explain objective differences in wages such as the level of education, age, seniority, job position. Gender was also considered as a possible explanatory variable. Then as a second measure of wage dispersion the standard deviation of errors of a wage equation is used. Wage dispersion is measured by the residual inequality after controlling for human capital variables. The framework is close to Winter-Ebner and Zweimuller (1999) and Lallemand, Plasman and Rycx (2007). It requires the estimation of a wage equation on a set of variables including a constant, age and age squared, seniority, gender and education correcting for possible heteroskedasticity. Dummy variables have been added to take into account for the job position in the bank. Seven main categories were considered: Heads, researchers and analysts, technicians, clerks and sales persons (noting that the bank provided information following some guidelines defined by STATEC). It proxies the level of compression of wages. A compressed pay distribution is one that is spread more equally across individuals in jobs.

$$\log(\textit{gross hourly wage}) =$$
$$\alpha_0 + \alpha_1 age + \alpha_2 age^2 + \alpha_3 female + \alpha_4 seniority + \alpha_5 education$$
$$+ \sum_j \beta_j job\_positions_j$$

First the equation is estimated for the whole sample and results are:

Table 3: Wage Equation Whole Sample

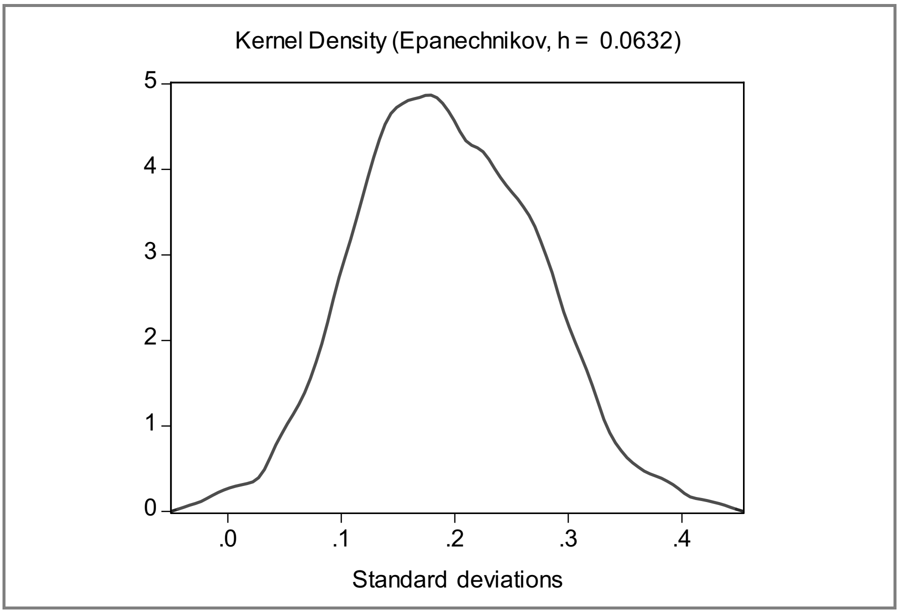
Variable	Coefficient	Std. Error	t-Statistic	Prob.
Constant	0.772104	0.134355	5.746738	0.0000
Age	0.085983	0.004360	19.72077	0.0000
Age squared	-0.000817	5.69E-05	-14.35887	0.0000
Women	-0.132094	0.009310	-14.18767	0.0000
Seniority	0.002305	0.000750	3.074417	0.0021
Education	0.036830	0.002511	14.66748	0.0000
Heads	0.886426	0.111601	7.942834	0.0000
Researchers – Analysts	0.458568	0.108568	4.223792	0.0000
Technicians	0.345235	0.108252	3.189187	0.0014
Clerks	0.249032	0.107935	2.307233	0.0211
Sales persons	0.234702	0.108203	2.169094	0.0301
Blue collars	0.263627	0.149435	1.764156	0.0778
Unqualified workers	(omitted)	(omitted)	(omitted)	(omitted)
R-squared	0.610121	Mean dependent var		3.314229
Adjusted R-squared	0.608872	S.D. dependent var		0.408623
S.E. of regression	0.255554	Akaike info criterion		0.112710
Sum squared resid	224.2016	Schwarz criterion		0.134114
Log likelihood	-182.1431	F-statistic		488.3915
N=3445		Prob(F-statistic)		0.000000

Note: White Heteroskedasticity-Consistent Standard Errors & Covariance.

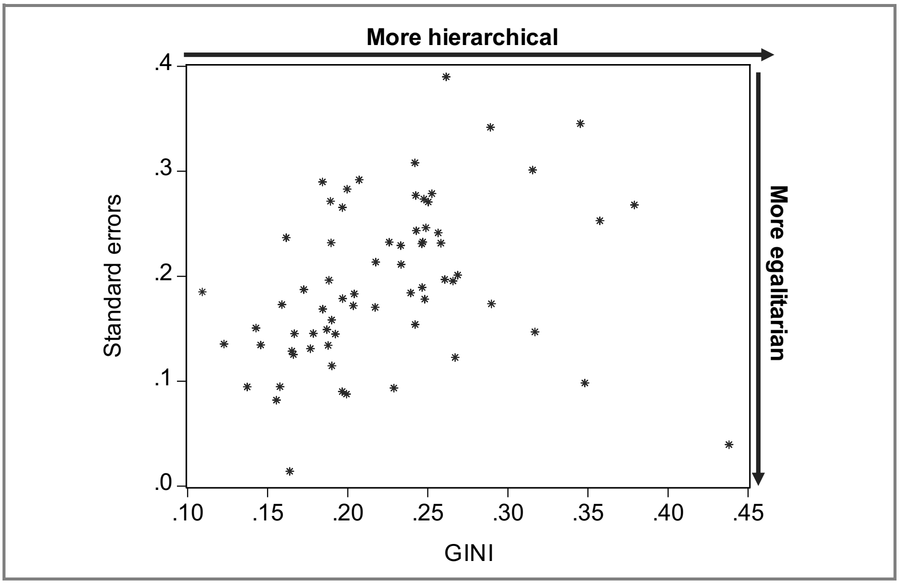
The higher the education level of the worker the higher his wage will be. There is also a positive relationship with age and seniority and as usual a lower wage is given to women. One should keep in mind that this coefficient is not always significant for all banks. In other words there is not a gender issue in some banks. However this coefficient is never positive! Then the same equation is estimated bank by bank and standard errors are collected. These standard errors measure to what extent 'similar' workers are given different wages, this is an intra-firm wage dispersion for similar workers. These standard errors may be thought as level paid differences due to individual performance given work responsibilities and human capital (Milkovich and Newman (1996)):

The mean value is 0.19 and standard errors range from 0.01 to 0.39. Furthermore the correlation with the Gini index is low (0.29). In other words, intra-firm wage dispersion and wage dispersion between similar workers move in the same direction but they are not closely tied. Interestingly it is often assumed that these two proxies are highly correlated (*e.g.* Beaumont and Harris (2003)). This issue should deserve more investigation and comparisons between different economic activities. One drawback in using standard errors compared to the Gini index is that it is impossible to state if inequality is significant as standard errors are only lower bounded by zero. The distribution of standard deviations is symmetric:

Graph 3: Kernel Density Estimates Standard Deviations



Graph 4:



9.2.3. Estimation of Bank Efficiency

The next step is the measurement of efficiency. Efficiency is measured in this study using Data Envelopment Analysis. Efficiency is the ability to maximize outputs for a given bundle of inputs compared to the best performers. The term Data Envelopment Analysis was first used by Charnes *et al.* (1978) who drew upon the efficiency concepts discussed in Farrell (1957). Thanassoulis (2001) provides a clear introduction to DEA models. Each bank (or decision making unit, DMU) produces a set of M outputs $y \in \Re_+^M$ using a set of N inputs $x \in \Re_+^N$. The technology is described by:

$$T = \{(x, y) : x \in \Re_+^N, y \in \Re_+^M, x \ can \ produce \ y\}.$$

For each input vector x there is a set $P(x)$ of possible outputs:

$$P(x) = \{y : (x, y) \in T\}.$$

The efficiency score of a DMU is then defined by an output distance function:

$$D(x, y) = \inf\left\{\theta : \left(\frac{y}{\theta}\right) \in P(x)\right\}.$$

Assume there is K DMU efficiency scores can be compute using the following linear program:

$$\max \lambda_k = \frac{1}{\theta_k}$$

$$\sum_{j=1}^{K} \mu_j x_{ij} \leq x_{ik},\ i = 1, \ldots, N$$

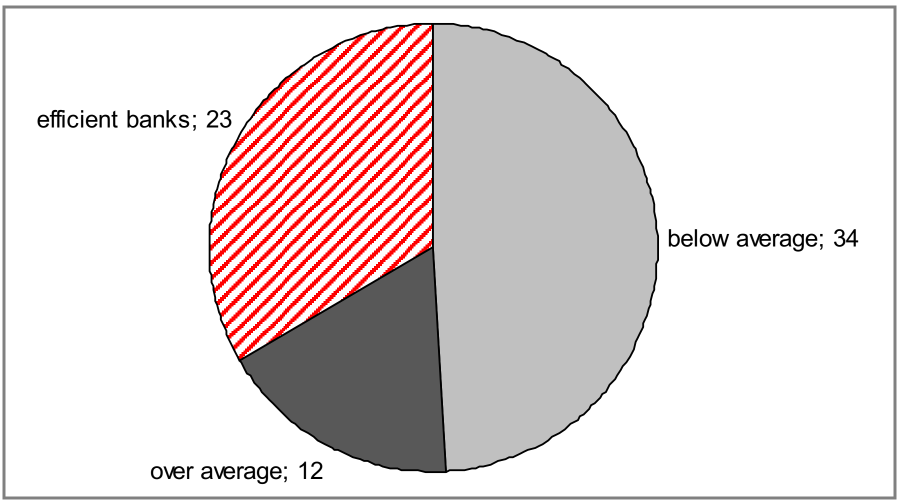
$$\sum_{j=1}^{K} \mu_j y_{rj} \geq \lambda_k\ y_{rk},\ r = 1, \ldots, M$$

$$\mu_j \geq 0, j = 1, \ldots, K$$

$$\lambda_k \geq 0$$

A bank is said to be efficient if the score takes value one and the closer to zero the score is the less efficient the bank is. One hypothesis that should be made is the nature of returns to scale defining the technology. Various returns to scale may be imposed and/or tested. It is assumed that constant returns to scale apply in this study. However, efficiency indexes were computed assuming: constant, non-increasing, non-decreasing and variable returns to scale and results are similar or close (correlation coefficients between indexes range from 0.88 to 0.99). The linear program is run for each bank and produces 69 efficiency scores. Results are the following: 23 out of the 69 banks are efficient, the average score is 0.62 and the minimum value is 0.06.

Graph 5: Repartition of Efficiency Indexes



9.2.4. Impact of Wage Dispersion

The next step is to investigate whether wage dispersion may explain efficiency of banks. A Tobit analysis is conducted. Simar and Wilson (2007) advocate for the use of a bootstrap procedure whereas a simple two-steps Tobit approach remains a popular method (*e.g.* Pasiouras (2008)). In this study a bootstrap approach has been used to compute the value of Tobit estimates only[4]. The aim is to assess to what extent wage policy – wage dispersion in banks affects their efficiency. According to the theoretical literature and applied works there is no clear answer.

By construction efficiency scores are bonded by zero and one. Efficient banks have a score of one while inefficient banks have a score close to zero but no bank can have a score of zero. In order to estimate a Tobit model, efficiency score are modified:

$$efficiency = \frac{1}{\theta_{CRS}}$$

Now efficient banks have a score of one and the scores may take any value between one and $+\infty$. To allow for some flexibility the wage dispersion is introduced in the equation in a non linear way. Other variables are added in order to take account for other phenomena that may explain efficiency of banks. Maddala (1983) presents the estimation procedure of Tobit models and results are:

[4] Simar and Wilson (2007) propose two algorithms, the first one only bootstrap Tobit estimates (this is the procedure followed in this study) the second algorithm bootstrap simultaneously Tobit estimates and efficiency estimates.

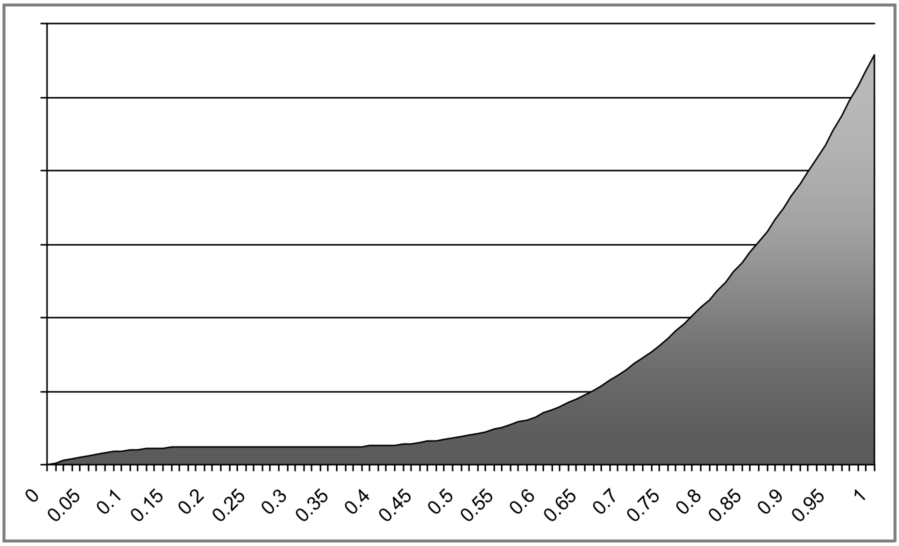
Table 4: Efficiency and Wage Dispersion

	Coefficient	Confidence Lower bound 5%	Interval Upper bound 5%
Wage dispersion			
Constant	-108.3816	-150.8946	-64.8577
Standard deviation	-121.5726	-192.3338	-55.2293
Standard deviation squared	278.0100	127.9352	443.1170
Gini	1495.6866	896.7642	2073.6697
Gini2	-5748.2496	-8081.1331	-3315.2434
Gini3	7042.4296	3884.1629	10069.4077
Other variables			
Seniority of the bank	-0.0234	-0.0356	-0.0122
Number of employees	0.0041	0.0016	0.0074
Share of employees having a wage convention	*0.0040*	*-0.0341*	*0.0400*
Share of employees having upper secondary education	-0.0421	-0.0749	-0.0104
Share of employees having Post-secondary non tertiary education	0.2384	0.1350	0.3575
Share of employees between 40 and 49 years	0.1873	0.1038	0.2749
20% banks having the lowest number of employees			
Constant	90.6478	41.6387	161.7310
Share of men	-1.1074	-2.1123	-0.4101
Share of employees between 40 and 49 years	-0.6376	-1.0093	-0.2914
Employees having lower than upper secondary education	*1.1750*	*-0.2143*	*2.4926*
25% oldest banks			
Constant	-8.0007	-10.4455	-5.8129
		Error Distribution	
SCALE	2.4498	2.0443	2.8669
R-squared	0.52		
Adjusted R-squared	0.35		
S.E. of regression	2.1234		
Left censored obs	23		
Uncensored obs	46	N=69	

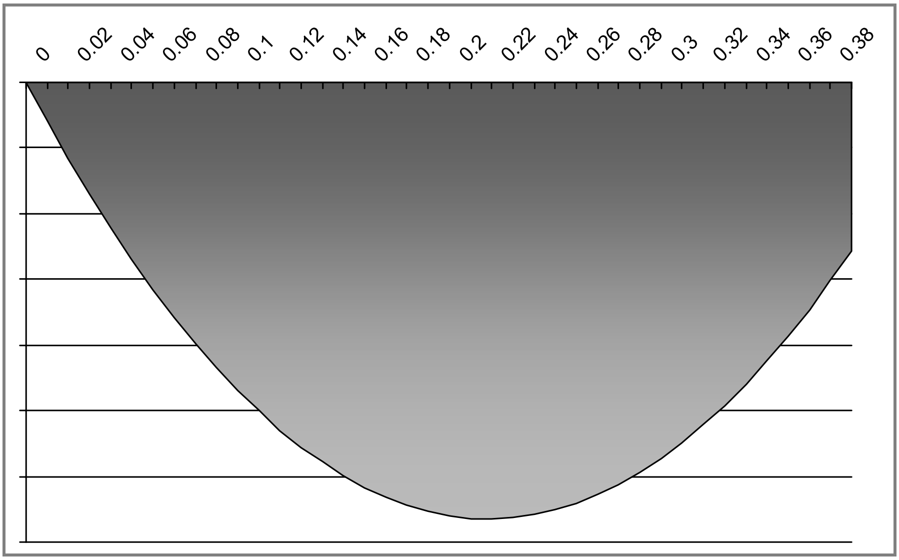
Note: based on 1994 replications. Intervals are based on percentiles and the R squared is computed based on the mean value of coefficients.

Results unearth two non linear relationships between efficiency and wage dispersion indicators. On the one hand the more inequality one has inside a bank regardless of worker characteristics the more inefficient the bank is (this is shown by the coefficients associated to Gini variables). On the other hand there is a non linear relationship with wage dispersion among workers and efficiency. Efficiency increases with some inequality and then decreases. Two graphs are provided. Regarding the Gini 'impact' everything being equal coefficients are applied for the range [0,1] but for standard deviations the graph is shown for values ranging from zero to the maximum value of observed standard deviations.

Graph 6: Effect of Wage Disparities Among Workers – Gini Index



Graph 7: Effect of Wage Dispersion Among Workers Sharing Similar Characteristics – Standard Deviations



9.3. CONCLUSION

Departing from previous studies this analysis considers simultaneously two different measures of wage dispersion. A 'pure' hierarchical wage dispersion regardless of employees characteristics and job occupation and another measure of wage compression taking account for the worker specificities. In addition, a non linear relationship is tested between wage dispersion indicators and efficiency. The main results show that a compressed wage structure is positively associated with bank performance. However, among workers sharing similar characteristics some wage disparity will also increase efficiency, but too much inequality will adversely affect efficiency and may even lower efficiency. It is important to note that the two indicators are not strongly correlated. Hence the human resources department may at the same time decrease wage differential between workers having different job positions while introducing another disparity scheme between workers having the same job positions. The wage structure should be in part hierarchical and not to compressed. The problem will lie in finding the optimal level of wage disparities for these workers to set-up an optimal 'coopetition' framework. Compensation pay should be a blend of incentive for coopetition inside teams and cooperation inside the bank between employees having different job duties.

However this work could be improved. First several alternatives for the definition of outputs and inputs could be used and the stability of results should be checked. Efficiency scores and the Tobit regression estimates could be improved using simultaneous bootstrap procedures as in Simar and Wilson (2007). Data for the year 2006 is now available and one may replicate the analysis on this new set of information and extend the analysis to the impact of wage dispersion on total factor productivity rather than on efficiency. Noting that, it leads to the definition of prices for inputs and outputs in order to have data at constant prices. In addition other motivating factors are not taken into accounts such as pension funds, stock options which might greatly affect efficiency. Another important point was left apart. It is likely that people do not only look at the wage scheme in their own bank but also in other banks. In that case another indicator should be introduced to assess the relative position of the bank compared to others.

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10. Impact of ICT and Human Skills on the European Financial Intermediation Sector

Georg Erber and Reinhard Madlener

Abstract

This paper investigates the impact of ICT- and non-ICT capital, and of labour at different skill levels, on productivity and employment in the financial intermediation sector of twelve EU member countries plus the US and Japan. A stochastic possibility frontier (SPF) approach is applied to assess the relation between the production inputs and to compute both time-varying and average inefficiencies. For the empirical analysis, annual data from 1995 to 2005 are employed that were obtained from recently released data contained in the EU-KLEMS database. The results obtained shed some light on the relative impact of ICT- and non-ICT capital and labour inputs, and provide new insights about the structural dynamics between these factor inputs. We find that the financial service sectors in the twelve EU member states studied are quite similar in terms of efficiency, and that efficiency and productivity depends much more on human capital than on physical capital. We conclude that learning-by-doing and learning-by-using are more decisive elements in shaping the productivity growth path than ICT investment alone, which can leave managers and employees overwhelmed by the complexity and needs of structural adjustments in the companies' organisation.

10.1. Introduction

In the financial services sector there is an ongoing convergence between banking and insurance industries. On the one hand, banks increasingly try to extend the range of financial services by offering insurance contracts as well. On the other hand, insurance companies have started to acquire banks, such as *e.g.* Allianz the Dresdner Bank in Germany, typically by merger and acquisition, enabling them to use banks as distribution platforms for their insurance service products. With the introduction of the Euro, and the integration of a subset of the EU-27 into a common currency area, the financial integration process across the national boundaries has made some further progress, enhancing competition between banks and insurance from different Eurozone countries in particular. A further deepening of the integration of the European financial markets is one important goal to enable Europe greater independence from external shocks, such as the one that triggered the subprime crisis in the US, which has diffused far beyond the US economy to Europe and other parts of the world.

With the increasing use of standardised products and services in the banking and insurance business that are based on electronic risk ratings of customers, the banking and insurance industry increasingly utilises computers and telecommunication equipment connected via the Internet as the ordinary distribution channel of their services. Ranging from Online brokerage and Home banking to Electronic insurance contracts by companies like CosmosDirect, information and communications technologies (ICTs) have changed the financial service industry significantly over the past decade.

The banking industry exhibits the highest proportion of IT investment compared to all other industries after 1995 (for the US see *e.g.* Council of Economic Advisors, 2001, for the EU see EITO, various yearbooks 1996 until 2001).

The financial service industry will only be able to grow steadily in the future by innovations in terms of new financial services. While automatic teller machines and credit cards were the early enablers to reduce the need for front-desk service workers, such as cashiers etc., the pervasiveness of the Internet provides the opportunity to offer and use ubiquitous financial services from virtually everywhere. A particularly attractive option is the conduct of financial transactions via mobile communications devices. This transformation process has not been completed yet, so that one might expect that there is a still ongoing labour-saving process that could last well into the near- and even mid-term future. This begs the question on whether there is a significant skill bias involved, *i.e.* whether the labour-saving process is unevenly spread across different skill levels.

In this paper we investigate the impact of ICT- and non-ICT capital, and labour input at different skill levels, on aggregate productivity and employment in the financial intermediation sector of twelve EU member countries, the US and Japan (the latter two as potential benchmarks). The EU countries covered are Austria, Czechia, Denmark, Finland, France, Germany, Hungary, Italy, the Netherlands, Spain, Sweden, and the UK. More specifically, we apply a stochastic possibility frontier (SPF) approach to assess the relation between different production inputs and to compute time-varying inefficiency trajectories and average technical inefficiencies. We employ annual data from 1995 to 2005, obtained from a recently released dataset (March 2008) contained in the EU-KLEMS database (www.euklems.net). The empirical results obtained shed new light on the relative impact of ICT- versus non-ICT capital versus labour inputs, and provide new insights about the structural dynamics between the different factor inputs considered.

The remainder of this paper is organised as follows. Section 10.2 introduces the theoretical framework and model specification used, section 10.3 contains a description of the data, sector 10.4 reports on the results gained, and section 10.5 concludes.

10.2. THE MODEL

Commonly used production functions or possibility frontiers restrict the number of input factors to a small set (*e.g.* two or three). The famous Solow model (1957), for instance, just distinguishes between the two primary input factors labour and capital, L and K, and additionally includes a time trend t representing autonomous (Harrod-neutral) technical change. If a Cobb-Douglas production function is used as a model specification, we can write

$$Y_t = f(L_t, K_t, t) = A \cdot e^{\gamma \cdot t} \cdot L_t^{\alpha} \cdot K_t^{1-\alpha}, \qquad (1)$$

where Y denotes output, A is a scaling parameter, γ the rate of technical progress, α the partial output to labour elasticity, and t a deterministic time trend (as a proxy for autonomous technical change). In macroeconomic production functions, typically constant returns to scale (CRS) are assumed, which implies that the partial output elasticity to capital is equal to $(1-\alpha)$. By following this tradition and taking logarithms, we obtain the following linear model in the transformed variables and parameters:

$$\ln Y_t = \ln A + \alpha \cdot \ln L_t + (1-\alpha) \cdot \ln K_t + \gamma \cdot t. \qquad (2)$$

We can now add the usual two random variables for a stochastic possibility frontier (Aigner *et al.* (1977); Kumbhakar and Lovell (2003)): an error term $v_t \sim iid\ N(0;\sigma_v^2)$ and a random variable for inefficiency $u_t \sim iid\ N^{+}(1/\theta_u, \sigma_u^2)$, the latter of which exhibits a left-truncated normal distribution. v_t and u_t are assumed to be independently distributed of each other and of the regressors (*e.g.* Kumbhakar and Lovell (2003), p. 74), which yields a stochastic Cobb-Douglas production frontier of the form

$$\ln Y_t = \ln A + \alpha \cdot \ln L_t + (1-\alpha) \cdot \ln K_t + \gamma \cdot t + v_t - u_t. \qquad (3)$$

Note that a shortcoming of the Cobb-Douglas function is that irrespective of the number of input factors considered the implicit substitution elasticity between all factors is always restricted to unity, which is admittedly a very restrictive assumption[1].

[1] The constant elasticity of substitution (CES) function, suggested as a useful alternative specification by Arrow *et al.* (1961), has an elasticity of substitution that is constant but not necessarily equal to one. This implies that the elasticity (or complementarity) between input factors becomes measurable.

For our empirical analysis we decided to use a stochastic possibility frontier (SPF) that is based on the secondary intermediate inputs, two primary input factors (capital broken down into two different types, ICT and non-ICT), and labour input, measured in working hours, broken down into three different skill levels (low, medium, high). In other words, we consider the following variables: (1) intermediate input per total hours worked (THW); (2) ICT capital stock per THW; (3) Non-ICT capital stock per THW; (4) High-skill working hours (WH) per THW; (5) Medium-skill WH per THW; (6) Low-skill WH per THW; and (7) a linear time trend.

We estimated this model using a panel data set for the twelve EU member countries mentioned above (see also section 10.3) plus two other major global financial markets, the US and Japan. As a particular specification we used the error component model of Battese and Coelli (1992), which not only allows to estimate average efficiency levels by country (*i.e.* 100 is equal to full-scale efficiency, values below measure the percentage points below the overall efficiency level of an industry production possibility frontier at a certain period of time). In order to guarantee CRS for the possibility frontier, the output and input variables were normalised by the total hours worked. This led to a restricted SPF model, where the real gross production value per working hour is explained by six factor intensities using total working hours as the denominator. In addition to the constant term, a time trend was included as well to measure autonomous technical change.

Additionally, an extension including fixed effects into the estimation of the SPF model was tested. This addresses some criticism raised by Greene (2002, 2005) that omitting fixed effects could lead to distortions and biases in the SPF parameters estimated. Caudill and Ford (1993) showed that omitting heteroscedasticity may lead to biased estimates of SPFs. In particular, an overestimation of the intercept and an underestimation of the slope coefficient might results from it.

While Kumbhakar and Wang (2005) and Kumar and Russel (2002) embodied such fixed effects in the estimation of a macroeconomic SPF, Lozano-Vivas *et al.* (2002) have applied a latent class stochastic frontier model (LCSFM) to account for heterogeneity in the individual banks at a country level. Specifically, they use environmental variables for different countries instead of simple fixed effects accounting for country differences. Numerous studies using a variety of different approaches including data envelopment analysis (DEA) have been undertaken for the banking industry. Accounting for heterogeneity by country fixed effects in the SPFs therefore offers the possibility to test the underlying assumption of a common frontier. In our analysis this would implicitly assume that by globalization, in particular in financial markets, a common global financial market frontier is a reasonable benchmark for the analysis. Due to flexible global capital markets and intensive competition across national boundaries, the separation between specific national regulatory environments and cultural traditions would become less important. However, this ideal state must not show up accordingly in the data available in the national statistics.

10.3. DATA

The financial intermediation sector, as defined by NACE 1.1 (classification code J) includes, apart from banking services, also insurance and pension funding as well as activities related to financial intermediation. The EU-KLEMS database published by the Groningen Growth and Development Centre (GGDC) in March 2008 has insufficient information on the banking sector alone. Hence, for our econometric analysis based on estimating a SPF, we decided to focus on the somewhat broader 'financial intermediation' sector.

From the currently 27 EU member states only less than half supply a complete dataset that is running at least over the time period from 1995 until 2005. EU-KLEMS is generally based on annual data only. The twelve countries included in EU-KLEMS that have a consistent dataset at least for this decade are: Austria, Czechia, Denmark, Finland, France, Germany, Hungary, Italy, Netherlands, Spain, Sweden, and the UK. They will be denoted as 'EU-12' in the following. Additionally, we have also included the US and Japan as non-EU member countries but important players in global financial markets in our sample.

Data are available for the gross production value, total intermediate inputs, total working hours, ICT capital stock and non-ICT capital stock input plus total working hours. The latter are broken down into working hours for three separate skill categories (high, medium, low skills).

10.4. RESULTS

For the econometric estimation we used the Frontiers 4.1 software program (Coelli (1996)). The estimation results were obtained for a Cobb-Douglas production function specification. We studied three different model specifications, in order to find out how much the inclusion of fixed effects in an SPF estimation influences the outcome. The first model included fixed effects for the US and Japan but omitted the dynamic adjustment term (model 1), the second included the fixed effects and the dynamic adjustment term (model 2), and the last excluded the fixed effects but included the dynamic adjustment term (model 3). The results are summarised in table 1, while the specific t-values etc. for each single model specification have been relegated to the appendix. We also tested a model variant with fixed effects for all twelve EU-member countries, but it turned out that eliminating the inefficiency term as a significant variable of the model leads to a collapse of the SPF model. This might be due to the still fairly short time frame of eleven years. One might test the consequences of a more unbalanced panel on the parameter estimation by using in the estimation all data back until 1970 for those countries for which these data are available. However, this exercise is beyond the current state of our analysis reported in this paper.

Table 1: Parameter Estimates of a Stochastic Possibility Frontier (SPF) for Financial Intermediation, Models 1, 2 and 3

Gross Production Value per Total Working Hours, based on EU-12[1] plus US and Japan Multi-Country-Panel, 1995-2005

	Model 1	Model 2	Model 3
Explanatory variables	**coeff.**	**coeff.**	**coeff.**
Constant	0.447***	0.362***	0.441***
Intermediate Input per TWH[2]	0.291***	0.394***	0.366***
ICT Capital Stock per TWH[2]	0.057	0.059	0.056
Non-ICT Capital Stock per TWH[2]	0.153***	0.193***	0.204***
High-Skilled WH per TWH[2]	0.162***	0.113***	0.120***
Medium-Skilled WH per TWH[2]	0.335***	0.243***	0.252***
Low-Skilled WH per TWH[2]	0.024***	0.020***	0.022***
Time	0.014***	0.017***	0.017***
Fixed effect USA	0.143***	0.053	–
Fixed effect Japan	0.169***	0.077	–
Sigma square	0.012***	0.026***	0.029***
Gamma	0.787***	0.909***	0.921***
Eta	–	-0.096***	-0.083***

1 EU-12 – Austria, Czechia, Denmark, Finland, France, Germany, Hungary, Italy, Netherlands, Spain, Sweden, UK
2 TWH – total working hours

*Note: *** denotes significance at the 5% level.*

Source: EU-KLEMS database provided by GGDC, own calculations.

The parameter estimates obtained are measures for the respective output elasticity of the respective input factor, *i.e.* an increase of one unit in the respective input factor increases the output variable by the respective output units. Looking at the six plus one parameter values we notice that, except for the ICT capital intensity, all parameters are statistically significant at the 5% level of significance[2]. It can also be observed that for all three model specifications tested the parameter estimates are fairly stable. However, when embodying fixed effects for the US and Japan, two financial markets quite different from the EU with regard to their regional and economic environment, we find that the significant fixed effects found in model 1 are not sustained if we allow for time-varying inefficiency terms. This is due to the fact that the possibility of each country to follow a specific

2 As a rule of thumb *t*-values above 2 (in absolute values) assure this 5%-signficance threshold of the test.

inefficiency trajectory is causing a trade-off with the fixed effects which can adjust for these differences in a more simple way. Keeping both effects statistically significant is impossible with the current data set and time frame.

So model 1 and model 3 show two alternative ways to explain most of the variance of the multi-country panel dataset. Only if there were additional variation in the data there is some hope that both dimensions of fixed effects for some or even all countries and a dynamic trajectory of inefficiency become statistically significant. Based on our analysis model 3 without fixed effects seems to be the superior specification because of the higher value obtained from the maximum likelihood estimation. The common frontier hypothesis for the EU-12 countries, the US and Japan finds support against the one where additional heterogeneity measured by country fixed effects matter.

Statistically, the single parameters in the three models, if tested for equality by using 95%confidence intervals calculated from the estimates of the three different models, confirm that they are equal at the chosen significance level (*cf.* table 2). Only if the respective intervals defined by lower and upper bounds would not overlap, the respective parameters would be statistically significantly different from each other. Therefore, the results show a robust performance of the SPF estimates even if different specifications are applied.

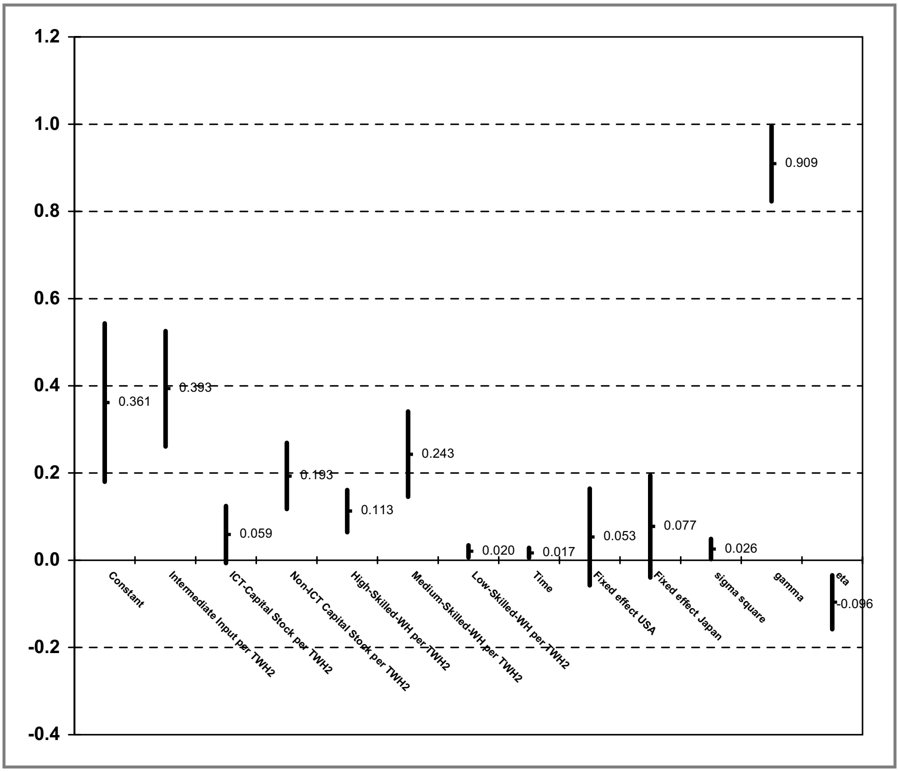
Table 2: Single Parameter 95%-Confidence Intervals

Explanatory variables	Model 1		Model 2		Model 3		Equality test
	lower bound	upper bound	lower bound	upper bound	lower bound	upper bound	
Constant	0.180	0.543	0.309	0.585	0.280	0.602	identical
Intermediate Input per TWH²	0.261	0.526	0.191	0.392	0.238	0.493	identical
ICT Capital Stock per TWH²	-0.006	0.124	-0.004	0.117	-0.007	0.119	identical
Non-ICT Capital Stock per TWH²	0.117	0.269	0.088	0.218	0.133	0.274	identical
High-Skilled WH per TWH²	0.064	0.161	0.124	0.200	0.069	0.171	identical
Medium-Skilled WH per TWH²	0.145	0.341	0.254	0.415	0.154	0.350	identical
Low-Skilled WH per TWH²	0.006	0.034	0.009	0.039	0.008	0.036	identical
Time	0.006	0.028	0.006	0.023	0.008	0.029	identical
Fixed effect USA	-0.058	0.164	0.024	0.262			identical
Fixed effect Japan	-0.040	0.194	0.066	0.272			identical
Sigma square	0.002	0.049	0.003	0.020	0.004	0.054	identical
Gamma	0.823	0.996	0.623	0.951	0.849	0.993	identical
Eta	-0.158	-0.035			-0.137	-0.028	identical

Source: EU-KLEMS database provided by GGDC, own calculations.

Figure 2 illustrates this outcome for model 2. Note that the different variability of the single parameter estimates is visualised nicely by this graph.

Figure 1: Confidence Intervals for Parameter Estimates of Model 2



Source: EU-KLEMS database provided by GGDC, own calculations.

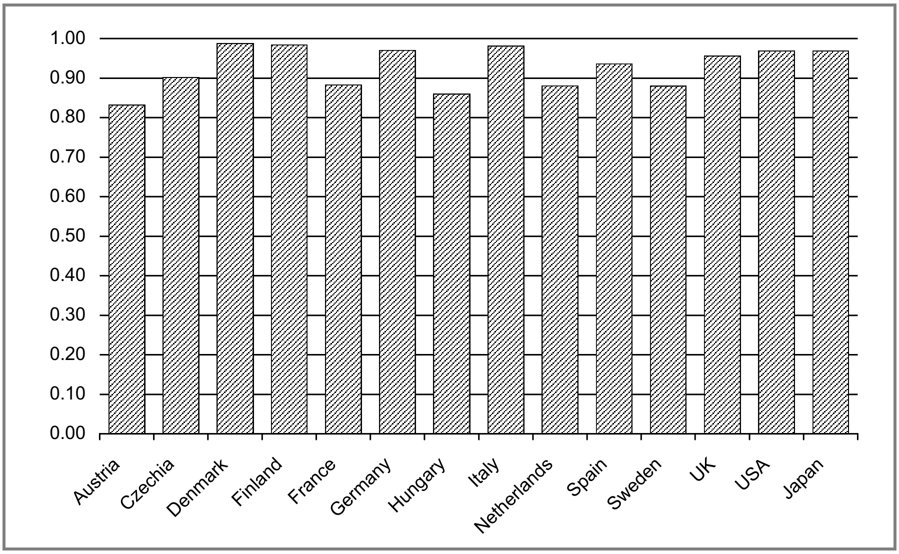
Looking at the individual values we can observe that the least significant output elasticity has to be attributed to the ICT capital stock intensity. This is somewhat surprising and in sharp contrast to previous empirical findings published, *e.g.*, by Jorgenson, Stiroh and others (see *e.g.* Jorgenson *et al.* (2000, 2005); Stiroh (2002)). Jorgenson and associates usually found a high impact in their growth accounting studies with US data on labour productivity growth. Similar finding are obtained by O'Mahony, Timmer and van Ark (2003, 2007, 2008) for Europe. However, they calculate their growth accounts using gross value added (*i.e.* excluding intermediate inputs) for their calculations and accounting for heterogeneity in the labour input by using a quality change indicator instead of the three more specific human capital variables differentiated by skill classes. Therefore, there seem to be two potential trade-offs to be considered between the gross production value approach versus the gross value added approach. In general, it can be shown that total factor productivity measured by using gross value added diminishes if the intermediate factor intensity varies with regard to the gross production value. A significant amount of outsourcing of financial intermediation services thus leads to a diminished total factor productivity growth based on gross production values. Furthermore, in the above-mentioned growth accounting studies, insufficient accounting for the impacts of compositional changes in the labour force according to their skills apparently tends to shift the balance from human capital as a dominant factor towards a more prominent role of physical capital, and in particular of ICT capital. By more explicitly taking into account these other dimensions in our econometric analysis the results are, however, still consistent with the common EU-KLEMS database. The more detailed data structure used in this analysis shifts the emphasis from physical capital towards the important role of human capital. This view is more in line with endogenous growth theory (see *e.g.* Barro and Sala-i-Martin (1995); Aghion and Howitt (1998)). It also emphasises the importance of outsourcing as a key driver of labour productivity growth in the financial intermediation industry.

In growth accounting analysis the labour inputs have been included in a very different approach, where total working hours where not broken down into different skill classes as it is done here. Therefore, a specific skill-bias of technological progress could not explicitly be analysed. Instead, only a compositional change indicator for the compositional changes was used as a proxy variable. This might have led to an important specification bias, where too much emphasis was put on physical capital inputs and much less so on human capital inputs. Our results, however, point into a different direction compared to those attributing a high impact on physical ICT capital investment. In contrast, we find a high significance in the increasing high- and medium-skill using bias while low-skilled labour inputs have little to contribute to enhancing output productivity. We find the strongest impact on output productivity per working hour for medium-skilled labour intensity with 0.335, followed by intermediate input intensity with 0.291, in model 1. This ranking is changed, when the time-varying efficiency term η is included in models 2 and 3. Now the intermediate inputs-output elasticity for models 2 and 3 is even larger, with 0.394 or 0.366 respectively, than the one for the medium-skilled labour intensity. The high value for the output elasticity of intermediate input intensity may be attributable to the productivity-enhancing effect of outsourcing of activities in the financial service industry. By focussing on the core competencies and outsourcing, those activities where financial intermediators in a particular country lack comparative advantages, the optimal make-or-buy decision-making according to Coase's theory of transaction costs (Coase (1937)) can contribute significantly to the productivity growth of the industry. This aspect has been neglected in studies which exclude intermediate inputs from their analysis. Non-ICT capital intensity and high-skilled labour intensity rank third and fourth, with output elasticities of 0.204 and 0.120, respectively, for model 3. Finally, we find an average annual rate of technical progress of about

1.7% for the labour productivity growth in the financial service industry in models 2 and 3.

Concerning the parameters σ, γ and η related to the efficiency estimates of the SPF we obtained the following findings: The first two estimates are statistically significant at the 5% level of significance, while the latter is not. η is a parameter determining the autoregressive trajectory of the inefficiency random variable. If it is statistically insignificant this shows that there is no statistically significant autocorrelation observable in the inefficiency random variable. The actual parameter value would show a mild negative autocorrelation. For this reason we omitted this parameter when estimating the average technical efficiencies by country, the results of which are summarised in figure 2.

Figure 2: Average Technical Efficiency Estimates in Financial Intermediation Based on Fixed Effects Estimates
EU-12 Member States plus US and Japan, 1995-2005 (average values)



[1] EU-12 – Austria, Czechia, Denmark, Finland, France, Germany, Hungary, Italy, Netherlands, Spain, Sweden, UK
Source: EU-KLEMS data provided by GGDC, own calculations.

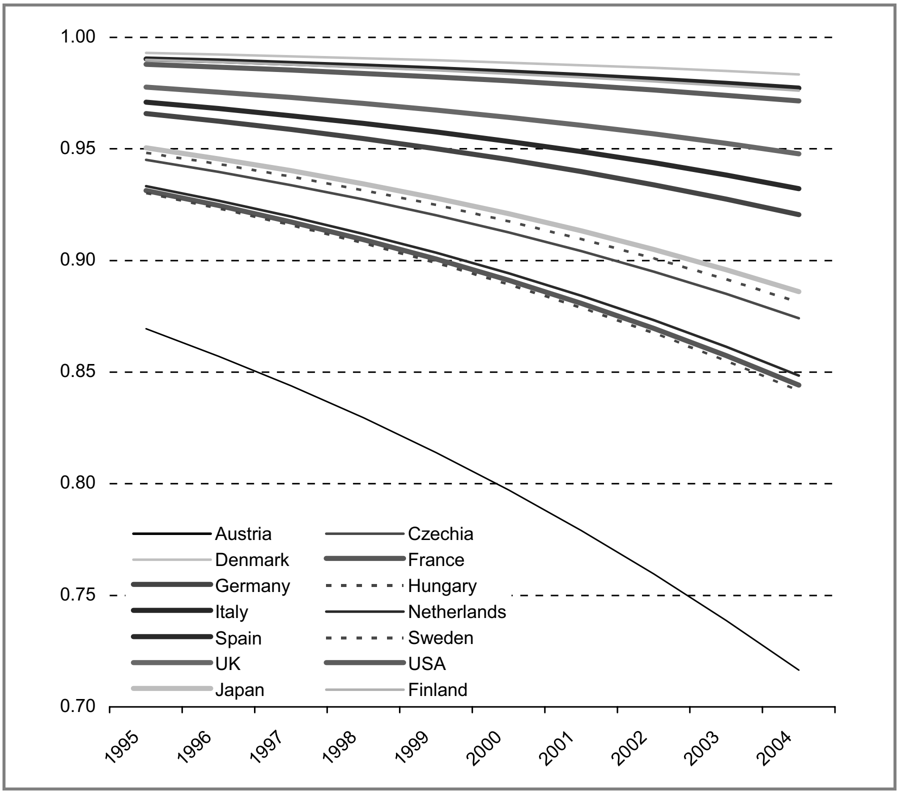
The range of average efficiency estimates by country varies between 0.98 for Denmark and Austria with 0.82. It is noteworthy that with the revised EU-KLEMS data the efficiency estimates for the UK improved considerably to 0.96, from 0.77 when using the old database[3], which embodied a significant underestimation of the gross production values for the UK. All other countries exhibit average efficiency levels in between. Apart from Denmark, Finland, Germany, Italy and the

[3] EU KLEMS (2007), Growth and Productivity Accounts Intermediate Release, November 2007, Groningen.

UK are very close to each other, with values ranging from 0.98 to 0.96, *i.e.* differing only by two percentage points. Similar average efficiency levels are found for the financial intermediation industries in the US and Japan, with 0.97 each. Spain (0.94), the Netherlands (0.88), Sweden (0.88), Czechia (0.90), Hungary (0.86), and France (0.88) are lagging by 5 to 10 percentage points behind those five, with values between 0.94 and 0.86. According to these results, the least efficient country in the financial service industry is Austria with 0.83.

These estimates are based on SPF including fixed effects for the US and Japan (*i.e.* model 1). By including a time-varying model specification we obtain the dynamic inefficiency trajectories depicted in figure 3.

Figure 3: Technical Efficiency Estimates in Financial Intermediation Based on Fixed Effects Estimates and Time-Varying Efficiencies
EU-12 Member States plus US and Japan, 1995-2004 (annual values)



1 EU-12 – Austria, Czechia, Denmark, Finland, France, Germany, Hungary, Italy, Netherlands, Spain, Sweden, UK

Source: EU-KLEMS data provided by GGDC, own calculations.

From the graph we can see that the efficiencies tend to decline for all countries. This might be attributable to the fact that technological progress makes it more and more difficult for all banking and insurance companies in the different countries to stay abreast, or to catch up, with the new technologies available. Structural, regulatory and cultural impediments lead to different paths of divergence from the overall efficiency frontier. However, this outcome would need further investigation, in order to find out whether it is robust against different alternative model specifications and interpretations.

10.5. CONCLUSIONS

The fairly invariant efficiency ranking for the twelve EU member countries obtained in our analysis might be attributable to the fact that we could utilise data ranging only over an eleven-year time span. It is worth noting that new EU-member countries are doing quite well in comparison with some of the older ones. The shock of the transition period and the complete overhaul of the financial service industry in the former socialist countries have had a significant efficiency-enhancing impact, since they did not have to gradually dismiss a defunct legacy. Starting from scratch they could realise quite reasonable efficiency levels.

Another aspect which probably should be taken into account in this industry is that with financial market integration, in particular in the Eurozone, the country-by-country efficiency perspective might be getting less and less appropriate. Due to the concentration of financial services in a few locations – like London, Paris, Frankfurt, but also Luxembourg, Dublin etc. – the industry is developing a more locally concentrated structure, supplying financial services for the entire European Union and worldwide. Therefore, the scale and scope effects of such financial centres and the mass market for local branch offices for the ordinary customers would be a much better separation principle to study the changing efficiency and productivity development. Innovations in complex financial services on the one hand, and the efficient supply of highly standardised mass at local offices of banks and insurance companies on the other hand, give very heterogeneous trajectories for the diffusion of new ICTs.

Overall, the financial service sector in the EU-12 member countries considered lacks a strong heterogeneity or divergence in efficiency with the exception of Austria. Furthermore, we observe that efficiency and productivity development depend much more significantly on human capital than on pure physical capital investment. In particular, there must also have been a significant overinvestment in ICT capital in this industry in the years 1995-2000, *i.e.* during the new economy boom. Only by developing complementary organisational changes and employing higher-skilled human capital the promises of the ICT revolution showed up in a much more gradual fashion. This would explain as well why labour productivity growth is more steadily related to human skills than to the pure ICT capital investment boom. Learning-by-doing and learning-by-using are much more determining the productivity growth trend than a pure ICT investment boom, which left both employees and managers overwhelmed by the complexity and needs for structural adjustments in the (re-)organisation of their companies. Only by solving these problems and overcoming a number of obstacles the true long-term benefits of the ICT revolution can be harvested by increased labour productivity growth.

The policy implications from our analysis are quite clear-cut. In a knowledge-economy driven by rapid technical change the ability to empower the work force by appropriate investments in training and skill-formation is much more important than investment in information and communications technology per se. ICT is an enabler, but without sufficient capabilities of the human workforce to use it efficiently, the costly investments become ineffective. The focus of managers making investment decisions should therefore be much more on the implications of a new technology related to changing needs in skill formation and consequences in the organisation of business processes than on pure technical equipment: A computer or a broadband Internet terminal device is a general purpose instrument, but the intelligence of their users and organization of the company concerned determine the real benefits obtained in the end.

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10.7. APPENDIX

Table A.1: Parameter Estimates of a Stochastic Possibility Frontier (SPF) for Financial Intermediation, Model 1: Error Component Model Including Fixed Effects, 1995-2005
Gross Production Value per Total Working Hours based on EU-12[1] plus US and Japan Multi-Country-Panel

Explanatory variables	coeff.	standard error	t-value
Constant	0.447	0.069	6.468
Intermediate Input per TWH[2]	0.291	0.050	5.814
ICT Capital Stock per TWH[2]	0.057	0.030	1.880
Non-ICT Capital Stock per TWH[2]	0.153	0.032	4.727
High-Skilled WH per TWH[2]	0.162	0.019	8.476
Medium-Skilled WH per TWH[2]	0.335	0.040	8.329
Low-Skilled WH per TWH[2]	0.024	0.007	3.258
Time	0.014	0.004	3.284
Fixed effect USA	0.143	0.060	2.400
Fixed effect Japan	0.169	0.051	3.281
Sigma square	0.012	0.004	2.798
Gamma	0.787	0.082	9.574

1 EU-12 – Austria, Czechia, Denmark, Finland, France, Germany, Hungary, Italy, Netherlands, Spain, Sweden, UK
2 TWH – total working hours

Source: EU KLEMS database provided by GGDC, own calculations.

Table A.2: Parameter Estimates of a Stochastic Possibility Frontier (SPF) for Financial Intermediation, Model 2: Error Component Model Including Fixing Effects and Time Varying Adjustment Term
Gross Production Value per Total Working Hours based on EU-12[1] plus US and Japan Multi-Country-Panel, 1995-2005

Explanatory variables	coeff.	standard error	t-value
Constant	0.361	0.091	3.987
Intermediate Input per TWH[2]	0.393	0.066	5.942
ICT Capital Stock per TWH[2]	0.059	0.033	1.805
Non-ICT Capital Stock per TWH[2]	0.193	0.038	5.079
High-Skilled WH per TWH[2]	0.113	0.024	4.652
Medium-Skilled WH per TWH[2]	0.243	0.049	4.975
Low-Skilled WH per TWH[2]	0.020	0.007	2.932
Time	0.017	0.006	3.050
Fixed effect USA	0.053	0.055	0.958
Fixed effect Japan	0.077	0.058	1.322
Sigma square	0.026	0.012	2.216
Gamma	0.909	0.043	21.061
Eta	-0.096	0.031	-3.128

1 EU-12 – Austria, Czechia, Denmark, Finland, France, Germany, Hungary, Italy, Netherlands, Spain, Sweden, UK
2 TWH – total working hours

Source: EU KLEMS database provided by GGDC, own calculations

Table A.3: Parameter Estimates of a Stochastic Possibility Frontier (SPF) for Financial Intermediation, Model 3: Error Component Model Including Time Varying Adjustment Term
Gross Production Value per Total Working Hours based on EU-12[1] plus US and Japan Multi-Country-Panel, 1995-2005

Explanatory variables	coeff.	standard-error	t-value
Constant	0.441	0.081	5.463
Intermediate Input per TWH[2]	0.366	0.064	5.744
ICT Capital Stock per TWH[2]	0.056	0.031	1.787
Non-ICT Capital Stock per TWH[2]	0.204	0.035	5.796
High-Skilled WH per TWH[2]	0.120	0.025	4.720
Medium-Skilled WH per TWH[2]	0.252	0.049	5.140
Low-Skilled-WH per TWH[2]	0.022	0.007	3.142
Time	0.019	0.005	3.616
Sigma square	0.029	0.013	2.306
Gamma	0.921	0.036	25.699
Eta	-0.083	0.027	-3.054

1 EU-12 – Austria, Czechia, Denmark, Finland, France, Germany, Hungary, Italy, Netherlands, Spain, Sweden, UK
2 TWH – total working hours

Source: EU-KLEMS database provided by GGDC, own calculations.

11. Are There Any EU Membership-Related Efficiency Enhancements in Banking Sectors of the New EU Member States Detectable?

Marko Košak and Jelena Zorić

Abstract

The aim of this paper is to evaluate the potential effects of the EU membership for the banking sectors' efficiency in the new EU member states. Following a general belief and relatively limited research on the positive effects of the EU integration processes for the improvements in competitiveness of banking markets and consequent enhancements in banking efficiency, we decide to test the evidence on banking efficiency prior to and after the entry to the EU for the set of eight acceded Central and Eastern European (CEE) countries that became EU members in 2004. Cost frontier function in the 1996-2007 period is estimated by employing different panel data stochastic frontier methods. Average cost efficiency is found to be around 80%, indicating a potential for significant cost reductions in the CEE banks. Contrary to the prior expectations that the EU accession processes and associated regulatory reforms and institutional changes, which intensify competition, should facilitate substantial bank efficiency enhancements, we find rather weak evidence in support of this hypothesis. It is very likely that some barriers to the full scale integration and efficiency improvements still remain in place.

11.1. Introduction

Prior to transition, banking sectors in most of the Central and Eastern European countries were virtually non-existent in terms of performing standard banking functions. Nevertheless, banking sectors in the new EU member countries in Central and Eastern Europe (CEE) have undergone a remarkable transformation, particularly in the process of the EU accession. They adopted the common EU legislation and regulation, undertook extensive structural and institutional reforms, and integrated their banking systems, at least to some extent, into the EU banking sector.

Several authors studied efficiency in banking sectors of the CEE countries (*e.g.* Weill (2003); Fries and Taci (2005); Rossi *et al.* (2005); Kasman and Yildirim

(2006); Holo and Nagy (2006)). These studies mostly focus on the impact of foreign and/or state ownership on bank efficiency and comparative analysis of banking sector efficiency across countries, while none of them has focused on the investigation of the impact of the EU membership on banking sector performance.

As pointed out by Altunbas *et al.* (2001) and Schure *et al.* (2004) the enforcement of the single market programme in the EU should increase competition in banking sectors of member states and therefore affect also the cost efficiency of the individual banking firms. Similarly Berger *et al.* (2000) elaborate extensively on the interrelationship between the efficiency and international consolidation within the financial services industry in the EU and confirm the existence of a substantial potential for efficiency gains from financial services industry consolidation in Europe. They postulate the actual efficiency gains to be relatively limited because of the different barriers preventing financial institutions from taking a full scale advantage of the EU integration. However, the empirical research on the efficiency gains in financial sector as a result of the EU integration is very limited and virtually not existent for the EU member states that joined the integration recently.

Therefore, the main challenge of this study is to evaluate cost efficiency improvements of banking firms in the CEE countries due to their entry in the EU. We hypothesize that vast institutional changes, regulatory and economic reforms, stimulated by the EU membership, should enable substantial enhancements in banking sector efficiency in the 'new' EU member countries. Several stochastic frontier panel data models are employed to estimate cost efficiency of the CEE banks, which also makes possible to examine the reliability of obtained efficiency scores. A translog cost frontier function is estimated based on an unbalanced panel data set of 221 banks over the 1996-2007 period. We are interested in detecting the effects of EU membership and related regulatory and institutional changes on the efficiency improvement of banking sectors in the 'new' EU member states. Due to the simultaneous entry in the EU on 1st May 2004 and very similar pre-accession development paths (*i.e.* similarities in the economic, political and social transition) we focus on a set of eight CEE countries (*i.e.* Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland, Slovakia, Slovenia) and their banking sectors.

The introductory section is followed by a brief literature review. In section three model specification and methodology are provided. Section four introduces data and provides description of the variables, while section five brings interpretation of the estimation results. Section six concludes the paper.

11.2. LITERATURE REVIEW

The research on banking efficiency in Central and Eastern European economies has intensified only recently and has been stimulated by the growing importance of these banking sectors, by improved data availability and the quality of the data. At first efficiency studies were focused strictly on studying efficiency in individual countries or smaller group of countries in the region, subsequently cross country studies have followed.

A study by Weill (2003) represents an attempt of a direct comparison of the banking efficiency in Western and Eastern European countries. Weill's research provides evidence on the existence of an efficiency gap between Western and Eastern banks, which is mainly caused by differences in managerial performance, while environmental and risk preference effects did not turn out to be important. As indicated by the author, further research in this area is needed, not only on the existence of the efficiency gap but also on the evolution of efficiency and its explanations.

In one of the first cross country studies in the region Yildirim and Philippatos (2002) examine cost and profit efficiency of banking sectors in twelve CEE economies over the 1993-2000 period. They show that higher efficiency levels are associated with larger size, higher profitability and equity. The level of competition and GDP growth are found to increase efficiency while market concentration is negatively linked to banking efficiency. With respect to the relationship between ownership and efficiency foreign banks are found to be more cost efficient but less profit efficient.

In the first one of the two papers Bonin, Hasan and Wachtel (2005a) analyse banking efficiency and related ownership effect for banks in eleven transition countries (five Central and Eastern European countries, three Baltic countries, and Bulgaria, Romania and Croatia) by using data for the 1996-2000 period. Their findings show that government-owned banks are not appreciably less efficient than domestic private banks but they proved that foreign-owned banks are more cost-efficient than other banks and that they also provide better service, in particular if a strategic foreign owner involved. In the second paper Bonin, Hasan and Wachtel (2005b) employ data for six transition countries, for the period 1994-2002 and show that both the method and the timing of privatization matter to the performance of banking firms.

The study by Fries and Taci (2005) was performed on a sample of 289 banks from 15 East European countries for the period 1994-2001. The authors focused on cost efficiency of banks and investigated an extensive set of correlating factors that could be associated with costs of banking operations. They confirmed that greater macroeconomic stability and competition resulting from foreign bank entry, as well as development of the supportive institutions, promoted cost efficiency. However, they emphasized that for most Eastern European countries the major challenge after their accession to the European Union and the common market for financial services would be the increased competitive pressure. As they used only data up to 2001, this effect could not have been examined empirically.

In the very recent paper Hollo and Nagy (2006) concentrate on studying bank efficiency in the enlarged EU. They confirm the existence of the X-efficiency gap between the banking sectors in the 'old' and 'new' EU member states, but the competitive edge of old EU members in relation to cost efficiency is decreasing over time. A comparative analysis of bank efficiency in eight CEE countries by Kasman and Yildirim (2006) reveals great variability in efficiency and superior efficiency of foreign owned banks.

Typically cross country studies on banking efficiency in Eastern European economies focus on comparing efficiency among transition economies (*e.g.* Kasman and Yildirim (2006)) or on detecting the existence of an efficiency gap between more developed banking sectors of Western Europe on the one side and still developing banking sectors in Easter European countries (*e.g.* Hollo and Nagy (2006); Košak and Zajc (2006)) on the other side. Studies, which would aim at capturing the effect of the EU membership on the efficiency in banking sectors of the new EU member states are rare. So Brissimis *et al.* (2008) for ten newly acceded countries show that banking sector reform has a positive effect on bank efficiency, which is partly channelled through the effects of competition and risk taking of banks. As opposed to the aforementioned studies Brissimis *et al.* (2008) in their model apply DEA method for measuring efficiency by using data for the 1994-2005 period.

In their attempt to analyse, at least indirectly, the effects of EU membership on banking sector efficiency most of the authors concentrate on the Western European countries. Schure *et al.* (2004) study cost efficiency of banks in 15 EU member countries in the 1993-1997 period and find out that the efficiency varies a great deal within Europe and there seems to be no tendency towards convergence. Altunbas *et al.* (2001) draw attention to the significance of the single market programme within the EU, which is supposed to strengthen competitive pressures and make firms to reduce costs either by enhanced productivity or by the improved exploitation of scale economies. In this paper the authors don't test directly the effects of the establishment of the single market but rather estimate scale economies, X-inefficiencies and technical change for a sample of European banks between 1989 and 1997.

Berger *et al.* (2000) are much more exhaustive in elaborating the efficiency gain potentials due to the European integration and related EU policies, such as the Single Market Programme and European Monetary Union. They hypothesize that international consolidation of financial institutions should be intensified across national boundaries in the EU and should be related to several efficiency effects (*i.e.* scale, scope and X-efficiency effects). However, they also point at several barriers to efficiency gains such as difficulty of managing and monitoring institutions from a distant headquarters, differences in language, culture, currency, differences in regulatory / supervisory structures, differences in explicit or implicit rules against foreign competitors etc. The findings provided by Berger *et al.* (2000) indicate that barriers to cross border operating efficiency offset most of potential efficiency gains from cross border consolidation. In their most recent paper Bos and Schmiedel (2007) address the issue of comparability of European major banking markets by employing the meta frontier approach and they find evidence in favour of the existence of a single European banking market, characterised by common cost and profit meta frontiers.

The integration and cross border consolidation opportunities seem to be critical to the achievement of significant efficiency gains. As stated by Goddard *et al.* (2007) the *"quantification of the extent to which European banking markets have achieved integration, in the sense of the complete elimination of barriers to cross border activity, remains an imprecise science"*, although some indicators are available. Dermine (2006) summarises evidence on the degree of banking integration in Europe based on three criteria: (i) the law of one price on the retail banking markets, (ii) cross border banking business and (iii) market share of foreign banks. Based on pricing of cross border transfers and interest margins on deposits the author claims that the law of one price (1st criterium) does not hold in the retail banking market. Similarly, the evidence on the cross border banking business and market share of banks in foreign ownership in the 'old' EU member countries is not very strong.

On the other side, we can find somewhat stronger evidence on the cross border banking business (2nd criterium) and market share of foreign banks (3rd criterium) for the banking sectors in the new EU member states. For example, the very recent report by UniCredit Group (UniCredit Group (2008)) designates the banking model commonly in place in Eastern European markets as a "banking model that implies need for external funding", which is predominantly provided to the local subsidiaries and branches by their parent banking companies. Similarly, the data on foreign ownership in banking sectors of Eastern European markets reveal heavy presence of foreign owned banks in most of the markets in Eastern Europe. Both, the presence of foreign owned banks and external funding dependence have intensified parallel to the progress of the EU accession processes in Eastern European economies, therefore we can assume that they reflect a relatively strong integration in the EU banking market, which was not the case before the accession processes started in these economies.

11.3. MODEL SPECIFICATION AND METHODOLOGY

The most commonly used approaches in empirical literature to model banks' costs are the *production approach* and the *intermediation approach*. The two approaches differ in the view on the role of deposits, which have both input and output characteristics. The first approach views banks as using labour and capital to produce deposits and loans and therefore considers deposits as an output, while the second approach considers financial institutions mainly as mediators of funds between savers and investors. Under the latter approach it is assumed that banks collect deposits to transform them using labour and capital in loans, meaning that deposits are considered as input. The production approach is usually viewed to be suitable when analysing the efficiency of bank branches. In contrast, the intermediation approach is adopted when analysing banks that operate as independent entities (Bos and Kool (2006)). Moreover, Berger and Humphrey (1991) and Bauer *et al.* (1993) proposed a *modified production approach*, which allows both the input and output characteristics of deposits to be considered in the cost function. According to this approach the volume of deposits should be viewed as an output while the interest rate paid on deposits should be considered as an input price (Rossi, Schwaiger and Winkler (2005)).

Following Sealey and Lindley (1977) the intermediation approach is employed in our study[1]. Additionally, by not considering deposits as outputs we avoid a potential multicollinearity problem as the estimated correlation between loans and deposits in our sample is very high[2]. For the specification of the cost model, we consider a bank which uses several inputs (borrowed funds, physical capital and labour) to produce multiple outputs (loans, securities and other earning assets). In addition, to control for heterogeneity between countries and banks several environmental and exogenous factors are introduced in the cost function.

Exogenous variables included in the model may belong in the cost frontier or they may belong in the inefficiency term. In the former case, the exogenous variables influence performance by influencing the production process and not by influencing efficiency, while an alternative approach tries to explain variation in efficiency with variation in exogenous variables. In the first formulation the frontier cost function is more accurately specified, but on the other hand, variation in inefficiency is left unexplained. On the contrary, in the second formulation environmental and non-discretionary variables influence costs indirectly through its effect on estimated efficiency. However, in most cases, it is not evident whether a certain exogenous variable is a characteristic of production technology or a determinant of inefficiency and a decision has to be made based on the researcher's

[1] The intermediation approach has been, for example, used by Berger and Mester (1997), Weill (2003), Bos and Kool (2006), and Hollo and Nagy (2006).

[2] The correlation coefficient between loans and deposits is estimated to be above 0.95.

judgment (Deprins and Simar (1989)). Both approaches will be considered in this work to establish to what extent are the efficiency estimates sensitive to the employed specification of the cost function.

Initially, a two-stage procedure was proposed for estimation of the frontier cost function when exogenous variables directly affect efficiency. The two-stage approach in which efficiency estimates from the first stage are regressed on a vector of potential correlates has been used in several bank efficiency studies, for example Allen and Rai (1996), Berger and Hannan (1998), Berger and Mester (1997), Chang, Hasan and Hunter (1998) and Mester (1993 and 1994). Hasan and Marton (2000a) performed a two-stage efficiency analysis for Hungary, and Nikiel and Opiela (2002) for Poland. Among the most recent studies a two stage approach was used in Bonin *et al.* (2005). However, the two-stage formulation has serious econometric flaws. Wang and Schmidt (2002) argue that if there are any interesting effects to be observed in the second step, then it follows from considerations of omitted variables that the first-step estimators are biased and inconsistent. To overcome this problem, Kumbhakar, Ghost and McGuckin (1991) proposed a single-stage stochastic production frontier model. Battese and Coelli (1995) extended this approach to accommodate panel data. Based on the above discussion, only the latter approach will be used in our study.

Estimation of cost function requires a specification of the functional form. The translog functional form is employed which is a locally flexible functional form widely used in the empirical literature[3]. The usual assumptions on linear homogeneity in input prices and symmetry conditions are imposed. Given the relative input prices, output levels and output mix, banks are assumed to choose inputs so as to minimise total cost. The translog form of the cost function to be estimated is specified in the following way:

$$\begin{aligned}\ln C_{it} = {} & \ln\alpha + \sum_j \beta_{y_j}\ln y_j + \sum_l \beta_{w_l}\ln w_l + \\ & + \frac{1}{2}\sum_j\sum_r \beta_{y_j y_r}\ln y_j \ln y_r + \frac{1}{2}\sum_l\sum_m \beta_{w_l w_m}\ln w_l \ln w_m \\ & + \sum_j\sum_l \beta_{y_j w_l}\ln y_j \ln w_l + \sum_k \beta_{z_k} z_k + \beta_t t + \varepsilon_{it}\end{aligned} \tag{1}$$

where $i = 1, \ldots, N$ and $t = 1, \ldots, T_i$, C represents total cost, y_j ($j = 1, 2, 3$) stands for j-th output, w_l ($l = 1, 2, 3$) stands for l-th input price, while z_k ($k = 1, \ldots, K$)

[3] An alternative would be to use a globally flexible Fourier functional form, which increases the number of parameters to be estimated and thus requires large samples. Given the relative small sample size of banks in our study, any gains from estimating more flexible and general functional form would be probably outweighed by the substantial loss of degrees of freedom. Moreover, Berger and Mester (1997) compared the translog to the alternative Fourier form and found out that the difference in results in terms of banks' inefficiency is almost negligible.

stands for k-th environmental variable. To allow for the impact of technological change on efficiency, a linear time trend term is included. Time variable t is considered to be a neutral technological change. Furthermore, normalization of cost and input prices by one of the input prices is used to impose linear homogeneity in input prices. Hence, the total cost, the price of borrowed funds and the price of physical capital are divided by the price of labour.

As the evidence from empirical studies shows that the various benchmarking methods often produce different results with respect to firms' efficiency scores and rankings[4], the stochastic frontier cost function in (1) is estimated using three different SFA methods. In this way we will be able to examine whether the obtained efficiency scores are sensitive to the method applied. The differences between the various specifications are related to the assumptions imposed on the error term (ε_{it}), cost inefficiency and firm-specific effects. **Model I** is a pooled frontier model estimated by Maximum Likelihood (ML) method as proposed by Aigner, Lovell and Schmidt (1977). Since the focus of the SFA is not on estimating the frontier cost function but rather on the error term, especially the inefficiency component, let us express the cost frontier function in (1) in the following way:

$$\ln C^{*}_{it} = c(\mathbf{y}_{it}, \mathbf{w}_{it}, \mathbf{z}_{it}; \alpha, \boldsymbol{\beta}) + v_{it} + u_{it}, \tag{2}$$

where C^{*} denotes the normalised costs, vectors of explanatory variables $\mathbf{y}$, $\mathbf{w}$ and $\mathbf{z}$ stand for outputs, input prices and environmental variables, respectively, $\boldsymbol{\beta}$ is the vector of coefficients and α is the regression constant. The error term (ε_{it}) in Model I is composed of two parts: a stochastic error (v_{it}), capturing the effect of noise, and a one-sided non-negative disturbance capturing the effect of inefficiency ($u_{it} \geq 0$). To estimate the stochastic cost frontier using the ML method, the following distributional assumptions have to be made: $v_{it} \sim \text{iid}N(0, \sigma_v^2)$, $u_{it} \sim \text{iid}N^{+}(0, \sigma_u^2)$, and v_{it} and u_{it} are distributed independently of each other and of the regressors. This model is referred to as a Normal-Half Normal Model. The cost efficiency is usually expressed in terms of cost efficiency score:

$$EF_{it} = \frac{C^{F}_{it}}{C_{it}} = \exp(-\hat{u}_{it}) \tag{3}$$

where C_{it} is the observed total cost and C^{F}_{it} is the stochastic frontier or minimum cost of the i-th firm in time t. Cost efficiency score of one indicates a firm on the frontier, while non-frontier firms receive scores between zero and one. Alternatively, the cost inefficiency score can be calculated as the reciprocal of the cost efficiency score defined in (3).

4 For example, see Bauer *et al.* (1998), Estache, Rossi and Ruzzier (2004), Farsi, Filippini and Greene (2005), Farsi, Filippini and Kuenzle (2005).

Since Model I does not assume any firm-specific effects, we furthermore turn to the panel data stochastic frontier models. The conventional panel data stochastic frontier methods proposed by Pitt and Lee (1981) and Schmidt and Sickles (1984) assume that inefficiency is time-invariant. In a lengthy panel, this can be rather limiting assumption. Therefore, in **Model II** we consider time varying inefficiency model proposed by Battese and Coelli (1992):

$$\ln C_{it}^{*} = c(\mathbf{y}_{it}, \mathbf{w}_{it}, \mathbf{z}_{it}; \alpha, \boldsymbol{\beta}) + v_{it} + u_{it}, \tag{4}$$

in which inefficiency component u_{it} is assumed to be an exponential function of time:

$$u_{it} = \exp[-\eta(t - T)]u_i \tag{5}$$

where eta (η) is the decay parameter in modelling the inefficiency effects. The function in parentheses is positive and decreases (increases) at an increasing rate if $\eta > 0$ ($\eta < 0$) or remains constant if $\eta = 0$. A normal distribution for v_{it} and a truncated normal for u_i is assumed and the model is estimated using the ML method. However, the systematic movement of inefficiency retains a rigid model structure.

In Model I and Model II the cost inefficiency is left unexplained by the model as environmental variables are included in the cost function. Therefore, in **Model III** we additionally estimate the stochastic frontier cost function in which inefficiency is specified to depend on exogenous variables. Battese and Coelli (1995) model is applied, which is formulated in the following way:

$$\ln C_{it}^{*} = c(\mathbf{y}_{it}, \mathbf{w}_{it}; \alpha, \boldsymbol{\beta}) + v_{it} + u_{it}, \tag{6}$$

where the cost inefficiency term u_{it} has a systematic component $\boldsymbol{\gamma}'\mathbf{z}_{it}$ associated with exogenous variables and a random component e_{it}:

$$u_{it} = \boldsymbol{\gamma}'\mathbf{z}_{it} + e_{it} \tag{7}$$

Inserting the expression for u_{it} in (7) in the cost frontier function in (6) yields:

$$\ln C_{it}^{*} = c(\mathbf{y}_{it}, \mathbf{w}_{it}; \alpha, \boldsymbol{\beta}) + v_{it} + \boldsymbol{\gamma}'\mathbf{z}_{it} + e_{it}, \tag{8}$$

This model is estimated in a single stage by the ML procedure where $u_{it} \sim N^{+}(\boldsymbol{\gamma}'\mathbf{z}_{it}, \sigma_u^2)$. It was introduced as an alternative to the two-stage estimation approach which was found to suffer from serious econometric problems.

11.4. DATA

The analysis includes eight new EU member states, five from Central and Eastern Europe (Czech Republic, Hungary, Poland, Slovakia and Slovenia), and three Baltic countries (Latvia, Lithuania and Estonia). Although there are differences among the banking sectors of these countries, they form a relatively homogeneous group. In particular, preparations for EU membership and the membership itself brought about the introduction of the common EU legislative framework and the common regulation standards. This allows us to compare estimated bank efficiencies across countries.

To construct the sample, we used information drawn from the financial statements of individual banks provided by the Fitch IBCA's BankScope database. Fitch IBCA collects data from balance sheets, income statements and other relevant notes in audited annual reports. To ensure consistency, only data for commercial banks in the *unconsolidated* format were used. Data, expressed in euros, were collected for the 1996-2007 period and corrected for inflation in order to ensure comparability in time (see Table 1 for description of variables obtained form the BankScope database).

Mathieson and Roldos (2001) indicate three important characteristics of the BankScope database. First, its comprehensive coverage as BankScope has data on banks accounting for around 90% of total bank assets in each country. Second, comparability – the data-collection process is based on separate data templates for each country to accommodate different reporting and accounting standards. Fitch IBCA adjusts the collected data for country specificities and presents them in a so-called global format, *i.e.* a globally standardised form for presenting bank data. Thus, BankScope data is comparable across banks and across countries, *i.e.* it allows cross-country comparisons (Claessens, Demirguc-Kunt and Huizinga, 2001). Third, BankScope provides balance sheet data for individual banks, which are usually not available from other sources.

In specifying input prices and outputs of the cost function, we follow the intermediation approach. Three inputs (labour, deposits and physical capital) are used to produce three outputs (loans, other earning assets and deposits). The three inputs reflect the three key groups of inputs in the bank production process: bank personnel and the management expertise necessary for the provision of bank services, funds collected on the liabilities side, and offices, branches and computer hardware.

Table 1: Input and Output Variables from the Bankscope Database

Variable type	Symbol	Variable name	Variable description
Dependent Variable	C	Total cost	Sum of personnel expenses, interest expenses, and noninterest expenses
Input Prices	w_1	Price of borrowed funds	Interest expenses over the sum of deposits
	w_2	Price of physical capital	Noninterest expenses over fixed assets
	w_3	Price of labour	Personnel expenses over total assets
Output quantities	y_1	Total loans	Sum of short- and long-term loans
	y_2	Securities	Sum of securities held by banking firms
	y_3	Other earning assets	Total earning assets less total loans and securities
Other variables	EQ	Equity ratio	Equity capital as proportion of total assets

BankScope does not provide data on the number of employees that would enable the construction of the *price of labour* (w_3). Instead, the ratio of personnel expenses over total assets is used as a proxy, which is a common approach in bank efficiency studies based on BankScope (Yildirim and Philippatos (2002)). *Price of funds* (w_1) is constructed as the ratio of interest expenses over funding. *Price of physical capital* (w_2) is obtained as noninterest expenses over fixed assets. The three outputs, loans, securities and other earning assets are considered to be suitable proxies for banking services provided. *Total loans* (y_1) is the total amount of loans of each individual banking firm. *Other earning assets* (y_3) is the sum of deposits with other banks and equity investments. *Total securities* (y_2) is the sum of securities held by banks among their assets. The dependent variable, *total cost* (C), is the sum of, personnel expenses, interest expenses and other expenses. *Equity ratio* (EQ) is considered in the model to reflect the riskiness of banking operations.

Furthermore, to control for the heterogeneity, a number of exogenous or environmental variables have been included in the model. Potential environmental variables have been tested in various studies, for example Allen and Rai (1996), Berger and Mester (1997), Casu and Molyneux (2000), Dietsch and Lozano-Vivas (2000) and very recently Fries and Taci (2005) and Bonin *et al.* (2005). To select environmental variables we particularly draw on three recently published studies. Dietsch and Lozano-Vivas (2000) was one of the first papers investigating closely the factors that could explain cross-country differences in measured efficiency scores. The authors isolated three groups of environmental variables: main conditions, bank structure and regulation, and accessibility of banking services. Fries and Taci (2005) employed two categories of variables: country-level factors and correlates with bank inefficiencies. Bonin *et al.* (2005) focus on ownership characteristics affecting efficiency score variability and also control for some environmental variables.

Following the above-mentioned studies we formed three groups of variables that are assumed to be associated with cost and efficiency differences across banks. The first group are *country level variables* explaining macroeconomic conditions (GDP per capita, population density and dummy for EU membership). The second group consists of variables describing the *structure of the banking industry* in specific countries (intermediation ratio, HH index of market concentration, number of banks operating within the country and EBRD index of banking sector development). Finally, variable indicating foreign ownership status, market share and net interest margin are included in the third group of variables describing the *individual bank characteristics*. Table 2 gives an overview of the selected variables to be included in the cost frontier function. Variables were obtained from different sources, including central bank publications, IMF's International Financial Statistics and from various issues of the EBRD Transition Reports.

Table 2: Description of the Environmental Variables Included in the Model

Variable type	Symbol	Variable name	Variable description
Individual bank characteristics	D_{OW}	Ownership status of individual bank	Dummy variable identifying the ownership of an individual bank (value 1 if bank is in foreign ownership, value 0 if not)
	MS^*	Market share	Market share of an individual banking firm as measured by total assets.
	NIM^*	Net interest margin	Net interest income to total assets ratio, where net interest income is calculated as a difference between the interest income and the amount of interest expense generated by a bank.
Structure of banking industry	*INTERMED*	Intermediation ratio	Ratio of total banking sector loans to total deposits of the banking sector
	HHI	Hirschman – Herfindahl index	HHI index of market concentration, measured by total assets of banking firms in each national market separately
	EBRD	EBRD index	EBRD banking sector development index as defined by EBRD and taking values on a 1 to 4 scale, where 1 reflects the least developed and 4 the most developed banking sector, according to the EBRD criteria.
	$NRBANK^*$	Number of banks	Number of banks operating in the banking sector.
Country level variables	*POPDEN*	Population density	Number of inhabitants per square kilometre.
	GDPpc	GDP p.c. in PPP	GDP per capita in purchasing power parity (in EUR)
	D_{EU}	EU membership	Dummy variable for post EU accession period (takes on value 1 from the year 2004 on and 0 value otherwise)

*Note: *– Variables MS, NIM and NRBANK are only included in Model III to explain variation in cost inefficiency.*

Special attention was paid to composing the ownership variable, which contains information on the ownership structure of each individual banking firm included in the sample. The BankScope database provides information on bank ownership. There are, however, two problems with this information. First, no ownership information is available for some banks, especially banks that ceased to exist, or were merged with or taken over by other banks. Second, BankScope classifies banks as foreign or domestic at the time the database was last updated. Many authors use the built-in filter to separate domestic from foreign banks, but we believe that this is not an optimal procedure. Although it is a very time consuming and difficult procedure, one should gather ownership data for each bank in each year. We used a wide array of sources, *e.g.* annual reports, home pages as well as financial periodicals to compile precise and up-to-date ownership data on individual banks. Bol *et al.* (2002) apply a similar approach to construct their database.

Descriptive statistics of all variables included in the model are presented in Table 3. The sample of banks is not constant over time. Thus, an unbalanced panel data set was created consisting of 221 banks over the 1996-2007 period. The sample consists of total 1093 observations. Following Bonin *et al.* (2005) prior to the estimation of the cost function all the observations containing missing variables and variables with non-positive values have been excluded. As a result not all of the active banks in individual countries were included in our sample.

Table 3: Descriptive Statistics

Variable	Symbol	Mean	Std. Dev.	Minimum	Maximum	N
Total cost (in thousands EUR)	TC	169,664	360,524	682	3,061,164	1093
Loans (in thousands EUR)	Y_1	918,376	1,615,583	130	14,927,987	1093
Securities (in thousands EUR)	Y_2	370,700	1,077,377	9	16,870,711	1093
Other earning assets (in thousands EUR)	Y_3	681,663	1,352,883	1,896	11,456,002	1093
Price of borrowed funds	W_1	0.05969	0.21673	0.00784	6.82779	1093
Price of physical capital	W_2	1.75585	2.63141	0.06673	9.92522	1093
Price of labour	W_3	0.01544	0.01019	0.00176	0.09463	1093
Equity to total assets ratio	EQ	0.11143	0.08101	0.00004	0.81053	1093
Foreign ownership dummy	D_{OW}	0.62855	0.48342	0	1	1093
Market share (share in banking sector total assets)	MS	3.01494	4.47750	0.01176	26.7288	1093
Net interest margin (%)	NIM	4.15005	3.04488	-1.66	23.89	1093
Loans to deposits ratio	$INTERMED$	0.60022	0.14666	0.27514	1.39932	1093
EBRD Index	$EBRD$	3.418	0.362	2.700	4.000	1093
Herfindahl-Hirschman Index	HHI	1,069.1	543.0	375	4,270.0	1093
Number of banks	$NRBANK$	41.3	22.1	6	83	1093
GDPpc (PPP) (in EUR)	$GDPpc$	11,419.4	3,253.9	5,000	22,000	1093
Population density (nr. of inhabitants per km^2)	$POPDEN$	101.6	32.7	28.8	130.6	1093
Post-EU accession period dummy	D_{EU}	0.3211	0.4671	0	1	1093

11.5. ESTIMATION RESULTS

The estimation results of the translog cost frontier function for the sample of CEE banks over the 1996-2007 period are given in Appendix. It can be noticed that different models lead to quite similar results with respect to the coefficient estimates. The expansion point of the translog stochastic frontier cost function is chosen to be the sample median. Since total cost and all the continuous explanatory variables are in logarithms, the estimated first-order coefficients can be interpreted as cost elasticities evaluated at the sample median. As expected, results show that input prices and outputs are positive and highly significant. The sum of the three output coefficients slightly exceeds 1, indicating the presence of slight diseconomies of scale in the median-sized banks. A one percent increase in loans, securities and other earning assets would lead to an increase of a little more than 1% in total cost at the median point. Nevertheless, the operation of median-sized bank is not very far from the optimal size which is characterized by the constant returns to scale and the sum of output coefficients equalling 1. Time seems to have a negative influence on the cost, where the time coefficient is being strongly significant in Model I and Model III. Based on the results it can be concluded that due to the technical progress total costs of CEE banks have been decreasing over the 1996-2007 period.

Table 4 provides descriptive statistics of the cost efficiency estimates of CEE banks obtained from Models I-III. It is evident that different models result in very similar average cost efficiency levels and that significant cost inefficiencies are present in the banking systems of the CEE countries. Cost efficiency is estimated to be between 79% and 82% on average indicating that the CEE banks should on average decrease their costs between 18% and 21% in order to become cost efficient. While cost inefficiency is left unexplained by the pooled model (Model I) and time-varying Battese and Coelli (1992) model (Model II), Battese and Coelli (1995) model (Model III) is formulated in such a way that variation in inefficiency can be explained by the exogenous variables considered in the model. Following from Table A.2 in Appendix, cost inefficiency in Model III tends to be lower for banks with higher market share and for countries with higher number of banks. The latter captures the effect of the degree of competition in a given country, while the former could indicate the existence of the efficient structure hypothesis. According to the efficient structure hypothesis high concentration endogenously reflects the market share gains of efficient banking firms (*e.g.* Berger *et al.* (2004)), which could be the case in rapidly developing Eastern European banking markets where the opening up process has led to fierce competition among banks. On the other hand, net interest margin and foreign ownership are not found to significantly influence the cost inefficiency of the CEE banks.

Results obtained by Model II furthermore indicate that the EU membership has a negative and significant influence on cost inefficiency which speaks in favour of our assumption that the EU membership would lead to improved cost efficiency of the CEE banks. Alternatively, when the EU membership is assumed to influence the cost directly as in Model I and Model II, it can be detected that the costs have on average lowered since the entrance in the EU, however, this effect is not being significant. A significant and positive coeffiecient η estimated in the time varying Model II (see Table A.2 in Appendix) provides evidence on average efficiency improvement over time, although it does not distinguish between the pre- and post-entry period.

Table 4: Estimated Cost Efficiency Scores (EF)

EF_{it}	Model I (Pooled)	Model II (BC92)	Model III (BC95)
Mean	0.7904	0.8183	0.7937
Median	0.8157	0.8588	0.8334
Std. Dev.	0.1021	0.1296	0.1335
Min	0.3533	0.3348	0.2444
Max	0.9625	0.9819	0.9727

As empirical literature provides mixed evidence on robustness of efficiency scores obtained by different methods, it is also important to check the reliability of obtained efficiency scores[5]. Bauer *et al.* (1998) proposed a set of consistency conditions which frontier efficiency measures should meet so as to be most useful for regulatory purposes. Following Bauer *et al.* (1998) the efficiency estimates should be consistent in their efficiency levels, rankings, identification of best and worst practice, consistent over time and with competitive conditions in the market, and consistent with standard non-frontier measures of performance. To test whether the models provide similar rankings of the banks with respect to the cost efficiency scores, the pair-wise Pearson correlation coefficients between the cost efficiency estimates are given in Table 5[6]. We can observe that the estimated correlation between the efficiency scores resulting from the three models is significant, positive and fairly high. In particular, very high correlation can be observed between the inefficiency scores from Model I (pooled) and Model III (BC 95).

5 For example, in the context of banking efficiency studies robustness is confirmed by Resti (1997), while Bauer *et al.* (1998) and Weill (2004) reveal some notable differences between the efficiency scores obtained by different parametric and non-parametric approaches.

6 The conclusions based on the rank correlation between the inefficiency scores from different models (Spearman correlation coefficients) are very similar to those found in Table 5.

Table 5: Correlation Between Cost Efficiency Scores (Pearson Correlation Coefficients)

	Model I (Pooled)	Model II (BC92)	Model III (BC95)
Model I	1.0000	0.6921*	0.9086*
Model II		1.0000	0.7399*
Model III			1.0000

*Note: * – significant at 0.1%.*

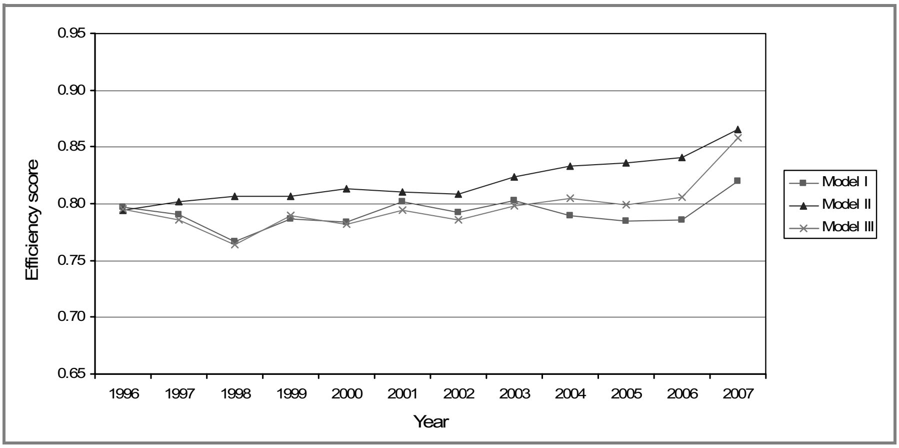
As the main objective of our paper was to analyse the impact of EU membership on the efficiency of the CEE banks, Table 6 compares the estimated average cost efficiency in the pre- and post-EU accession period. Both Battese and Coelli (1992, 1995) models provide certain evidence in support to our assumption that the process of accession to the EU and associated regulatory reforms and changes in institutional settings of the new EU Member States would facilitate efficiency improvements. Nevertheless, the evidence is not particularly strong, as the average efficiency scores in Model II and Model III are found to be only slightly higher for the post-accession period as compared to the pre-accession period. In contrast, the pooled model does not find any improvement in the cost efficiency of the CEE banks in the post-EU accession period as compared to the pre-accession period. Similar findings also follow from the average annual efficiency scores as presented in Figure 1.

Table 6: Estimated Average Cost Efficiency Scores in the pre- and post-EU Accession Period

D_{EU}	Pre-accession period (0)	Post-accession period (1)	Total
N	742	351	1093
Model I (Pooled)	0.7907	0.7897	0.7904
Model II (BC92)**	0.8086	0.8389	0.8183
Model III (BC95)*	0.7869	0.8082	0.7937

*Note: * (**) – difference between group means significant at 1% (0.1%). We applied group mean comparison t test and alternatively also non-parametric Wilcoxon-Mann-Whitney test. Both tests render same results.*

Figure 1: Breakdown of Average Cost Efficiency Scores by Year



Finally, Table 7 provides average cost efficiency estimates and rankings at a country level. All three models reveal some notable differences in average cost efficiency at a country level. Based on the average rankings from all three models Estonia, Slovenia and Poland are found to have the most efficient banks, while on the contrary Slovakia and Czech Republic have the worst performing banks on average. Reassuringly, all three models provide very similar rankings of the CEE countries according to the bank average cost efficiency.

Table 7: Breakdown of Average Efficiency Scores (EF) by Country

Country	N	Model I (Pooled)		Model II (BC92)		Model III (BC95)		Average rank
		EF	*Rank*	*EF*	*Rank*	*EF*	*Rank*	
Czech Rep. (CZ)	176	0.7461	8	0.7039	8	0.7272	7	8
Estonia (EE)	56	0.8299	2	0.9001	1	0.8484	1	1
Hungary (HU)	114	0.7696	6	0.7840	6	0.7659	6	6
Lithuania (LT)	90	0.8049	4	0.8605	4	0.8107	4	4
Latvia (LV)	84	0.7726	5	0.8107	5	0.7800	5	5
Poland (PL)	344	0.8150	3	0.8778	3	0.8385	2	3
Slovenia (SI)	114	0.8312	1	0.8914	2	0.8273	3	2
Slovakia (SK)	115	0.7468	7	0.7099	7	0.7262	8	7
Total	1093	0.7904		0.8183		0.7937		

Based on the estimated results it can be concluded that the reliability of obtained efficiency scores in our study is fairly satisfactory, although the mutual consistency conditions proposed by Bauer *et al.* (1998) are not fully met. Estimated average cost efficiency levels based on the three models are highly similar and all models seem to be quite consistent over time and they also lead to very similar country rankings. Some differences can be observed in rankings of the CEE banks, which is to a certain extent expected since the various models employ different assumptions regarding cost inefficiency.

Finally, the decision on the most appropriate model has to be made. Baring in mind our research question, the pooled model does not seem to be particularly appealing, as it does not provide an answer regarding the evolution of cost efficiency due to the EU accession. The predominant reason for introduction of this model was to check for the robustness and reliability of the obtained results. Furthermore, Battese and Coelli (1992) model allows for the cost efficiency to systematically evolve over time, but can only be used to indirectly compare cost efficiency of pre- and post-accession period. The most suitable model to directly address the research question posed is therefore believed to be Battese and Coelli (1995) model, where efficiency is modelled to depend on environmental variables, including the EU post-accession period. By adopting this model we are able to show that the EU membership had a positive effect on the cost efficiency of the CEE banks. The final point to be made is that although both Battese and Coelli models provide some evidence on cost efficiency improvement over time and/or due to the EU accession, this improvement is not found to be particularly strong.

11.6. CONCLUSIONS

Banking sectors in Central and Eastern Europe have undergone a remarkable transformation since mid 1990s, particularly in those, more advanced, countries that started the process of the EU accession early and eventually became part of the enlarged EU in 2004. They adopted the common EU legislation and regulation, undertook extensive structural and institutional reforms, and integrated their banking systems, at least to some extent, into the EU banking sector. According to the integration indicators provided by Dermine (2006) we could say that the degree of integration has been elevated significantly with the EU membership of those economies. Taking into account the fact, that back in the mid 1990s the level of internationalisation in Eastern European banking markets was poor and markets were dominated by government owned credit institutions, the progress that was made in terms of internationalisation, regulatory reforms and institutional changes in the ten year period is astonishing. Simultaneously to the opening up and accomplished reforming processes the competitiveness of these markets has been intensified and one would expect the cost efficiency of banking firms to be improved accordingly. Having in mind all this, we decided to evaluate the potential efficiency effects that could be associated with the EU membership of the ten Central and Eastern European countries due to related institutional and regulatory changes in banking markets.

Based on different stochastic frontier panel data models, the average cost efficiency in the 1996-2007 period is estimated to be between 79% and 82%, indicating the presence of significant cost inefficiencies in the CEE banks. Some minor improvements can be detected in terms of both decreasing cost and increasing efficiency over time. The reliability of obtained results is fairly good as all three models lead to very similar cost efficiency levels and country rankings and they also exhibit sufficient stability over time.

As considers the EU membership and related efficiency effects in the studied CEE banking sectors, we find some evidence on the beneficial effects of the EU membership and related regulatory and institutional changes for the average banking efficiency. This finding is firstly based on the comparison of the average efficiency scores for the pre- and post-accession period, where both Battese and Coelli (1995) and Battese and Coelli (1992) models confirm improved efficiency of the CEE banks after the EU accession. Secondly, time dynamics of cost efficiency was also explicitly tested within both models. So, Battese and Coelli (1995) model also reveals a significant and positive effect of the EU membership on the cost efficiency improvement. Similarly, the time-varying cost inefficiency model by Battese and Coelli (1992) reveals evidence on a significant cost efficiency improvement over time, although it does not distinguish between the pre- and post-entry period. Nonetheless, it is likely that some barriers to efficiency enhancements are still in place, since the empirical evidence on efficiency improvements is found to be rather weak. This implies that policy makers could take some additional measures for further strengthening of the integration processes.

11.7. REFERENCES

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11.8. APPENDIX

Table A.1: Estimation Results of the Cost Frontier Function

Coefficient	Model I (Pooled)	Model II (BC92)	Model III (BC95)
Frontier cost function			
constant	-1.1023***	0.1895	-0.0827
	(0.3480)	(0.5186)	(0.3398)
b_{W1}	0.4730****	0.4578****	0.4583****
	(0.0122)	(0.0152)	(0.0123)
b_{W2}	0.0248***	0.0444****	0.0330****
	(0.0078)	(0.0088)	(0.0075)
$b_{W1,W1}$	-0.0797****	-0.0792****	-0.0793****
	(0.0046)	(0.0049)	(0.0045)
$b_{W2,W2}$	0.0076	0.0163**	0.0040
	(0.0067)	(0.0069)	(0.0064)
$b_{W1,W2}$	0.0088	0.0032	0.0090
	(0.0057)	(0.0064)	(0.0058)
b_{Y1}	0.4246****	0.4471****	0.4543****
	(0.0112)	(0.0123)	(0.0114)
b_{Y2}	0.1135****	0.1200****	0.1227****
	(0.0073)	(0.0077)	(0.0070)
b_{Y3}	0.4656****	0.4439****	0.4730****
	(0.0110)	(0.0123)	(0.0118)
$b_{Y1,Y1}$	0.1336****	0.1250****	0.1340****
	(0.0064)	(0.0072)	(0.0065)
$b_{Y2,Y2}$	-0.0352****	-0.0217****	-0.0337****
	(0.0049)	(0.0051)	(0.0051)
$b_{Y3,Y3}$	-0.1039****	-0.1031****	-0.1076****
	(0.0065)	(0.0070)	(0.0066)
$b_{Y1,Y2}$	0.0453****	0.0460****	0.0480****
	(0.0045)	(0.0046)	(0.0045)
$b_{Y1,Y3}$	-0.0137**	-0.0215****	-0.0166***
	(0.0055)	(0.0053)	(0.0058)
$b_{Y2,Y3}$	0.1097****	0.1186****	0.1155****
	(0.0105)	(0.0108)	(0.0104)
$b_{W1,Y1}$	-0.0073	-0.0008	-0.0098*
	(0.0060)	(0.0064)	(0.0059)
$b_{W1,Y2}$	0.0209****	0.0038	0.0103*
	(0.0059)	(0.0059)	(0.0059)
$b_{W1,Y3}$	0.0373****	0.0467****	0.0398****
	(0.0069)	(0.0072)	(0.0070)
$b_{W2,Y1}$	0.0142**	-0.0073	0.0064
	(0.0063)	(0.0065)	(0.0063)

Table A.1: Estimation Results of the Cost Frontier Function *(continued)*

Coefficient	Model I (Pooled)	Model II (BC92)	Model III (BC95)
$b_{W2,Y2}$	0.0085**	0.0162****	0.0107**
	(0.0042)	(0.0043)	(0.0041)
$b_{W2,Y3}$	-0.0388****	-0.0234****	-0.0352****
	(0.0064)	(0.0063)	(0.0064)
$b_{EQ/TA}$	-0.1516****	-0.1255****	-0.1372****
	(0.0131)	(0.0149)	(0.0126)
b_t	-0.0125**	-0.0099	-0.0132***
	(0.0052)	(0.0069)	(0.0045)
b_{GDPpc}	0.0925*	-0.0023	-0.0148
	(0.0497)	(0.0686)	(0.0478)
b_{POPDEN}	-0.0079	0.0152	-0.0238
	(0.0314)	(0.0403)	(0.0306)
$b_{INTERMED}$	-0.0919*	0.1481***	-0.0568
	(0.0541)	(0.0554)	(0.0539)
b_{HHI}	0.0192	-0.0146	0.0204
	(0.0237)	(0.0273)	(0.0226)
b_{EBRD}	-0.0285	-0.0731*	-0.0104
	(0.0306)	(0.0414)	(0.0301)
d_{OW}	0.0306*	0.0024	/
	(0.0177)	(0.0257)	
d_{EU}	-0.0334	-0.0330	/
	(0.0261)	(0.0215)	
Cost inefficiency term			
d_{OW}	/	/	-0.0024
			(0.0422)
d_{EU}	/	/	-0.2020***
			(0.0734)
MS	/	/	-0.1268****
			(0.0081)
NIM	/	/	0.0207
			(0.0070)
NRBANK	/	/	-0.0100****
			(0.0018)
const	/	/	0.4154****
			(0.1136)
σ^2	0.1187****	0.2168***	0.1733***
η	/	0.0381***	/
$\gamma = \sigma_u^2/(\sigma_v^2 + \sigma_u^2)$	0.7683****	0.8485****	0.8802****
logL	-3.262	146.472	48.607

*Notes: standard errors in brackets; * – significant at 10%, ** – significant at 5%, ***– significant at 1%, **** – significant at 0.1% (two-sided significance level)*

12. How Output Diversification Affects Bank Efficiency and Risk: An Intra-EU Comparison Study

Nikolaos I. Papanikolaou[1]

Abstract

This paper examines how banks have been diversifying away from traditional financial intermediation activity into noninterest income business and how this shift has affected their efficiency and risk-taking behaviour. To this end, we construct a global best-practice efficiency frontier following the Stochastic Frontier Approach and relying on the technique of Battese and Coelli (1995), which permits the estimation of the frontier and of the coefficients of efficiency variables in a single stage. We opt for an application of this model to the EU-27 countries performing an intra-Union comparisons between the old and the new EU members that provide us with substantial information concerning the level of harmonization of the European banking systems. Results indicate that the diversification of bank output enlarges efficiency margins in both cost and profit terms without altering the way banks treat risk. Moreover, that the environment identically affects the performance of European banks. By and large, both old and new EU member states are found to follow similar behavioural patterns that are not influenced by product diversification, which reveals a rather harmonized European banking market.

12.1. Introduction

Over the past couple of decades or more, the extensive regulatory changes and the technological advances have transformed financial systems to a great extent. Banks have reacted to the challenges posed by the new operating environment by creating new products and services and expanding the already existing ones, which allowed them to diversify the product mix of their portfolio. The traditional business of taking deposits from households and making loans to agents that require capital has thus declined in favour of a considerable growth in activities that generate noninterest (fee) income and are not necessarily reported on

1 The author would like to thank Angelos Antzoulatos for his support and guidance. Thanks are also due to Charles Calomiris and other participants at the 7th Conference on Research on Economic Theory & Econometrics (CRETE) for their valuable remarks as well as participants at the SUERF Conference on 'Productivity in the Financial Services Sector' for helpful comments and suggestions. The usual disclaimer remains.

banks' balance sheets[2]. In consequence, the sources of revenues and profits of banking institutions have been diversified as noninterest income relative to its interest counterpart from traditional financial activities has considerably increased[3].

In the present work we assess the effect of alterations in product mix on the performance of European banking markets. To clarify, we examine how banks in the EU have been diversifying away from traditional financial intermediation activity into noninterest income business and how this shift has affected their efficiency and risk-taking behaviour. Cost and profit efficiency frontiers are estimated with and without proxies of non-traditional activities in order the impact of diversified product offerings on banking performance to be explicitly measured. Regarding risk, it plays a central role in our analysis as non-traditional instruments are thought of as a basic tool for financial institutions to manage risk more efficiently. Recognizing this modern way of dealing with risk exposure and also taking into account that efficiency is likely to be miscalculated in case risk characteristics are not included in the cost and profit functions, we investigate the relationship that holds between product diversification and bank risk-taking behaviour focusing on the most important sources of bank risk.

Our data set encompasses the EU-27 countries thus allowing us to test whether the move towards the new financial intermediation business has affected the Union's banking systems uniformly. In other words, we examine whether European banking markets have *jointly* improved their performance by increasing their efficiency and lowering their risk after diversifying their portfolios. To this aim, we proceed in making various intra-EU comparisons between the 15 long-term members and the group of the 12 states that lately ascended to the Union. Such comparative analysis can provide us with substantial information concerning the performance of banks within the Union, thus giving us a thorough picture of the level of harmonization in the European banking environment as a whole.

For the intra-EU efficiency comparisons to be meaningful, it is of importance not only to allow for variation in relative factor prices across countries, but also to control for country- and bank-level characteristics that lead to performance heterogeneities across banking systems or individual banks, respectively. In fact, efficiency literature has reached the agreement that operational environment is such an important component in cross-country efficiency comparisons that, if ignored,

2 A number of studies have documented this upsurge in fee-generating activities of banks using data from different banking industries. See *e.g.* Rogers (1998), Rogers and Sinkey (1999), and Stiroh (2004) for US banking; also, Rime and Stiroh (2003) and Tortosa-Ausina (2003) for the Swiss and Spanish banking sectors, respectively.

3 It has to be mentioned here that banks have long earned noninterest income by charging their customers' fees in exchange for a number of traditional services like checking and cash management, safe-keeping services (*e.g.* insured deposit accounts and safety deposit boxes), investment services (*e.g.* trust accounts and long-run certificates of deposits), and insurance services (*e.g.* annuity contracts). This sort of income, however, has only been a small fraction of banks' total income.

results will vary a lot (see *e.g.* Dietsch and Lozano-Vivas (2000); Cavallo and Rossi (2002)). We thus employ the stochastic efficiency frontier model of Battese and Coelli (1995), which enables efficiency comparisons as it pools the data defining a common frontier for all the countries under scrutiny also accounting for both environmental conditions – which are far beyond the control of bank managers – and bank-specific factors in a single stage[4].

To account for differences in the regulatory conditions among the EU banking sectors, we exploit the World Bank Regulation and Supervision Databases of Barth *et al.* (2001, 2008). Moreover, the Worldwide Governance Indicators developed by Kaufmann *et al.* (2002) are employed to capture the various levels of institutional development in our sample countries. The degree of banking market concentration that significantly affects efficiency (see *e.g.* Dietsch and Lozano-Vivas (2000)) is further considered in our empirical analysis. Finally, we control for variations in the macroeconomic environment, the level of technological progress, and the size of banks.

Our study contributes significantly to the current literature from several perspectives[5]. First, in contrast to the existing works that focus exclusively on individual banking industries and mainly that of US, the analysis here focuses on the effects of product diversification on the performance of a group of banking markets - those of the EU-27- also conducting intra-EU comparisons.[6] Second, the current analysis is differentiated from previous ones in that it investigates whether banks alter their risk-taking behavior after being entangled with diversified activities. In fact, the impact of output diversification on risk has been rather neglected from bank performance literature. More specifically, if we except the studies of Rogers and Sinkey (1999) and Vennet (2002) that explicitly examine how non-traditional activities influence the level of bank risk, the rest of the relevant studies either simply control for risk preferences by incorporating capital ratio or total equity in their empirical models (see, e.g. Lozano-Vivas and Pasiouras, 2008), or indirectly consider for risk by utilizing several risk-based measures of non-traditional activities (see, e.g., Stiroh, 2000; Clark and Siems, 2002). A further inno-

4 The Battese and Coelli (1995) methodology, though not so recently developed, has been very lately employed in several bank efficiency comparison studies (Cavallo and Rossi (2002); Williams and Nguyen (2005); Fries and Taci (2005); Kasman and Yildirim (2006); Barros *et al.* (2007); Lozano-Vivas and Pasiouras (2008); Lensink *et al.* (2008)). Nevertheless, with only exception the study of Lozano-Vivas and Pasiouras (2008) that shares some common features with the current one, none of the other studies that belong to this recent empirical literature strand shows any interest in the impact of output diversification on bank performance thus at best accounting for non-traditional activities only parenthetically. In fact, all the above studies are designed to address other issues, such as the efficiency differences among European banking sectors (Cavallo and Rossi (2002)), the effect of financial deregulation on bank performance in transition economies (Fries and Taci (2005); Kasman and Yildirim (2006)) or in South East Asian countries (Williams and Nguyen (2005)), the main factors that explain the probability of bank efficiency (Barros *et al.* (2007)), and the link between efficiency and bank ownership (Lensink *et al.* (2008)).

5 For an extended review of the current literature, see Section 12.2 that follows.

6 An exception in the literature is the recent empirical study of Vennet (2002) that also uses data from a group of European banking markets. Vennet (2002), however, does not proceed in making any cross-country efficiency comparisons.

vative feature of our work is that it sketches the theoretical considerations that provide the rationale for the shift of banks away from traditional services. Overall, the current paper offers the ground to empirically test the dilemma of focus versus diversification, which has not been addressed thoroughly in the context of financial intermediation theory.

Our empirical results indicate that product diversification increases cost and profit efficiencies without affecting the way banks treat risk. As for the environmental conditions, they seem to have an identical role in the performance of European banks. On the whole, the banking sectors of both old and new EU member states are found to follow similar behavioural patterns, which are not significantly influenced by output diversification. This is to say a rather harmonized European banking industry is supported by the findings.

The rest of this paper proceeds as follows. Section 12.2 reviews the role of non-traditional activities in bank performance literature, whereas Section 12.3 illustrates the theoretical underpinnings of the paper. Section 12.4 provides a description of the data set and a justification of the variables used. Section 12.5 presents the cost and profit efficiency models and the estimation methodology followed. Section 12.6 discusses the empirical findings, and, finally, Section 12.7 concludes.

12.2. THE ROLE OF NON-TRADITIONAL ACTIVITIES IN BANK PERFORMANCE LITERATURE

As noted earlier, deregulation process and technological innovation have let banks to engage with non-traditional business. Even though one part of bank performance literature does not consider the relevance of this sort of business at all (see Grifell-Tatjé and Lovell (1996); Wheelock and Wilson (1999); Maudos *et al.* (2002); Lensink *et al.* (2008)), some other has recently turned to utilize different proxies of non-traditional products as an additional bank outputs. In particular, Altunbas *et al.* (2000) examine the link between efficiency and risk in the Japanese commercial banking sector proxying non-traditional activities with the nominal value of Off Balance Sheet (OBS henceforth) items. The same proxy is also incorporated in the output vector of the models of Altunbas *et al.* (2001a, 2001b) and Casu *et al.* (2004) that study the efficiency and productivity of European banks.

Moreover, Isik and Hassan (2003) evaluate the performance of Turkish banks including the risk-adjusted value of OBS activities according to the Basel Accord in their econometric model arguing that such an adjustment provides conformity with other bank outputs in terms of credit risk. Alternative proxies of non-traditional products are also included in the output vectors of other bank performance studies: Dietsch and Lozano-Vivas (2000) and Maudos *et al.* (2002) use *other* *earning assets*, Drake and Hall (2003) utilize *net fee and commission income*, while Tortosa-Ausina *et al.* (2008) employ the broader proxy of *noninterest income*.

Notwithstanding the incorporation of alternative proxies of non-traditional activities in the vector of outputs, none of the above studies estimates the clear effect that portfolio expansion has on bank performance. This gap is bridged by a recently developed thread of literature that compares performance measures derived by alternative models specifications, that is, with and without the inclusion of non-traditional items. The origins of this literature can be traced back to 1994, when DeYoung explicitly addressed the impact of noninterest and fee income on the efficiency of US commercial banking sector. DeYoung (1994) estimated a cost efficiency frontier and found that the standard formulation, which disregards non-traditional income devalues efficiency for banks with a large share of this type of income.

Albeit several works followed that of DeYoung (1994), research has been almost exclusively focused on the US banking system. Indeed, Jagtiani *et al.* (1995) estimate the importance of OBS activities captured by guarantees, foreign currency transactions and interest rate products on the efficiency of US commercial banks, where efficiency is measured in terms of scale economies and cost complementarities[7]. Also using US commercial banking data, Rogers (1998) formulates cost, revenue, and profit frontiers to estimate efficiency with and without non-traditional services, which are proxied by net noninterest income. The same proxy measure is used by Rogers and Sinkey (1999), who empirically assess the level of involvement of US banks in non-traditional activities, and Stiroh (2000), who examines cost and profit efficiencies as well as productivity growth and scale economies for US bank holding companies. The latter study also uses a Basel-based credit equivalent measure (CEM) that converts all OBS activities to credit risk equivalents. Net noninterest income, CEM, and AEM (an asset equivalent measure that uses the rate of return on balance-sheet items to capitalize the noninterest income from OBS activities) are utilized in the empirical work of Clark and Siems (2002) that gauges the importance of non-traditional activities in the performance of US commercial banks.

As already mentioned, there is just a handful of works that use data other from US to estimate how non-traditional items affect bank performance. To start with, Vennet (2002) investigates the existence of efficiency differences between specialized and non-specialized financial institutions in Europe; whereas the latter form of institutions consists of universal banks and conglomerates that offer both traditional and non-traditional services. Moreover, Rime and Stiroh (2003) measure

[7] Using the same proxies for OBS activities, Jagtiani and Khanthavit (1996) study the effect of the introduction of risk-based capital requirements on the cost structure of large US banks.

cost and profit efficiencies as well as economies of scale and scope of large Swiss banks. In their analysis, output is defined in such a way as to include two proxies for non-traditional services: the CEM of OBS derivative activities and the trading and portfolio management activities (see above). Furthermore, Tortosa-Ausina (2003) examines the role of noninterest income on the efficiency of Spanish commercial and savings banks, where the more recent study of Casu and Girardone (2005) tests whether the expansion of OBS activities has an effect on the productivity of five large European banking sectors.

Although proxies of non-traditional activities, bank performance measures and estimation techniques vary in the studies reviewed above, the empirical findings converge to the conclusion that ignoring non-traditional activities leads to a misspecification of bank output[8]. In particular, average performance is improved when these types of activities are taken into account. A possible explanation for this is that the resources that are used to produce non-traditional products are included in the input vector but not in the output vector. Or, according to some other explanation, banks are better producers of non-traditional rather than traditional items (Rogers (1998)). In either way, the finding that bank performance is underestimated in case non-traditional activities are ignored corroborates the growing importance of this kind of activities in the operation of banks.

12.3. THE FINANCIAL INTERMEDIATION THEORY: THE TRANSITION FROM THE TRADITIONAL TO MODERN APPROACH

The traditional financial intermediation theory relies mostly upon the vitiation of the Arrow-Debreu complete markets paradigm and of the Modigliani-Miller famous theorem. According to the former, firms and governments are financed by households via financial markets. As these markets are assumed to be perfect and complete (*i.e.* there are no transaction costs and no credit rationing, whilst there is a full set of contingent markets), the allocation of resources is Pareto optimal and hence there is no role for intermediaries. The Modigliani-Miller theorem, on the other hand, assumes that all households are involved and there is full participation in markets. This implies that financial structure is irrelevant as households can construct portfolios offsetting actions of intermediaries and thus intermediation cannot add value.

Still, in real life, imperfect information and transaction costs that exist in the economy restrict the scope for direct financing and vitiate the Arrow-Debreu

[8] Exceptions are the study of Jagtiani *et al.* (1995) that finds no impact of non-traditional activities on bank performance, and that of Clark and Siems (2002), which concludes that cost efficiency estimates increase with the inclusion of OBS items, whereas profit efficiency estimates are largely unaffected.

model of resource allocation. Moreover, there is evidence that full participation does not hold in practice and thus the Modigliani-Miller theorem is not valid. Accordingly, financial institutions intervene between savers and borrowers taking advantage of market frictions[9]. Financial intermediaries allow transaction costs to be shared thus obtaining an advantage over individuals. In addition, they signal their informed status by investing their capital in assets about which they have special knowledge. By doing so, intermediaries manage to limit the problems that asymmetric information generates.

In recent decades, however, transaction costs have been reduced and information asymmetries have shrunk as information has become cheaper and more easily available due to technological advances. However, these changes have not coincided with a decline in financial intermediation; instead, the volume of intermediation has been enhanced. In fact, where banks' total assets as a percentage of financial intermediation assets have fallen in all developed financial sectors and the total number of banking institutions has dropped mainly due to Mergers & Acquisitions (M&A), the intermediation role of banks has been amplified. Apparently, the traditional financial intermediation theory, which relies on the existence of transaction costs and asymmetric information, cannot satisfactorily explain the observed increase in intermediation activity.

The answer to this puzzle has been provided by Allen and Santomero (1998, 2001) who revised the traditional intermediation theory. By arguing that the focus of the latter theory has been too narrow, they indicated risk management and reduction of participation costs as the primary factors that have led to the increase of the overall volume of intermediation. More specifically, Allen and Santomero showed that financial liberalization and technological progress have generated a large amount of novel financial products and thus the need for new markets where all these products could be traded. Most individuals and firms, however, have neither the appropriate information nor the specialized knowledge to deal with this complex maze of modern financial tools. For them, the costs of learning how to use these tools and then participate in the new markets on a daily basis are especially high. However, this does not hold for financial institutions that are both informed and skilled enough to intervene in the new financial markets and trade all this volume of non-traditional instruments in favour of their

9 The two major aspects of financial intermediation activity are brokerage and qualitative asset transformation. Brokerage is usually referred to as 'soft' intermediation, while asset transformation as 'hard' intermediation activity. By brokerage, banks match transactors with complementary needs asking for a fee-based compensation. Banks take no particular position, although reputation risk is inherent in brokerage activity. Moreover, brokerage incurs a cost of gathering information; yet, information can be reused – either cross-sectionally or through time – at zero cost. Examples of banks' brokerage activity are transaction services, financial advice, screening, origination, issuance, and funding. As regards qualitative asset transformation, it refers to the transformation of the attributes of an asset (*e.g.* monitoring, management expertise, guaranteeing, liquidity creation etc.).

clients at significantly lower costs. Thereby, financial institutions facilitate participation, whereas at the same time can manage risk more effectively.

In the EU, which is the focus of the current study, limits on banking activities were substantially removed with the implementation of the Second Banking Directive in 1989 and the Directive on Investment Services in 1996. These two enactments allowed all banks to operate outside their home countries and engage in all sorts of financial services. As a result, a number of bank consolidations within and across EU member states have taken place over the past years that have led to the emergence of universal financial institutions, which provide a broad range of diversified activities that generate substantial amounts of noninterest income.

12.4. DATA AND VARIABLES

12.4.1. Data Description

All the bank-level data used in the study are obtained from the *BankScope* database produced by the Bureau van Dijk and Fitch-IBCA. In particular, our dataset is composed of commercial banks from the 27 EU member states and covers the period 2000-2007. We incorporate all those banks for which at least four years of data are available. This refinement allows us to reliably distinguish between the random and the inefficiency component in the Battese and Coelli composite error model that we use (see Fries and Taci (2005)). After checking the data for reporting errors and other inconsistencies (missing, negative or zero values), we obtain an unbalanced panel of 5928 observations corresponding to 741 banks[10]. The choice of using an unbalanced panel is mainly justified by the fact that we would like to account for mergers and acquisitions as well as for any bank failures and new entries that took place during the sample period in order to avoid selectivity bias. All data are reported in euros as the reference currency and are expressed in real 2000 prices.

The data for market concentration as well as those used in the construction of the regulatory variables were gathered from Versions II and III of the Bank Regulation and Supervision databases of Barth *et al.* (2001, 2008)[11]. Since regulatory policies do not vary a lot from year to year (see Barth *et al.* (2008)), we use the information contained in Version II and collected from 2000 to 2002 for the first four years of our data set (*i.e.* 2000-2003), and the Version III information that describes the situation in the 2005-2006 period for the rest four years (2004-

[10] The Battese and Coelli (1995) model has the advantage that can be estimated for an unbalanced panel dataset. This augments the number of observations and thus the accuracy of the results obtained.

[11] An important point that has to be made here is that the Barth *et al.* databases refer only to commercial banking, which is the focus of our study.

2007) of our sample. Regarding the degree of institutional development and the quality of governance, they are both captured by an overall index based on the Worldwide Governance Indicators developed by Kaufmann *et al.* (2002). Lastly, real GDP growth rate and interbank rates are extracted from Eurostat.

12.4.2. Variables Definition

We now move to describe the variables employed in our empirical analysis. We justify why we decide to use these specific variables and how each is calculated. An analysis of summary statistics is offered in Table 1.

12.4.2.1. Output Quantities and Input Prices

An important concern in the empirical estimation of efficiency is the definition of bank inputs and outputs, which is strongly related to the specific role that deposits play in the operation of financial institutions. The banking literature addresses this issue by largely using two approaches: the intermediation or asset approach and the production or value-added approach[12]. Under the former one, financial firms are thought of as intermediaries that transform deposits and purchased funds into loans and other earning assets. This is to say, liabilities and physical factors are viewed as inputs, whereas assets are treated as outputs. The production approach, on the other hand, views financial institutions as producers of services for account holders measuring output with the number of transactions or documents processed over a given time period. Therefore, deposits are encompassed in the output and not in the input vector, which exclusively includes physical entities.

Berger and Humphrey (1991), however, propose a third approach that, contrary to the above two approaches, captures the dual role of banking operations. In fact, the so-called modified production approach can be viewed as a combination of intermediation and production approaches as it enables the consideration of both the input and output characteristics of deposits in the cost/profit functions. More specifically, the price of deposits is considered to be an input, whilst the volume of deposits is accounted as an output. In this specification, banks are assumed to provide intermediation and loan services as well as payment, liquidity, and safekeeping services at the same time.

In the current paper we adopt the modified production approach to define the inputs and outputs since it seems to go one step further describing the activities of banks in a more complete setting providing therefore a closer representation of

12 See Berger and Humphrey (1997) for a detailed analysis of the advantages and disadvantages of each of the two approaches.

reality. Five variable outputs are specified in total: traditional banking activities are captured by three outputs, namely total loans (y_1), total other earning assets (y_2), and total deposits (y_3), whereas non-traditional activities are proxied by noninterest income (y_4) – calculated as the sum of commission, fee, trading and other operating income – and the value of OBS items (y_5). As regards inputs, we consider three of them in our analysis, *i.e.* deposits, labour, and physical capital. The price of deposits (w_1) is defined as the ratio of interest expense scaled by total deposits, the price of labour is calculated by dividing personnel expense to total assets (w_2)[13], and the price of physical capital (w_3) is proxied by the ratio of noninterest expense other than personnel expense to fixed assets.

12.4.2.2. Risk Variables

We utilize four different metrics to capture the variation in the risk-taking strategies of banks. The first two concern individual bank risk-taking, whereas the other two measure risk at a country level. In particular, the ratio of loan loss provisions to total loans is used to proxy credit risk (*crdrisk*); the ratio of liquid to total assets measures liquidity risk (*lqdrisk*); the one-year standard deviation of the day-to-day interbank rate captures interest rate risk (*intrisk*); and, lastly, insolvency risk (*inslrisk*) is measured with the Z-score computed as follows:

$$Z_{jt} = \frac{(\overline{ROA}_{ijt} + \overline{TE_{ijt}/TA_{ijt}})}{\sigma(ROA_{ijt})}$$

where $\overline{ROA}$ stands for the average Return On Assets calculated by the mean ratio of variable profits (Pr_{ijt}) to total assets (TA_{ijt}), and TE_{ijt}/TA_{ijt}) is the mean ratio of equity to total assets[14]. Z-score combines three elements of bank risk and is inversely related to the probability of failure. By taking average values, we measure the z-score of the typical bank in each country at every sample year.

12.4.2.3. Environmental and Control Variables

With the purpose of enhancing the comparability of bank performance across the groups of old and new EU member states, we select a set of variables that capture a number of bank- and country-level differences. In specific, these variables account for the level of bank regulation and supervision, the quality of governance and the degree of institutional development, the structure of the banking

13 We recognize that dividing personnel expense by the total number of employees instead of total assets would produce a rather more accurate measure of the unit price of labour. Nevertheless, due to a paucity of data on the number of employees in the Bankscope database, such an approach would result in the loss of a large number of observations.

14 The definition of profits (Pr_{ijt}) differs between the restricted and the unrestricted model specifications (see Section 12.5.3 below). As a result we obtain two different Z-scores, one for each specification.

market, the macroeconomic conditions, the technological advances and the size of the sample banks.

To start with, we construct five indices that describe the regulatory and supervisory environment of the banking sectors under examination[15]. The first one is the activity restrictions index (*restr*) that measures the degree to which banks are free to engage in securities, insurance and real estate activities as well as the extent to which banks may own and control nonfinancial firms. This index takes values between 4 and 16, with higher scores indicating a less liberalized banking environment, where banks are prevented from diversifying their product offerings.

Moreover, we construct the capital regulatory index (*capreg*) that considers: a) the stringency of regulatory requirements concerning the amount of capital that banks must hold, b) the extent to which banks are allowed to include assets other than cash, government securities, or borrowed funds in their initial regulatory capital, and c) whether authorities confirm the sources of capital. This index ranges from 0 to 8, with larger values signifying greater capital stringency. Yet, the relationship that holds between capital and risk is rather vague. On the one hand, capital serves as a safety net for banks especially in periods of increased uncertainty. Under this scenario, better capitalized banks are expected to be less fragile. On the other hand, more stringent capital regulations are associated with reduced banks' rents, since banks are forced to supply fewer loans. To hedge losses, banks may engage in riskier activities.

The third index is the private monitoring index (*prvmon*) that measures the degree to which supervisory authorities encourage private-sector oversight of banks and is calculated according to the following qualitative criteria: a) whether banks are required to obtain outside licensed audits and/or ratings by internationally credit-ratings agencies, b) whether an explicit deposit insurance scheme is imposed, c) whether banks are required to disclose accurate information to the public by producing consolidated accounts that cover the whole range of their activities and risk-management procedures, and, finally, d) whether bank directors are legally liable for erroneous/misleading information. This index varies from 0 to 9, where higher values implying more private monitoring. Again, there exist contradictory views in the literature regarding the role of private sector in bank monitoring. Some assert that private monitoring agencies operate more reliably and efficiently than official supervisory authorities mainly because they are not influenced by political or similar pressures, whereas others provide support to the supervisory role of public authorities.

Finally, the quality characteristics of bank supervision are proxied by two different indices: the first is the official supervisory power index (*suprvpower*), which

[15] The exact survey questions used for the construction of each index as well as the scoring system followed are that of Barth *et al.* (2004).

measures the extent to which supervisory authorities have the power to intervene in the banking system. This index has a minimum value of 0 and a maximum value of 14, with 14 being the highest level of supervisory power. The second is the supervisory forbearance discretion index (*forbdiscr*) that shows the degree to which authorities is likely to engage in forbearance in cases banks behave imprudently. It takes values from 0 to 4, with higher values indicating greater discretion. Whereas strong supervisors can undertake specific actions against the vulnerabilities of the system (market failures, asymmetric information, excessive risk-taking) that will potentially improve bank performance, at the same time, it is easier for a powerful authority to benefit favoured constituents thus undermining competition and interrupting the development of the banking sector. Accordingly, the influence of supervisory power on the operation of banking system is rather contradictory.

To proxy the overall level of institutional development and the quality of governance we construct the KKZ index, which is the simple average of the following six indicators: voice-accountability, political stability, governance effectiveness, regulatory quality, rule of law, and control of corruption. Higher values of the KKZ index indicate a more developed institutional framework[16].

An important determinant of bank performance is market structure, which is strongly related to the degree of competition. We measure the degree of market concentration with the 5-bank concentration ratio (*c5*), *i.e.*, the sum of assets of the five largest banks divided by the value of total banking system assets[17].

It is widely accepted that the demand and supply of banking services are seriously affected by economic performance. More precisely, high levels of banking activity are generally related to favourable economic conditions. We thus include real GDP growth rate (*GDPgr*) to control for differences in the level of economic development and also proxy the degree of bank activity.

According to the conventional wisdom big banks are heavily involved in non-traditional activities. We thus employ the log of TA in the model to capture the non-linear effect of bank size on performance. The inclusion of a size variable (*size*) is also essential since a strong scale bias might be produced making large banks more efficient than small banks, if otherwise.

Finally, technological changes over time are captured by a linear time trend (t) as well as its squared root (t^2) since the model used follows a second order approximation (see Lensink *et al.* (2008)).

16 Since no values are reported for 2001 for any of these six indicators, we use the mean average of 2000 and 2002 to proxy KKZ for this particular year.

17 Concentration ratios for Austria and Ireland are not available in the Barth et al (2001, 2008) databases and are therefore computed using data from Bankscope.

12.5. Empirical Analysis

12.5.1. Cost and Profit Efficiency Frontiers

The Battese and Coelli (1995) model that we use to estimate bank efficiency relies on the Stochastic Frontier Analysis (SFA) of Aigner *et al.* (1977). SFA is commonly represented by two-stage parametric models: in the first stage the stochastic frontier production function is specified and estimated together with technical efficiency; in the second stage efficiency estimates are regressed against a set of environmental variables to test whether these variables have an effect on efficiency levels. However, as Wang and Schmidt (2002) point out, parametric two-step approaches produce biased coefficients for the reason that the assumptions made in the first step concerning the distribution of the inefficiency term are violated in the second[18]. The Battese and Coelli model avoids the pitfalls present in the standard SFA by estimating bank efficiency and its determinants in a one-step process. To clarify, efficiency scores are drawn from an *ex ante* specified functional form and regressed on a vector of bank- and country-specific variables in a single step. An additional advantage of the model is that it can be estimated for an unbalanced panel data set, which enhances the number of observations and thus the reliability of the empirical outcome.

Both cost and profit specifications of the Battese and Coelli model are employed in our analysis. Regarding cost efficiency, it refers to technical and allocative efficiency and is defined on the basis of how close the actual cost of a sample bank is to the cost of the best-practice bank, according to which the cost efficiency frontier is determined. Using longitudinal data the model specifies a stochastic global cost frontier of the following general form:

$$\ln C_{ijt} = C(y_{ijt}, w_{ijt}, q_{ijt}; \beta) + v_{ijt} + u_{ijt} \tag{1}$$

where C_{ijt} is the observed variable cost that bank i ($i = 1, 2, \ldots, N$) faces in country j ($j = 1, 2, \ldots, K$) at time t ($t = 1, 2, \ldots, T$); y_{ijt} denotes the vector of output quantities for bank i in country j at time t; w_{ijt} denotes the vector of input prices for bank i in country j at time t; q_{ijt} is the vector of risk variables that influence bank efficiency; β is a vector of all unknown parameters to be estimated; v_{ijt} stands for the random error term that is assumed to be *i.i.d.* $N(0, \sigma_v^2)$, and independent of the term $u_{ijt} \geq 0$ that accounts for technical and/or allocative inefficiency in production and is imposed to be non-negative (as higher level of inefficiency is associated with higher cost); moreover, u_{ijt} is independently but not identically distributed, such that it is obtained by truncation at zero of the normal

[18] In the first stage typical SFA assumes that the inefficiency component of the error term has a truncated-normal distribution. This assumption is vitiated in the second stage, where a normal distribution is assumed instead.

distribution with mean m_{ijt} equal to $z_{ijt}\delta$, and variance σ_u^2, *i.e.* $u_{ijt} \sim N(z_{ijt}\delta, \sigma_u^2)$ [19]. The term z_{ijt} represents the vector of explanatory variables that affect the inefficiency of bank i of country j at t and δ is the vector of the unknown coefficients to be estimated that also includes an intercept term[20]. The inefficiency term can therefore be written as follows:

$$u_{ijt} = z_{ijt}\delta + w_{ijt} \qquad (2)$$

where w_{ijt} is defined by the truncation of the normal distribution with zero mean and variance σ^2, such that the point of truncation is $-z_{ijt}\delta$, and because $u_{ijt} \geq 0$, we obtain that $w_{ijt} \geq -z_{ijt}\delta$.

The stochastic cost frontier (1) and the model for the inefficiency term (2) are simultaneously estimated using the maximum likelihood method. The likelihood function is expressed in terms of the variance parameters, that is, $\sigma^2 = \sigma_v^2 + \sigma_u^2$ and $\gamma = \sigma_u^2/(\sigma_v^2 + \sigma_u^2)$. The cost inefficiency score for an individual bank i in country j at the t-th observation is obtained as $Costineff_{ijt} = \exp(u_{ijt})$, and takes values between unity and infinity. To stay in line with bank performance literature that measures efficiency rather than inefficiency scores, we calculate $CEFF_{ijt} = (Costineff_{ijt})^{-1}$, which produces the cost efficiency score for bank I in country j at time t. Values closer to unity correspond to higher efficiency.

While cost efficiency has been almost monopolized the interest of bank performance evaluation literature, profit efficiency might be of equal or even greater importance if compared with its cost counterpart as it combines both the cost and revenue sides of banking operation[21]. Profit efficiency measures the extent to which the profits of a sample bank fall below the profits of the best practice bank. Literature (*e.g.* Rogers (1998); Stiroh (2000); Clark and Siems (2002)) estimates profit efficiency utilizing the so-called alternative profit function, which takes input and output quantities as given for banks letting output prices to vary. This non-standard approach is also preferred in the current study for a couple of reasons. First, in the standard profit function output prices are exogenously given implying that banks have no market power in the pricing of their output. However, empirical evidence shows that, notwithstanding the fact that deregulation has increased the degree of competition in the financial sector of the economy, banks still do not operate under perfectly competitive conditions[22]. This provides support to the use of the alternative profit function that allows banks to have

19 The truncation at zero safeguards that the costs of the best-practice bank are always lower than those of the best-practice bank.

20 As Battese and Coelli (1995) note, *"not including an intercept parameter may result in the estimators of δ-parameters associated with the z-variables being biased and the shape of the distribution of the inefficiency effects, u_{ijt}, being unnecessarily restricted"*.

21 Berger and Mester (1997) characteristically argue that *"profit efficiency is superior to the cost efficiency concept for evaluating the overall performance of the firm"*.

22 See *e.g.* the study of Bikker and Haaf (2002) that evaluates competitive conditions and market structure in the banking sectors of 23 industrialized countries including those of the EU-15.

control over the output prices. Second, literature reports a serious lack of output price data, which are necessary for the standard profit function approach to be implemented. This is also the case for the current study, since it is not possible to calculate the prices of non-traditional output for which only income information is available. Overall, the alternative profit specification seems to be much more attractive.

The empirical procedure that we follow in the estimation of profit efficiency is essentially the same with that discussed above for cost efficiency, except that we replace variable cost (C_{ijt}) with variable profit (Pr_{ijt}) in Eq. 1 and transform the dependent variable to $\ln[Pr_{ijt} + |\min(Pr_{ijt})| + 1]$, where $|\min(Pr_{ijt})|$ represents the absolute minimum value of profit over all sample banks. This transformation safeguards that, in case there are banks in the sample that report losses, the natural logarithm is taken of a positive value. Moreover, the sign of the inefficiency term of the profit function now turns into negative thus obtaining the profit efficiency score for an individual bank *i* in country *j* at time *t* as $PREFF_{ijt} = \exp(-u_{ijt})$. $PREFF_{ijt}$ takes values from zero to one, with unity being the highest score achieved by the best-practice bank.

The cost (profit) function is specified as a standard translog specification. Therefore Eq. (1) can be written as follows[23]:

$$\ln\left(\frac{C_{ijt}}{w_{2,ijt}}\right) =$$

$$a_0 + \sum_{m=1}^{3} a_m \ln\left(\frac{w_{m,ijt}}{w_{2,ijt}}\right) + \sum_{m=1}^{3} \beta_s \ln y_{s,ijt} + \frac{1}{2}\sum_{m=1}^{3}\sum_{m=1}^{3} a_{mh} \ln\left(\frac{w_{m,ijt}}{w_{2,ijt}}\right) \ln\left(\frac{w_{h,ijt}}{w_{2,ijt}}\right)$$

$$+ \frac{1}{2}\sum_{s=1}^{3}\sum_{p=1}^{3} \beta_{sp} \ln y_{s,ijt} y_{p,ijt} + \sum_{m=1}^{3}\sum_{m=1}^{3} \gamma_{ms} \ln\left(\frac{w_{m,ijt}}{w_{2,ijt}}\right) \ln y_{s,ijt}$$

$$+ \phi_1 crdrisk_{ijt} + \phi_2 lqdrisk_{ijt} + \phi_3 inslrisk_{ijt} + \phi_4 intrisk_{ijt} + u_{ijt} + v_{ijt} \qquad (3)$$

where the inefficiency term u_{ijt} is defined by

$$\begin{aligned} u_{ijt} = {} & \delta_0 + \delta_1 restr + \delta_2 capreg + \delta_3 prvmon + \delta_4 \sup rvpower \\ & + \delta_5 forbdiscr + \delta_6 KKZ + \delta_7 c5 + \delta_8 GDPgr + \delta_9 size \\ & + \delta_{10} t + \delta_{11} t^2 + w_{ijt} \end{aligned} \qquad (4)$$

23 This model refers to the restricted cost model as the cost function contains only traditional bank outputs. The extension to the unrestricted models is straightforward. (For the distinction between the restricted and the unrestricted models see Section 12.5.2 that follows).

In Eq. (3), the restrictions of symmetry of the second order parameters are imposed, *i.e.* $\alpha_{mh} = \alpha_{hm}$ and $\beta_{sp} = \beta_{ps}$. Also, the dependent variable and all input prices are scaled by one price (here we arbitrarily choose w_2) in order to guarantee linear homogeneity in prices. Thus, the sum of the coefficients of input prices equals to 1, *i.e.* $\sum_{m=1}^{3} a_m = 1$. The basic model that is estimated in a single-step by using maximum likelihood consists of Eqs. (3) and (4).

12.5.2. Restricted and Unrestricted Models

As already said, we use two different frontier specifications: one that relies on the cost function and one that relies on the alternative profit function. Across the two specifications, three separate models are estimated to test for the significance of output diversification on bank performance. The first model is the restricted model that includes only traditional banking products in its output vector. The second (which we call unrestricted model A) also considers modern banking activities by augmenting the output vector with noninterest income. The third model (labeled unrestricted model B) differs from A in that it proxies output diversification not with noninterest income, but with OBS items. A comparison of the findings of the three models is expected to lead to a robust view of the importance of diversified products on bank performance and risk.

12.5.3. Cost and Profit Definitions

The definition of variable cost (C_{ijt}) depends on the vector of inputs used that remains unaltered across the restricted and the unrestricted model specifications. Thus C_{ijt} is computed by adding interest with noninterest expense. On the other hand, the way variable profit (Pr_{ijt}) is defined differs between the two model specifications depending on the income-generating activities of banks. More specifically, in the case of the restricted model where the output vector consists solely of traditional bank products that create interest income, profit is equal to interest income less the variable cost defined above. Yet, in the case of the unrestricted models (A and B), profit is calculated as the sum of interest income and noninterest income (which is mainly produced by non-traditional banking activities) less cost.

12.6. EMPIRICAL RESULTS

12.6.1. Efficiency Estimates

Tables 2 and 3 report the mean cost and profit efficiency scores for the traditional EU-15 countries and for the 12 New Member States (NMS). Apparently, the banking systems of the first group of countries operate more efficiently in both cost and profit terms (see restricted models). This superiority is further verified when noninterest income is included in the output vector (see unrestricted models A in Tables 2 and 3). In particular, cost efficiency is augmented by approximately 10% for EU-15 and by 7% for NMS. In similar vein, profit efficiency estimates increase by 15% in the case of EU-15 and by 13% in the case of NMS. On the contrary, almost no change is reported in the efficiency levels when OBS items are considered instead of noninterest income (see unrestricted models B in Tables 2 and 3). This might be evidence that the nominal value of OBS activities is a rather poor proxy of diversified banking products.

We test the statistical significance of the observed differences in efficiency scores between the restricted and the unrestricted model A of both cost and profit functions by conducting the non-parametric Wilcoxon signed-rank test. It turns out that the p-value of the Wilcoxon t-statistic is below.05 in all cases, which indicates that the mean scores obtained from the restricted models are statistically lower than the ones obtained from the unrestricted models A[24].

12.6.2. Output Diversification and Risk-taking

Let us now turn to analyze the performance of risk variables. Tables 4, 5, 6, and 7 document a negative and significant relationship between cost and profit efficiencies with all four measures of risk. In fact, this relationship remains unchanged across the restricted and the unrestricted model specifications. This finding suggests that output diversification does not affect the risk-taking behaviour of banks.

More analytically, our results reveal that more efficient banks perform a lower credit risk. This implies that banks should focus more on credit risk management, which has proved problematic in the recent past. Serious banking problems have arisen from the failure of banks to recognize impaired assets and create reserves for writing off these assets. A considerable help toward smoothing these anomalies would be provided by improving the transparency of the financial systems,

[24] Using the parametric t-statistic we reach the same conclusion.

which in turn would assist banks to evaluate credit risk more effectively and avoid problems associated with hazardous exposure.

Concerning liquidity risk, it has also a negative sign showing that increased liquidity leads to higher efficiency levels. This finding is rather expected as banks have been traditionally solving their liquidity problem by holding cash together with a considerable amount of short-term government securities that they could sell for cash. As regards interest rate risk and insolvency risk, they are also found to significantly reduce cost and profit efficiencies.

All in all, the estimation results suggest that higher levels of risk aversion are related to increased levels of efficiency. And, more importantly, this behavioral pattern is not influenced by the inclusion of non-traditional items in the model since the signs of all risk coefficients remain unaltered across the different model specifications.

12.6.3. How the Environment Affects Bank Efficiency

Results (Tables 4, 5, 6, and 7) confirm the effectiveness of regulatory policies for increasing bank efficiency. Indeed, looser restrictions on bank activities combined with more stringent capital regulations, higher degree of private monitoring and powerful supervisory authorities boost the efficiency of the EU banking sectors. Furthermore, the KKZ index has a significantly positive effect on the dependent variable in all models showing that developed institutional environments are positively associated with cost and profit efficiencies. We interpret these results as suggesting that bank regulations and high-quality governance are both necessary and sufficient conditions for banking systems to operate in high efficiency levels.

To continue, the most efficient banking sectors are those with higher market concentration. Moreover, economic development boosts efficiency since a statistically significant positive link between real GDP growth and efficiency is documented. This latter finding implies that an increase in GDP leads to lower total costs and higher profits. An explanation for this could be that the more prosperous countries become, the better access to new technologies their banks acquire. Banks are thus able to produce more output using less input. This is supported to a great extent by the finding that technological advances (captured by t and t^2) have a positive impact on cost and profit efficiencies. Finally, we report a positive relationship between bank size and efficiency, which shows that larger banks – that are highly involved in non-traditional activities – operate more efficiently.

12.7. CONCLUSION

In this study we examined the effect of output diversification on the performance of the European banking systems utilizing cost and profit efficiencies as well as the risk-taking behaviour of banks as alternative performance measures. To assess the degree of harmonization in the entire European banking market, we compared the performance of the 15 old EU member states with that of the 12 recently acceded EU countries. To make comparisons meaningful, we relied upon the technique of Battese and Coelli (1995), which allows the estimation of the frontier and of the determinants of efficiency in a single-stage. A number of sophisticated variables that account for environmental differences were also taken into account in our econometric analysis.

A rather uniform impact of output diversification on the performance of the EU banking sectors is documented: on average, cost and profit efficiency margins are enlarged, while the risk-taking behaviour of European banks is not critically altered. Concerning environment, it plays an essential role in bank efficiency: greater market openness combined with stricter capital regulations and stronger supervision positively affect efficiency. Economic development and technological progress are also found to increase efficiency levels. Most notably, the involvement of banks in diversified product offerings has no considerable impact on the aforementioned trends.

On the whole, the banking sectors of both old and new EU member states are found to follow very similar behavioural patterns, which are not significantly influenced by output diversification. This finding might suggest that the banking markets in the EU are highly harmonized, thus paving the way for further research.

12.8. REFERENCES

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12.9. APPENDIX

Table 1: Descriptive Statistics

Variable Country	w1	w2	w3	y1 (th EUROS)	y2 (th EUROS)	y3 (th EUROS)	y4 (th EUROS)	y5 (th EUROS)	crdrisk	lqdrisk	intrisk	Z-score (restricted model)	*Z-score* (unrestricted models)	restr	capreg	prvmon	suprvpower	forbdiscr	c5	KKZ
Austria	0,049	0,022	5,524	3.703.931	3.011.302	4.645.903	80.098	1.285.564	0,046	0,161	0,313	1,85	5,55	7,00	6,50	5,00	11,50	2,50	0,91	1,62
	0,097	0,034	16,612	14.238.607	11.617.482	18.578.617	317.523	5.270.219	0,401	0,169	0,193	0,21	1,48	0,00	1,50	0,00	1,50	0,50	0,02	0,03
Belgium	0,034	0,018	3,031	1.038.242	1.492.207	2.167.644	27.174	1.756.660	-0,003	0,299	0,313	2,70	4,37	8,00	3,50	6,00	10,50	2,50	0,90	1,41
	0,032	0,025	5,030	1.439.891	1.564.794	2.019.505	22.392	1.791.785	0,085	0,272	0,193	0,58	1,22	1,00	0,50	0,00	0,50	0,50	0,02	0,06
Bulgaria	0,042	0,019	0,334	202.289	125.883	291.367	6.620	58.505	0,013	0,193	0,473	11,22	11,65	9,50	7,00	6,00	11,00	1,50	0,55	0,22
	0,067	0,013	0,355	318.676	175.768	405.891	8.142	114.138	0,022	0,124	0,263	3,53	2,66	0,50	0,00	0,00	0,00	0,50	0,01	0,03
Cyprus	0,063	0,016	0,634	2.931.669	1.561.228	4.079.230	58.932	664.183	0,021	0,208	0,378	6,51	6,48	11,0	6,00	7,00	10,00	2,00	0,78	0,94
	0,048	0,009	0,855	4.128.615	2.233.871	5.623.132	95.597	1.107.372	0,040	0,165	0,270	5,52	4,32	0,00	1,01	0,00	2,02	1,01	0,11	0,04
Czech Republic	0,056	0,009	1,273	1.993.646	2.804.895	3.959.701	82.390	1.217.049	0,005	0,183	0,302	6,47	9,53	12,0	6,50	6,50	8,99	1,50	0,67	0,78
	0,079	0,007	1,933	3.081.868	4.077.746	5.899.269	125.190	1.929.610	0,019	0,167	0,190	1,25	2,96	0,00	0,50	0,50	1,00	0,50	0,02	0,07
Denmark	0,078	0,020	3,959	4.044.638	2.079.921	3.251.139	27.384	987.824	0,006	0,201	0,351	8,70	11,79	9,50	5,00	6,50	9,50	1,50	0,86	1,81
	0,515	0,011	17,711	22.187.841	11.786.042	17.630.707	120.713	5.005.258	0,010	0,184	0,242	1,68	2,89	0,50	1,00	0,50	0,50	0,50	0,04	0,04
Estonia	0,029	0,016	1,038	2.199.664	472.609	1.995.328	47.360	255.028	0,007	0,166	0,373	12,58	18,06	6,50	4,00	6,50	13,50	2,50	0,98	0,99
	0,012	0,007	0,909	3.528.314	701.851	2.552.468	61.789	275.778	0,013	0,154	0,271	11,16	11,19	1,52	1,02	0,51	0,51	0,51	0,00	0,07
Finland	0,058	0,006	3,686	23.695.132	27.318.381	25.072.267	535.548	9.459.400	0,000	0,113	0,313	16,49	47,46	8,50	4,50	7,00	7,50	1,50	0,99	1,90
	0,049	0,002	1,995	17.518.430	30.753.117	22.692.731	346.642	7.482.499	0,001	0,116	0,197	9,35	12,28	0,51	0,51	1,02	1,53	0,51	0,00	0,04
France	0,109	0,019	4,397	2.986.370	5.013.420	4.287.181	122.578	2.973.744	0,006	0,166	0,312	3,43	4,64	7,50	5,49	5,50	7,50	2,00	0,62	1,21
	0,615	0,018	28,341	18.914.109	38.654.142	25.732.348	708.116	17.740.407	0,059	0,184	0,193	0,58	0,94	1,50	2,50	0,50	0,50	1,00	0,02	0,03
Germany	0,038	0,018	4,847	6.917.108	7.225.941	8.808.582	134.782	38.382.512	0,587	0,321	0,313	2,82	3,82	7,00	5,50	5,50	8,50	3,50	0,46	1,54
	0,036	0,019	21,735	35.343.645	37.132.941	40.530.828	570.153	341.240.689	4,039	0,252	0,193	0,54	1,15	0,00	0,50	0,50	0,50	0,50	0,26	0,06
Greece	0,024	0,017	0,873	7.985.242	2.429.355	8.575.930	118.966	3.786.583	0,012	0,074	0,306	8,97	11,23	9,04	4,56	6,48	11,04	2,52	0,70	0,74
	0,008	0,005	0,615	9.152.725	3.032.894	9.141.745	133.859	5.765.811	0,009	0,051	0,191	6,25	7,40	1,01	1,51	0,50	1,01	0,50	0,04	0,07
Hungary	0,051	0,023	1,288	2.720.031	1.109.920	3.270.210	106.670	1.344.984	0,006	0,065	0,891	6,02	12,31	11,0	6,00	6,00	14,00	2,00	0,63	0,89
	0,018	0,022	1,336	2.784.696	1.263.395	3.150.040	140.684	832.344	0,006	0,058	0,584	2,87	4,34	0,00	2,01	1,01	0,00	1,01	0,00	0,05
Ireland	0,053	0,003	2,925	11.536.263	8.729.858	11.009.977	185.612	3.048.782	0,002	0,182	0,313	8,65	15,96	7,00	2,50	6,50	11,50	3,50	0,88	1,54
	0,048	0,003	5,640	26.051.178	13.293.232	21.064.691	349.440	8.168.498	0,010	0,139	0,194	5,89	6,47	0,00	0,50	0,50	0,50	0,50	0,06	0,04

Variable Country	w1	w2	w3	y1 (th EUROS)	y2 (th EUROS)	y3 (th EUROS)	y4 (th EUROS)	y5 (th EUROS)	crdrisk	lqdrisk	intrisk	Z-score (restricted model)	*Z-score* (unrestricted models)	restr	capreg	prvmon	suprvpower	forbdiscr	c5	KKZ
Italy	0,035	0,017	8,309	4.326.072	1.572.623	3.994.180	146.238	829.270	0,007	0,110	0,313	2,87	10,09	11,0	4,00	5,50	7,00	2,00	0,54	0,75
	0,039	0,011	31,433	6.919.236	2.472.527	6.989.780	222.629	1.837.452	0,011	0,203	0,193	0,63	1,54	1,00	0,00	0,50	0,00	0,00	0,03	0,12
Latvia	0,023	0,014	0,896	450.807	204.970	550.406	13.614	79.414	-0,011	0,147	0,618	11,22	12,14	7,50	5,50	7,00	11,51	3,50	0,67	0,65
	0,019	0,007	0,896	729.327	237.822	667.580	17.080	128.094	0,176	0,158	0,781	1,12	4,49	0,50	0,50	0,00	1,51	0,50	0,01	0,09
Lithuania	0,027	0,018	0,704	818.786	245.656	836.781	19.134	201.757	0,008	0,150	0,682	8,88	14,04	9,50	3,50	6,00	12,50	1,50	0,85	0,71
	0,012	0,010	0,545	1.201.393	296.538	953.985	22.648	376.262	0,014	0,107	0,622	1,75	1,91	1,51	0,50	1,01	1,51	0,50	0,03	0,10
Luxemb.	0,053	0,006	4,232	1.483.681	4.661.632	5.313.658	56.964	1.012.207	-0,016	0,436	0,313	3,42	5,54	7,50	6,00	6,50	11,50	3,00	0,29	1,82
	0,058	0,007	12,639	2.854.768	7.009.354	8.175.933	100.141	2.433.807	0,363	0,263	0,193	1,27	1,06	1,50	0,00	0,50	1,50	1,00	0,02	0,05
Malta	0,031	0,011	0,494	931.292	816.086	1.654.912	15.741	417.804	0,005	0,203	0,156	24,84	28,09	10,5	6,00	7,00	14,00	2,50	0,63	1,24
	0,009	0,005	0,455	947.253	815.012	1.592.971	16.474	402.047	0,008	0,172	0,090	28,69	8,62	0,51	0,00	0,00	0,00	0,51	0,21	0,05
Netherl.	0,062	0,010	2,774	18.635.144	18.073.921	25.017.601	355.715	8.244.625	-0,005	0,346	0,312	8,45	10,81	6,00	5,50	6,50	5,99	1,50	0,89	1,72
	0,071	0,008	5,911	67.849.837	75.969.274	97.466.569	1.332.398	32.147.393	0,076	0,215	0,194	4,84	4,41	0,00	0,50	0,50	1,00	0,50	0,01	0,07
Poland	0,054	0,017	7,532	678.350	630.036	1.071.462	40.253	1.489.296	0,013	0,092	0,840	5,32	5,30	7,50	4,50	6,00	8,50	2,00	0,53	0,57
	0,036	0,017	14,609	1.075.103	992.506	1.571.892	79.978	3.970.820	0,029	0,115	0,562	2,63	2,31	0,50	1,50	0,00	0,50	1,00	0,04	0,08
Portugal	0,053	0,010	1,472	19.881.245	7.648.750	17.551.821	445.088	10.215.965	0,003	0,087	0,313	14,90	19,49	11,0	6,50	5,50	14,00	4,00	0,83	1,16
	0,024	0,004	1,177	20.966.003	6.226.680	17.539.112	401.294	9.226.300	0,002	0,099	0,196	3,27	6,65	1,02	0,51	0,51	0,00	0,00	0,04	0,10
Romania	0,062	0,030	1,232	310.241	161.665	493.517	16.322	97.371	0,016	0,141	3,826	6,11	6,96	11,5	4,99	5,00	9,00	1,50	0,62	0,01
	0,044	0,018	1,804	622.491	370.424	921.528	29.666	170.978	0,035	0,143	3,507	3,21	3,06	0,50	1,00	0,00	0,00	0,50	0,03	0,07
Slovakia	0,037	0,012	0,780	682.228	804.806	1.333.866	21.469	309.976	0,006	0,173	0,478	10,15	10,57	10,5	5,00	5,00	13,50	1,00	0,67	0,66
	0,019	0,003	0,574	737.051	1.058.216	1.490.456	25.596	415.452	0,019	0,131	0,309	5,02	4,28	0,50	2,01	0,00	0,50	0,00	0,00	0,11
Slovenia	0,045	0,013	0,786	1.150.416	693.494	1.333.733	31.394	414.054	0,012	0,063	0,522	7,61	9,67	10,5	6,50	7,00	12,50	1,00	0,66	0,95
	0,015	0,003	0,734	1.543.644	862.459	1.634.236	38.197	441.536	0,014	0,065	0,285	2,42	3,59	0,50	1,51	0,00	0,50	0,00	0,03	0,04
Spain	0,039	0,016	0,679	30.096.968	13.626.555	29.122.657	624.731	11.714.345	0,042	0,070	0,313	8,31	8,15	6,50	8,00	6,50	10,00	1,38	0,53	1,15
	0,048	0,018	0,861	84.836.369	43.618.477	83.167.259	1.753.025	31.654.500	0,390	0,090	0,193	5,15	2,59	0,50	0,00	0,50	1,00	0,49	0,00	0,15
Sweden	0,024	0,013	5,450	10.795.688	6.181.605	10.452.125	167.453	14.014.274	0,002	0,092	0,283	19,69	15,32	9,00	2,50	6,00	6,50	4,00	0,79	1,76
	0,017	0,005	17,735	28.217.887	18.615.563	27.812.216	469.611	51.087.978	0,007	0,071	0,119	4,51	4,34	1,00	0,50	0,00	1,51	0,00	0,17	0,04
UK	0,048	0,012	7,079	22.752.626	21.272.241	27.032.567	514.425	12.072.014	0,007	0,289	0,262	8,49	6,95	4,50	5,50	6,50	9,51	4,00	0,45	1,56
	0,062	0,010	43,120	87.285.340	101.097.547	108.085.544	2.027.677	51.140.839	0,021	0,264	0,164	1,16	0,66	0,50	0,50	0,50	1,50	0,00	0,22	0,06

Note: For each country, the first number is the mean and the second is the standard deviation of the variable.

Table 2: Cost Efficiency Estimates

Model specification	Restricted		Unrestricted A *(incl. noninterest income)*		Unrestricted B *(incl. OBS activities)*	
	EU-15	12 NMS	EU-15	12 NMS	EU-15	12 NMS
Mean efficiency scores	0.69	0.64	0.79	0.71	0.70	0.63

Table 3: Profit Efficiency Estimates

Model specification	Restricted		Unrestricted A *(incl. noninterest income)*		Unrestricted B *(incl. OBS activities)*	
	EU-15	12 NMS	EU-15	12 NMS	EU-15	12 NMS
Mean efficiency scores	0.72	0.66	0.87	0.79	0.73	0.66

Table 4: Cost Function, EU-15

Model specification	Restricted	Unrestricted A *(incl. noninterest income)*	Unrestricted B *(incl. OBS activities)*
constant	1.593*** (.0059)	1.944*** (.066)	1.622*** (.064)
$ln(w_1/w_2)$	.617*** (.0088)	.679*** (.0095)	.611*** (.0077)
$ln(w_3/w_2)$	.345** (.164)	.399** (.201)	.331** (.158)
$ln(y_1)$	.475*** (.0077)	.424*** (.0081)	.471*** (.0081)
$ln(y_2)$	.503** (.248)	.444** (.223)	.504** (.251)
$ln(y_3)$	.654*** (.0087)	.728*** (.0090)	.643*** (.0064)
$ln(y_4)$		.109*** (.0096)	
$ln(y_5)$			.0017 (.0051)
crdrisk	-1.186*** (.0297)	-1.075*** (.0176)	-1.162** (.574)
lqdrisk	-3.696*** (.5467)	-2.774*** (.4832)	-3.189** (1.513)
inslrisk	-2.437*** (.4358)	-1.873*** (.3295)	-2.264*** (.4133)
intrisk	-8.176*** (.377)	-7.700*** (.514)	-9.112* (4.982)
restr	-2.785*** (.3569)	-2.999*** (.3457)	-3.205*** (.4358)
capreg	.768** (.350)	.987** (.460)	1.086** (.5086)

Model specification	Restricted	Unrestricted A *(incl. noninterest income)*	Unrestricted B *(incl. OBS activities)*
prvmon	.335***	.247***	.294***
	(.0178)	(.0112)	(.0143)
superpower	1.765**	2.893**	2.341**
	(.824)	(1.390)	(1.183)
forbdiscr	.435	.789	.276*
	(.3210)	(.5542)	(.1409)
KKZ index	.180***	.132***	.239***
	(.0893)	(.0631)	(.0254)
C5	.607***	.523***	.584***
	(.0488)	(.0299)	(.0377)
real GDP growth rate	.896***	.818***	.716***
	(.060)	(.061)	(.067)
size	.189***	.193**	.276***
	(.086)	(.081)	(.0943)
t	.131**	.090**	.110**
	(.0592)	(.0431)	(.0530)
t^2	.285**	.201***	.145**
	(.1427)	(.0257)	(.068)

*Note: The first number in each cell is the mean and the second is the standard deviation of the variable. Also: ***, **, * correspond to 1%, 5% and 10% level of significance, respectively.*

Table 5: Cost Function, 12 NMS

Model specification	Restricted	Unrestricted A *(incl. noninterest income)*	Unrestricted B *(incl. OBS activities)*
constant	1.789**	2.378***	2.098***
	(.8024)	(.0247)	(.0186)
$ln(w_1/w_2)$	.430***	.499***	.436***
	(.0022)	(.0108)	(.0029)
$ln(w_3/w_2)$	.286**	.345**	.334**
	(.141)	(.139)	(.159)
$ln(y_1)$	.321***	.397***	.654***
	(.0054)	(.0678)	(.1209)
$ln(y_2)$	1.204**	1.498**	1.352**
	(.568)	(.659)	(.661)
$ln(y_3)$	.876***	1.069***	.989***
	(.1986)	(.3429)	(.2361)
$ln(y_4)$		.578***	
		(.201)	
$ln(y_5)$			.0197
			(.0138)
crdrisk	-2.897**	-4.920***	-3.925**
	(1.365)	(.9830)	(1.792)
lqdrisk	-2.734***	-4.528***	-3.852***
	(.4990)	(.8726)	(.6403)
inslrisk	-3.461**	-6.302**	-5.983**
	(1.563)	(3.038)	(2.409)

Model specification	Restricted	Unrestricted A *(incl. noninterest income)*	Unrestricted B *(incl. OBS activities)*
intrisk	-2.960***	-3.946***	-4.720*
	(.6701)	(.8402)	(2.510)
restr	-3.897***	-4.238***	-3.970***
	(1.432)	(1.910)	(1.678)
capreg	.654**	.765**	.704**
	(.3186)	(.3764)	(.3548)
prvmon	.782***	1.099***	.986***
	(.2001)	(.3561)	(.2409)
superpower	1.854**	2.630**	2.132**
	(.8563)	(1.327)	(1.008)
forbdiscr	.997	1.004	1.208
	(.685)	(.7024)	(.8730)
KKZ index	.199***	.231***	.268***
	(.0460)	(.0504)	(.0614)
C5	.753***	.985***	.783***
	(.1405)	(.2540)	(.1976)
real GDP growth rate	.9520***	1.278***	1.097***
	(.2585)	(.4127)	(.3018)
Size	.743***	.859**	.821***
	(.1979)	(.2090)	(.2034)
t	.396**	.679**	.530**
	(.1708)	(.3231)	(.2368)
t^2	1.864**	2.288**	.2063**
	(.898)	(1.087)	(.915)

*Note: The first number in each cell is the mean and the second is the standard deviation of the variable. Also: ***, **, * correspond to 1%, 5% and 10% level of significance, respectively.*

Table 6: Profit Function, EU-15

Model specification	Restricted	Unrestricted A *(incl. noninterest income)*	Unrestricted B *(incl. OBS activities)*
constant	1.678***	2.893***	2.320**
	(.1260)	(.3492)	(1.510)
$ln(w_1/w_2)$	.530***	.674***	.655***
	(.0196)	(.0285)	(.0233)
$ln(w_3/w_2)$	.201**	.297**	.254**
	(.1003)	(.138)	(.119)
$ln(y_1)$	.329***	.401***	.348***
	(.0069)	(.0097)	(.0090)
$ln(y_2)$	.870**	.999**	.876**
	(.432)	(.439)	(.434)
$ln(y_3)$	.762***	.870***	.797***
	(.0333)	(.0431)	(.0390)
$ln(y_4)$		.604***	
		(.0756)	
$ln(y_5)$			.0805
			(.0673)

Model specification	Restricted	Unrestricted A *(incl. noninterest income)*	Unrestricted B *(incl. OBS activities)*
crdrisk	-1.452** (.674)	-1.987*** (.1974)	-1.760* (.973)
lqdrisk	-3.673*** (.7602)	-3.980*** (.8310)	-3.791*** (.7999)
inslrisk	-2.528** (1.243)	-2.896** (1.350)	-2.730** (1.338)
intrisk	-4.672*** (.2407)	-6.520*** (.3510)	-5.672*** (.2890)
restr	-2.845*** (.4320)	-3.563*** (.5620)	-3.133** (1.570)
capreg	.873*** (.1208)	1.093*** (.2204)	1.001*** (.2096)
prvmon	.540*** (.0139)	.762*** (.0247)	.657*** (.0207)
superpower	1.650** (.8304)	1.906** (.8504)	1.784** (.7969)
forbdiscr	.230* (.1401)	.320 (.2541)	.290* (.1598)
KKZ index	.260*** (.0452)	.341*** (.0650)	.328*** (.0586)
C5	.974*** (.1208)	1.891*** (.3096)	1.673*** (.2874)
real GDP growth rate	.769*** (.102)	.980*** (.276)	.853*** (.236)
Size	.340*** (.0410)	.783** (.0894)	.645*** (.0761)
t	.450** (.2243)	.873** (.4382)	.652* (.3631)
t^2	1.320** (.5859)	1.894** (.8575)	1.520** (.7109)

*Note: The first number in each cell is the mean and the second is the standard deviation of the variable. Also: ***, **, * correspond to 1%, 5% and 10% level of significance, respectively.*

Table 7: Profit Function, 12 NMS

Model specification	Restricted	Unrestricted A *(incl. noninterest income)*	Unrestricted B *(incl. OBS activities)*
constant	1.532** (.7301)	2.730*** (.4308)	2.329** (1.1851)
$ln(w_1/w_2)$	.634*** (.0356)	.762*** (.0560)	.719*** (.0521)
$ln(w_3/w_2)$	.263** (.1291)	.355** (.1329)	.298** (.1384)
$ln(y_1)$	.245*** (.0054)	.640*** (.0231)	.903*** (.0563)
$ln(y_2)$	1.250** (.5940)	1.984** (.8623)	1.512** (.7480)

Model specification	**Restricted**	**Unrestricted A** *(incl. noninterest income)*	**Unrestricted B** *(incl. OBS activities)*
ln(y_3)	.659***	.983***	.620***
	(.0320)	(.0536)	(.0382)
ln(y_4)		1.562***	
		(.3901)	
ln(y_5)			1.673
			(.9932)
crdrisk	-1.734**	-2.341***	-1.905**
	(.8404)	(.1620)	(.9199)
lqdrisk	-3.782**	-4.871**	-4.494**
	(1.840)	(2.399)	(2.104)
inslrisk	-2.780***	-3.783***	-2.945***
	(.3401)	(.4567)	(.3767)
intrisk	-4.840**	-9.056***	-6.904**
	(2.356)	(2.316)	(3.473)
restr	-3.103***	-3.999***	-3.867***
	(.5632)	(.6745)	(.6520)
capreg	1.783**	1.984**	1.876**
	(.8212)	(.8309)	(.8278)
prvmon	.578***	.767***	.634***
	(.0145)	(.0290)	(.0198)
superpower	1.235**	1.784**	1.520**
	(.6095)	(.8049)	(.7123)
forbdiscr	1.756	1.983	2.008*
	(1.253)	(1.421)	(1.867)
KKZ index	.278***	.345***	.299***
	(.0490)	(.0734)	(.0600)
C5	1.563***	2.777***	1.967***
	(.2710)	(.4045)	(.3028)
real GDP growth rate	.631***	1.389***	.956***
	(.0890)	(.1113)	(.0988)
Size	.389***	.831**	.774***
	(.0478)	(.1002)	(.0853)
t	1.563**	1.890**	1.783**
	(.7301)	(.8510)	(.8459)
t^2	.903**	1.064**	1.004*
	(.4436)	(.4599)	(.5849)

*Note: The first number in each cell is the mean and the second is the standard deviation of the variable. Also: ***, **, * correspond to 1%, 5% and 10% level of significance, respectively.*

13. The Effect of the Environment on Profit Efficiency of Bank Branches

Mohamed E. Chaffai and Michel Dietsch

13.1. Introduction

The banking efficiency literature presents two peculiarities: (i) it has focused mainly on cost efficiency; (ii) most of works in that field have been devoted to measure the efficiency at the bank level. Concerning the first peculiarity, it has been proved that profitability is a better measure to be considered when the objective is to measure bank performance. Färe *et al.* (2004) provided a recent overview of the empirical literature on profit efficiency and they noticed that profit efficiency is in its 'infancy'. Concerning the second point, among the numerous papers devoted to bank efficiency measurement very few have been devoted to the issue of efficiency at the branch level. Berger *et al.* (1997) have encouraged researchers to consider the efficiency measurement in banking using branch level data; they have also presented an exhaustive literature survey of empirical efficiency studies at the branch level. Moreover, they have noticed that efficiency at the branch level was largely missing. Compared to the empirical banking efficiency literature at the industry level, the literature at the branch bank level is still limited.

Cook and Hababou (2001) have considered a measure of efficiency scores by evaluating both sales and service performance for a sample of 20 Canadian branches; while Conceição *et al.* (2005) have estimated profit efficiency measures of a sample of 57 Portuguese bank branches. In this study these authors have proposed a new methodology to decompose profit inefficiency into technical and allocative inefficiency. To our knowledge, this is the only empirical paper devoted to profit inefficiency at the branch level.

Another important issue addressed in this paper is the link between profit efficiency and environment. Dietsch and Lozano Vivas (2000) find evidence in France and Spain, that environment is an important component while comparing cost inefficiency of banks at the industry level. In their study, the authors show that the introduction of environmental variables, together with macroeconomic, bank structure, and regulation variables in the cost frontier model reduces the cost inefficiency gap between the studied two countries. However, they do not propose any specific measure of the inefficiency related to environment. This paper contributes to this field by showing the environment effect at the branch level. We also propose a measure of environment on technical inefficiency.

The paper is organised as follows. In section 2, we outline the methodology. Section 3 presents the data and the specification of the frontiers. Section 4 discusses the results and section 5 concludes.

13.2. THE METHODOLOGY

Färe and Grosskopf (1997) have emphasized the duality between the profit function and the directional distance function. Their model has been used by Färe *et al.* (2004) to obtain a measure of profit efficiency of US banks and recently by Park and Weber (2005) for Korean banks. These authors used the directional distance function: The first paper decomposes profit technical inefficiency into allocative inefficiency and technical inefficiency while the second focuses on inefficiency changes and productivity changes. In this study we also use the methodology of parametric directional distance function to establish an efficiency measure to bring into consideration the impact of the environment. This methodology has two advantages at least while conducting efficiency at the branch level. Firstly, it allows a simultaneous contraction of the inputs and expansion of the outputs in constructing the efficiency frontier. This is based on the duality between the directional distance function and the profit function (Färe and Weber (2004)). So, this technical inefficiency measure is more complete at the branch level than the restricted measures derived from an input distance function or the output distance function. These two functions are dual to the cost function and revenue function respectively. Secondly, the aggregate inefficiency of the mother bank is the sum of the inefficiencies of the branches (Färe *et al.* (2005)).

13.2.1. The Parametric Directional Distance Function

We consider that each branch uses a vector of inputs $X = (x_1, x_2, \ldots, x_k) \in R_k^+$ to produce a vector of outputs $Y = (y_1, y_2, \ldots, y_p) \in R_p^+$. Let T denotes the production possibilities set of all the combinations of inputs X which can produce the vector Y. We also assume that this set satisfies the familiar regularities conditions[1]. The directional distance function envelop the data in the direction vector $g = (-g_{x,}\ g_y)$ and is defined by:

$$\vec{D}(X, Y; -g_x, g_y) = \underset{\beta}{\mathrm{Max}}\{(X - \beta g_x, Y + \beta g_y) \in T\} \tag{1}$$

The directional distance function is defined by simultaneously expanding the outputs and contracting the inputs in the direction g, which needs to be specified. The scalar b solution of (1) will measure the maximum outputs expansion and input

[1] The set T is non empty and convex. Both outputs and inputs are freely disposable.

contraction technically possible. For any combination of inputs and outputs, profit is maximum when the branch inputs outputs combination is on the frontier $\beta = 0$. If not, $\beta > 0$, the branch could improve profit by improving its technical efficiency in the g-directional vector.

It is important to mention that the measure of inefficiency derived from this model depends on the direction vector g in which the data are projected on the frontier. Two important particular directions vectors should be mentioned. The first direction $g = (0, g_y)$ allows for only output expansion given a level of inputs. This model refers to the output distance function which is dual to the revenue function. The second direction $g = (-g_x, 0)$ allows for input contraction given the level of outputs produced which refers to the input distance function. We retain the direction $g = (-g_x, g_y) = (-1, 1)$ which allows to measure technical efficiency that the branch can reach if it increases its revenues by one Euro and reduces its costs by one Euro.

To estimate the frontier two methods could be used: the non parametric method, which uses the DEA methodology, and the parametric-econometric method. In this paper we chose the latter one to estimate the directional distance function.

The directional distance function should verify the translation property[2] (Chambers *et al.* (1996)). Not all flexible functional forms such as the Translog or the Fourier verify this property. Chambers (1998) has proposed the flexible quadratic functional form. The latter is linear with respect to the parameters. This form has been used in several studies (Färe *et al.* (2005), Park and Weber (2005)), among others. The estimation of the model needs to add linear restrictions to the model parameters in order to verify the translation property. This is the only functional form used in the empirical studies dealing with the directional distance function.

The quadratic directional distance function is:

$$\vec{D}(X, Y; -1, 1) = \alpha_0 + \sum_{j=1}^{p} \alpha_j Y_j + \sum_{h=1}^{k} \gamma_h X_h + \frac{1}{2} \sum_{h=1}^{k} \sum_{h'=1}^{k} \gamma_{hh'} X_h X_{h'} + \frac{1}{2} \sum_{j=1}^{p} \sum_{j'=1}^{p} \alpha_{jj'} Y_j Y_{j'} + \sum_{j=1}^{p} \sum_{h=1}^{k} \eta_{jh} Y_j X_h \tag{2}$$

Two methods are used to estimate the parameters of the directional distance function. The linear programming method of Aigner and Chu (1967) and the stochastic frontier approach. The first method consists in solving the following program for the sample of N branches:

[2] The directional distance function satisfy the translation property if $\vec{D}(X - \alpha g_x, Y + \alpha g_y; -g_x, g_y) = \vec{D}(X, Y; -g_x, g_y) - \alpha$.

$$\operatorname*{Min}_{i} \sum_{i=1}^{N} \vec{D}(X_i, Y_i; -1, 1) \tag{3}$$

subject to:

(i) $\vec{D}(X_i, Y_i; -1, 1) \geq 0$

(ii) $\partial\vec{D}(X_i, Y_i; -1, 1)/\partial Y_i \leq 0$

(iii) $\partial\vec{D}(X_i, Y_i; -1, 1)/\partial X_i \geq 0$

(iv) $\vec{D}(X - \alpha g_x, Y + \alpha g_y; -1, 1) = \vec{D}(X, Y; -1, 1) - \alpha$

The set of restrictions (i) imply that each branch is located on or below the frontier; the restrictions (ii) and (iii) imply the monotony of the directional distance function which should be non increasing in output and non decreasing in inputs, which means that the branch becomes less inefficient when its outputs increase given the level of its inputs, and more inefficient if for a given level of outputs the inputs increase. The translation property of the directional function generates the following set of linear restrictions on the parameters of the directional distance function:

$$\begin{cases} \sum_{j=1}^{p} \alpha_j - \sum_{h=1}^{k} \gamma_h = -1 \\ \sum_{h'=1}^{k} \gamma_{hh'} = 0 \qquad h = 1, \ldots, k \\ \sum_{j'=1}^{p} \alpha_{jj'} = 0 \qquad j = 1, \ldots, p \\ \sum_{h=1}^{k} \eta_{jh} = 0 \qquad j = 1, \ldots, p \end{cases} \tag{4}$$

In addition, the symmetry restrictions are imposed: $\alpha_{jj'} = \alpha_{j'j}$ and $\gamma_{hh'} = \gamma_{h'h}$. The main advantages of the LP method are: (i) the possibility to estimate the frontier while taking into account all the restrictions on the derivatives of the distance function (see the restrictions (4) in the optimization program (3)), and (ii) the possibility of obtaining directly the inefficiency scores once the parameters of the distance function are estimated. However this method has many disadvantages: no error noises are incorporated in the frontier, there is no possibility to obtain the standard error of the parameters estimates[3] and finally this estimation method is not suitable to conduct some tests on frontier specifications (for example, to test whether the frontier is common to all the environments or it is specific to each of them).

The stochastic specification of the directional functional is due to (Färe *et al.* (2005)). Using the translation property in equation (2), a stochastic specification of the directional functional form is possible using the translation property of the directional distance function. According to these authors, the stochastic specification of the directional functional form is possible using the translation property with respect to x_K, for example. The stochastic frontier becomes:

$$\vec{D}(X - x_K, Y + X_K; -1, 1) = \vec{D}(X, Y; -1, 1) - X_K \tag{5}$$

$$\begin{aligned} -X_K = {} & \alpha_0 + \sum_{j=1}^{p} \alpha_j (Y_j + X_K) + \sum_{h=1}^{k-1} \gamma_h (X_h - X_K) + \\ & \frac{1}{2} \sum_{h=1}^{k-1} \sum_{h'=1}^{k-1} \gamma_{hh'} (X_h - X_K)(X_{h'} - X_K) + \frac{1}{2} \sum_{j=1}^{p} \sum_{j'=1}^{p} \alpha_{jj'} (Y_j + X_K)(Y_{j'} + X_K) + \\ & \sum_{j=1}^{p} \sum_{h=1}^{K-1} \eta_{jh} (Y_j - X_K)(X_h - X_K) + v - u \end{aligned} \tag{6}$$

where $u \geq 0$ is a one sided disturbance term which captures technical inefficiency. v is a usual normal two-sided noise disturbance. This frontier could be estimated by maximum likelihood method or by the method of moments (Kumbhakar and Lovell (2000)). In that case, we need to assume that the two error components are independent and also a particular choice for the inefficiency distribution u (half-normal, truncated normal,…). In our case, we assume that u is half normal. The inefficiency components are obtained by taking the expected value of u conditional on $((v - u))$, as is suggested by Jondrow *et al.* (1982).

The main advantage of the stochastic approach is that the model takes into account possible noise in the data and also that it is possible to conduct inference tests of the value of model parameters. It has the disadvantage of not imposing the inequality restrictions on the derivatives of the directional distance function[4].

3 Unless one uses the bootstrapping method.

4 The other disadvantage is the endogeneity problems with the inputs. The solution could be to use instrumental variable estimators instead of the maximum likelihood method. But the decomposition of the u terms from the residuals still remains.

13.2.2. The Environment Inefficiency Effect

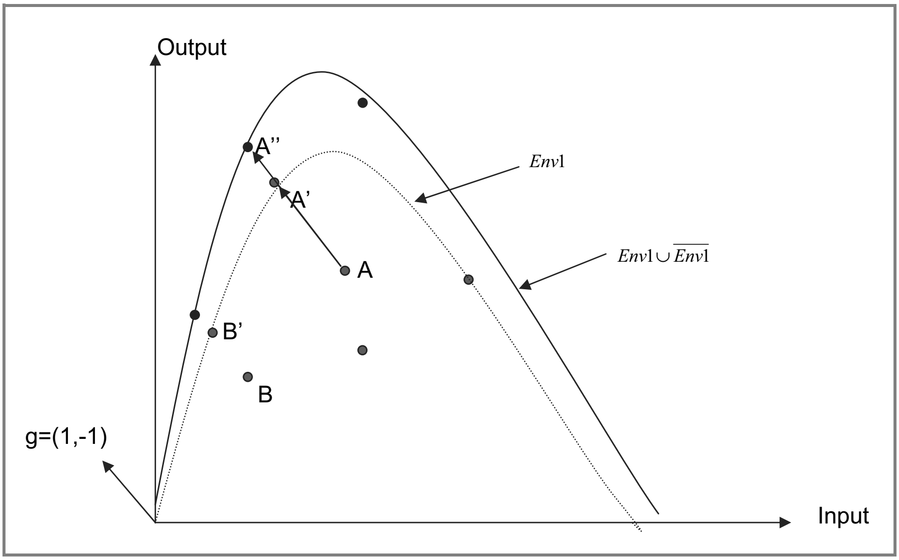
Environment is an important issue at the bank industry level. Dietsch and Lozano (2000) have found evidence that environment is important in efficiency comparisons between banks at the industry level. At the branch level, environment should also affect branches' profitability. So, it would be interesting to derive measures of the inefficiency components and to decompose the environmental effect on this inefficiency.

To capture the environmental effect on the efficiency differences between branches which operate in several environments, we proceed in three steps as follows. In a first step, we estimate a frontier by environment. The environments are previously classified according to a cluster analysis. We notice, at this step, that the technical inefficiency measurement is net of environmental effect, let $\vec{D}(X_i, Y_i;-1, 1)$ this score estimated. In a second step, we translate all the branches on their frontier, according to their level of estimated inefficiency. Here, this translation or correction should be made for each specific environment separately. The transformation of the observed point into efficient ones is obtained by expanding the inputs and contracting the outputs according to the measure

$$(X_i - \hat{\vec{D}}(X_i, Y_i; -1,1), Y_i + \hat{\vec{D}}(X_i, Y_i; -1, 1)).$$

Now, the new sample in a given environment *J* is composed of efficient branches only. In a third step, and for environment *J*, we re-estimate the frontier by considering a new pooled sample. Let *J* be the sub-sample of the efficient branches in their environment (with data adjusted on the frontier), $\bar{J}$ the sub-sample of all other branches in the five other environments. It should be noted that the data in the last sub-sample $\bar{J}$, on outputs and inputs are the observed ones and are not corrected to take into account potential inefficiency. In this third step, we re-estimate a distance function on the pooled sample and calculate the new efficiency scores for the branches which belong to the environment *J* only. These scores will measure potential profit which could be realised if the branches which belong to environment *J* would switch to the other environments. If the estimated value of the distance function is null, it means that switching to the other environments would not increase profit for the branches which belong to environment *J*.

Figure 1.



To illustrate this decomposition in the case of two environments, we consider the figure 1. Branch A which belongs to environment 1 is projected in A' by estimating the frontier for all the branches which belongs to that environment. In the second step, all the branches which belong to environment 1 are projected on their own frontier. In the third step, the adjusted data for environment 1 and the unadjusted data for all other environments except ENV1, denoted here $\overline{ENV1}$, are pooled and a second frontier is estimated and we focus only on the inefficiency score for the branches which belongs to environment 1. For example, point A' is projected to A" if we re-estimate a frontier model on the pooled sample in order to get the second measure of technical inefficiency for the branches which belong to environment 1. The last inefficiency score A'A" derived from the second frontier measures the pure environmental effect. Let us mention that when estimating the pooled sample without adjusting the data in the first step, we just get the distance AA" for branch A, which is a gross technical efficiency measure incorporating both technical inefficiency and environmental inefficiency.

13.3. DATA AND SPECIFICATION OF THE PROFIT FRONTIERS

The sample we use in this study contains 1.618 branches belonging to the branches' network of a large French banking group. In fact, each branch is affiliated to one regional bank. The role of this regional center is to allocate means (human and physical capital) to the branches and to assign commercial objectives in agreement with the commercial policy of the banking group. The database gives two types of information at the branch level: (i) annual accounting information about the branches' activities and results – information concerns year 2004 – and (ii) information about the characteristics of the branches' local environment, such as the commercial potential of the merchandising zone, the average wealth of its inhabitants, their socio-demographical characteristics, the unemployment rate, the conditions of the housing markets and so on. By using a cluster analysis, we have been able to regroup the branches in six different types of environments. This typology of local environments was then validated by the management of regional branches. The six environments are defined as follows: (1) rural zones; (2) tourist residential areas; (3) medium-sized towns; (4) medium-sized towns with high unemployment rate; (5) residential suburban areas of large urban centers; and (6) city centre areas of large urban centers.

The measure of technical inefficiency and the environmental effect may be sensitive to the specifications of the input and output vectors. In this paper, we used three different approaches of branches' profitability. The first one considers bank branches gross operating income, defined as the sum of interest margins and commissions. The second one defines profit as the branch's net operating income and subtracts personal expenses and other expenses from gross operating income. The last one takes into account loans losses on branch's customers-borrowers and defines net profit as net operating income minus loans losses. Ultimately, three different frontiers have been estimated and in each case, the set of inputs and outputs depends on the model specification.

Therefore, the origin of profitability comes in the three approaches from the same sources which are linked to the main functions of the branches in a bank: the lending function, the depository function, the sale of financial savings products such as shares on mutual funds and the sale of insurance products. The revenues associated to the bank branches' lending function are twofold: (a) interest paid by the customers on loans and (b) commissions on loans. The second source of branch's revenues comes from the depository function. Here the revenues take the form (a) of commissions on the sale of credit cards and on the operations linked to the management of the customers' demand deposits accounts, for instance and (b) of interest gained on the customers' balance of demand deposits surplus: in fact, the interests the branch receives for the investment of these excess funds in the regional bank. The third source of revenues comes from commissions on the sale of savings products, such as term deposits, life insurance products or mutual funds shares. Finally, the fourth source of revenues comes from the sale of car or personal insurance products. These revenues define the fourth outputs of the three profit frontiers we are estimating in this work.

The inputs change with the frontier specification. Concerning the gross operating income frontier, we have taken as inputs a set of two financial costs: (a) financial costs of deposits, that correspond to interests paid by the branch to its customers on their deposits accounts (demand deposits and savings accounts) and (b) financial costs of funds borrowed to the regional bank centre to finance loans. Concerning the net operating income frontier, we add to the previous one two other types of costs which are associated with the use of human and real capital. The labor costs, measured by the salaries paid to the employees and the expenses linked to the use of real physical capital (office rental costs and current operating costs). Finally, concerning the net of losses profit frontier, we have taken into account the loans losses measured by loans in state of default (90 days past due). These losses have been added to financial costs.

Thus, we have used three frontier specifications: a gross operating income frontier (model 1), a net operating income frontier (model 2) and a net profit after losses frontier (model 3). In these frontiers outputs are measured by the financial revenues raised by the branches. As mentioned above, the frontiers differ in terms of costs specifications. It is straightforward to verify that the difference between revenues (outputs) and financial costs (inputs) is equal to gross operating income (before taking into accounts branches' real expenses) in the first model. Therefore, the difference between revenues and the sum of real and financial costs is equal to the net operating income or gross profit in the second model and equal to the profit net of losses in the third model. These specifications of the profit frontiers are consistent with the distance function methodology which is dual to the profit function, as shown by Färe, Grosskopf and Weber (2004).

According to these definitions of the profit frontier at the branch level, the distance functions have been estimated by using two specifications: (a) four outputs and two inputs specification, model 1 and (b) four outputs and four inputs specification model 2 and model 3.

13.4. EMPIRICAL RESULTS

13.4.1. Common Frontier Results

We first estimate a common frontier for the 6 environments by pooling the data. Two different estimation methods have been used: the deterministic LP method, and the stochastic maximum likelihood method. The inefficiency component is assumed to follow a half normal distribution. The objective here is to check for the robustness of our results relying on the two different estimation methods used. The first estimation method ignores the noise while the second incorporates it. The stochastic frontier model allows us to test for the pooling assumption needed for the efficiency decomposition. We will not report the parameter estimates obtained for the six frontiers here. We just report in table 1 the mean efficiency scores obtained environment by environment, and for the three distance specifications. The inefficiency scores obtained by the LP method are much higher than those obtained using the stochastic frontier model. However, the magnitude of the mean inefficiency scores is quite stable according the three different model specifications. Inefficiency varies between environments; the branches in environment 4 and 6 (medium-sized towns, large towns center areas) are the most inefficient, versus the branches which belong to environment 1 and 2, the least inefficient (rural zone and tourist zone). These inefficiencies differences may be attributed to managerial inefficiencies, but also they may reflect environmental differences.

Table 1: Mean Technical Inefficiency Estimates – Common Frontier

# Branch by environment		Model 1		Model 2		Model 3	
		LP Stochastic	LP Stochastic	LP Stochastic	LP Stochastic	LP Stochastic	LP Stochastic
Env1	*428*	*.071*	*.021*	*.048*	*.016*	*.064*	*.016*
Env2	*59*	*.080*	*.024*	*.053*	*.017*	*.082*	*.017*
Env3	*345*	*.091*	*.024*	*.060*	*.018*	*.074*	*.018*
Env4	*137*	*.118*	*.031*	*.071*	*.023*	*.082*	*.023*
Env5	*554*	*.096*	*.024*	*.064*	*.019*	*.073*	*.019*
Env6	*95*	*.140*	*.031*	*.084*	*.022*	*.093*	*.022*
Total	*1618*	*.092*	*.024*	*.060*	*.018*	*.073*	*.018*
Spearman Rank correlation		*0.4364 p-value 0.000*		*0.6002 p-value 0.000*		*0.4744 p-value 0.000*	

We also calculate the spearman rank correlation coefficient of the inefficiencies scores obtained by the two methods. The correlations are positive and significant, which suggests that the two estimation methods are robust in classifying these branches in terms of their inefficiencies. Since the LP estimation method is not suitable to conduct a specification test on the effect of environment on the technology, we can focus only on the stochastic frontier model in order to test whether the frontiers are common for the six environments or not. Table 2 provides the likelihood ratios test values obtained for the six models specifications. The null hypothesis of common frontier is rejected by the three models at 99% level of significance. We can conclude that the frontiers are different among the environments. This result suggests that the inefficiency differences between branches obtained by estimating a common frontier have two possible sources: differences in the managerial inefficiencies (technical inefficiency) and the impact of the environment, *i.e.* environmental inefficiency. This last component is less under the control of the staff managers of these branches compared to the first component. So the question becomes how important is the impact of environment on the inefficiency scores of theses branches.

Table 2: Likelihood Ratios Test Statistics

Frontier Specification	Likelihood Ratio test statistics	
	LR	DF
Model 1 (4outputs- 2 Inputs)	738.34 ***	125
Model 2 (4 outputs- 4Inputs)	976.51***	190
Model 3 (4 outputs-5 inputs)	921.33***	190

13.4.2. The Environmental Impact on the Branches Inefficiencies

The second issue addressed in this paper is the effect of environment on profit inefficiency. We will apply the decomposition method developed in the previous methodology section of the paper, and for the decomposition the LP method[5] will be used. In a first step we estimate a frontier by environment in order to obtain the net technical inefficiency of the branches which belong to each environment. In a second step, the data are adjusted on their frontier by adding the distance to the outputs and by subtracting the same distance from the inputs. This exercise has been done 6 times. The adjusted data are pooled in the last step to the five other environments (without adjusting the data) and the frontier is re-estimated. According to the LP programming method used, the distance to the frontier in this last step is still positive or equal to zero. In this latter case, it would suggest that the contribution of environment to technical inefficiency for the branch retained is not relevant. If the distance is not equal to zero, it shows by how much the revenues could be increased and the costs could be reduced if the branches under consideration in a specific environment would switch to the other environments. In table 3, we provide technical inefficiency scores obtained environment by environment from the first step. In the last column of this table, we report the percentage of branches on the frontier. We notice here that the average inefficiency components between environments are not comparable since they are evaluated from environment specific frontiers, but they will be compared later with the inefficiency due to environment.

[5] The stochastic method is not suitable here, because adjusting the data and pooling them with the unadjusted ones may alter the statistical distributions of the inefficiency components in the second step. For this reason this estimation method has not been used for the decomposition.

Table 3: Net Technical Inefficiency Measure by Environment

Environment		Mean	Std	Min	Max	% of branches on the frontier
Env1	Model 1	.0475	(.040)	0	0.357	0.030
	Model 2	.0373	(.026)	0	0.191	0.033
	Model 3	.0406	(.031)	0	0.183	0.033
Env2	Model 1	.0288	(.035)	0	0.183	0.136
	Model 2	.0204	(.027)	0	0.133	0.237
	Model 3	.0254	(.028)	0	0.139	0.237
Env3	Model 1	.0496	(.048)	0	0.333	0.032
	Model 2	.0352	(.026)	0	0.136	0.041
	Model 3	.037	(.028)	0	0.148	0.041
Env4	Model 1	.037	(.029)	0	0.119	0.095
	Model 2	.0285	(.023)	0	0.093	0.153
	Model 3	.0305	(.027)	0	0.121	0.153
Env5	Model 1	.084	(.069)	0	0.827	0.014
	Model 2	.0528	(.042)	0	0.341	0.022
	Model 3	.065	(.056)	0	0.415	0.022
Env6	Model 1	.036	(.029)	0	0.149	0.105
	Model 2	.027	(.020)	0	0.090	0.137
	Model 3	.028)	(.020)	0	0.080	0.137

The second issue addressed in this study is the importance of environment contribution to the inefficiency. In table 4 we present the environmental effect obtained according to the methodology presented below.

The mean value of environmental inefficiency scores averaged between 1.3% and 10.3%, which suggests a high heterogeneity in environmental inefficiency scores obtained among environments. The highest levels of environmental inefficiency are obtained in environment 6 (large towns center areas), when compared to the five other environments. Environmental inefficiency varies between 5.7% in model 2 to 10%, according to the three model specifications. Three other environments 4, 2 and 3 follow (medium-sized towns with high unemployment rate, tourist zones and medium-sized towns). However, the branches located in environment 5 (residential sub-urban areas) have the lowest average rate of environmental inefficiency. This result reinforces our assumption on the importance of environment while comparing profit inefficiency at the branch level. In other words, there is evidence that when pooling all the branches together their profitability is sensitive to which environment these branches belong. The common frontier results reported in table 1, show that the branches located in environments 6, 4 and 3 are the most inefficient. But this inefficiency is also environment depending. To check for the robustness of the three models specifications (gross profit. net profit...), we have calculated the Spearman rank correlation between the environmental scores obtained by the three models. The correlations are positive and highly significant whatever is the model specification[6]. This result suggests that the conclusions do not seem to be sensitive to the model specification.

To show the importance of environment in branch inefficiency, we consider the ratio of environmental inefficiency to total inefficiency (the sum of environmental inefficiency and net technical inefficiency). Figure 2 reports the average ratios obtained according to the three model specifications (shr1 is the ratio obtained for model 1, shr2 for model 2, and shr3 for model 3). The results suggest that the environment is an important component of the branches profitability in most of the cases. The share of environmental effect is on average greater than 60% for the branches which belong to environment 6, 4 and 2. It varies between [40%, 55%] in environment 1 and 3. Finally, the environmental effect is the lowest in environment 5, with a 20% value. In figure 1 we show the share effect obtained for the three estimated models.

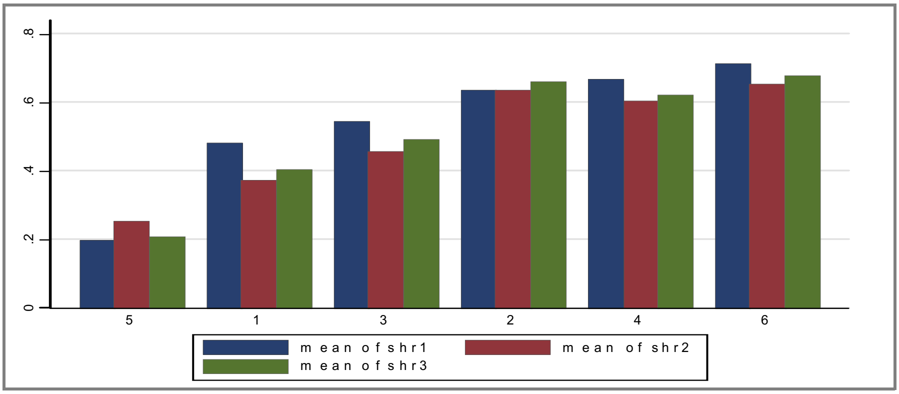
Table 4: Environmental Inefficiency Measures

Environment		Mean	Std	Min	Max	% of branches on the frontier
Env1	Model 1	.040	(.021)	0	.193	.021
	Model 2	.028	(.026)	0	.151	.023
	Model 3	.020	(.031)	0	.200	0.02
Env2	Model 1	.051	(.040)	0	.216	0
	Model 2	.032	(.029)	0	.116	.017
	Model 3	.056	(.063)	0	.349	0
Env3	Model 1	.052	(0.036)	0	.243	.017
	Model 2	.027	(.024)	0	.163	.009
	Model 3	.036	(.034)	0	.245	.003
Env4	Model 1	.079	(.072)	0	.496	.007
	Model 2	.043	(.028)	0	.135	.015
	Model 3	.051	(.043)	0	.215	0
Env5	Model 1	.016	(0.017)	0	.205	.014
	Model 2	.015	(0.014)	0	.118	.027
	Model 3	.013	(0.015)	0	.188	.025
Env6	Model 1	.103	(.088)	0	.635	0.010
	Model 2	.057	(.047)	0	.228	0.011
	Model 3	.063	(.045)	0	.206	0.021

6 The rank correlations between the environmental inefficiency scores obtained according to the three model specifications and the six environments (Env1-Env6) are the following:

Model1 & Model2 Spearman	[0.82. 0.83. 0.35. 0.87. 0.73. 0.79]
Model1 & Model3 Spearman	[0.84. 0.65. 0.47. 0.72. 0.62. 0.60]
Model1 & Model2 Spearman	[0.85. 0.61. 0.69. 0.76. 0.66. 0.80]

Figure 2: Environmental Contribution to Total Inefficiency



We have also calculated the Spearman correlations between the net inefficiency scores obtained in table 3 and the environmental inefficiency scores obtained in table 4. The correlations provided in table 5 do not suggest that there is a clear conclusion between the two inefficiency components. The sign of these correlations depends on the environment and also on the model specification. Moreover, even for a given environment the sign varies according to the frontier specification.

Table 5: Rank Correlation Matrix: Net Technical Inefficiency-environmental Inefficiency

	Env1	Env2	Env3	Env4	Env5	Env6
Model1	-0.198	-0.239	-0.125	-0.306	-0.306	0.084
	(0.000)	(0.068)	(0.025)	(0.000)	(0.000)	(0.421)
Model2	-0.039	-0.561	-0.135	-0.108	0.155	0.257
	(0.425)	(0.673)	(0.012)	(0.210)	(0.000)	(0.012)
Model3	0.197	0.076	0.281	0.225	0.335	0.368
	(0.000)	(0.569)	(0.000)	(0.008)	(0.000)	(0.000)

(Numbers between brackets are the p-values of the test that the correlation is null.)

13.5. CONCLUSION

This paper has attempted to estimate technical inefficiency of a sample of 1.618 branches of a large French banking group, while taking account the impact of the environment. The branches are located in 6 different environments. Using the directional distance function which allows for simultaneous adjustments of inputs and outputs and the linear programming methodology, a decomposition of these two components has been proposed. First, we have estimated gross technical inefficiency levels ignoring the environmental effect and a pooling test assumption has been conducted. Then, we have re-estimated the frontiers by environment to get adjusted measures of net technical inefficiency and environmental inefficiency. The results show that, at the branch level, environment is an important factor of technical inefficiency. In most of the cases, the average inefficiency contribution of environment to total inefficiency is greater than 40%.

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14. Efficiency and Productivity of Russian Banks: Distinguishing Heterogeneity and Performance

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Abstract

This paper describes procedures in panel data econometrics for efficiency measurement and productivity decomposition in the banking system of an economy in transition: Russia. The estimation challenge is to allow for both latent heterogeneity and inefficiency, encapsulating the monetary authorities' dilemma in comparative efficiency analysis for banking system regulation. Panel data methods offer a potential means of achieving this in a credible and consistent manner, however, the specification of the error terms in panel data analysis is critical. In a transition economy just emerging from decades of state control, it can be expected that efficiency change is initially slow moving; but such time-invariant inefficiency can often be confused with latent heterogeneity giving rise to opposing modelling strategies. This paper uses a large panel data set of over 900 banks from 1997-2006 to identify sources of inefficiency in the banking system by estimating a stochastic input distance function with composed error term. It then develops a productivity decomposition from the fitted distance function.

14.1. Introduction

This paper describes procedures in panel data econometrics for efficiency measurement and productivity decomposition in a transition economy's banking system.

The transformation of the transition countries and the development of their banking systems have attracted considerable attention in terms of highlighting the need to better understand the competitiveness and the efficiency of financial institutions in the process of financial integration and convergence in the global market. In particular, since the banking sector plays an important role in financial systems, the stability of Russian banking is crucial for the overall systemic stability in the country and given the high economic cross-border repercussions of any instability, for the stability in the entire region itself. Hence, we aim to investigate the performance of Russian banking system in terms of its efficiency and productivity.

However, the first hurdle that such as analysis faces is the difficulty of modelling banking production processes not only because of *"the usual difficulties in studies of this kind, such as measuring 'input' properly, but raise even more difficult questions concerning concepts of output"* (Speagle and Kohn (1958), p. 22). Several input/output approaches are suggested in the literature, nevertheless there is no consensus among them. Thus, this study focuses on a comparative analysis of the performance of Russian banks from the financial intermediation, production and profit generating perspectives. In our investigation, we make use of a wide panel of over 900 commercial banks in Russia covering the years 1997-2006 thereby covering the 1998 Russian financial crisis. In addition, this sample contains a large number of variables that indicate the technology of the banks as well as a substantial collection of heterogeneous bank characteristics, including branch network, and participation in deposit insurance scheme. Distinguishing heterogeneity, *i.e.* bank characteristics, from performance is a critical and difficult issue for both the suppliers of equity capital and regulators; yet it is a vital indicator in the prediction of successful risk management.

In the empirical analysis we utilize the recent parametric stochastic frontier techniques which separate the inter-bank heterogeneity effect from the banking inefficiency and, importantly, can be applied to panel data setting. The models used in the paper allow the researcher to be more confident in specifying the importance of heterogeneity and differences in market and bank characteristics in explaining relative bank performance. We specify a stochastic frontier model represented by the input distance function, which captures the technology of banking in a fully comprehensive manner. The productivity of intermediation, production and profit generating activities of Russian banks is estimated by the methodology of Orea (2002). The results demonstrate whether, allowing for a rich variety of heterogeneous characteristics, it is possible to identify inefficiencies in relative performance and to relate these to differences in banking management goals.

Despite substantial research efforts, it is generally recognised that one of the main difficulties in the analysis of performance in banking is the lack of agreement in defining of banks' inputs and outputs. We utilize three different input/outputs approaches to describing the banking production process, namely Intermediation, Production and Profit/Revenue. In our model specifications, the Profit/Revenue approach captures the profit maximization goal of bank management; service/utility production bringing together elements of service provision and utility provision (Production approach); and finally the intermediation of deposits to loans (Intermediation approach).

The Russian banking system has undergone rapid transformation in the last few years, and the Central Bank itself is less than 20 years old in its present formulation. A dominant trend in the banking system, as the Russian economy has been in transition is, as Bank of Russia (2008b) notes that growth in banking sector assets was largely a result of greater lending, with a particularly strong growth in lending to the household sector. However, the Russian banking system has not been immune to the worldwide credit crunch, and considerable central bank intervention has been necessary to maintain the stability of the banking system in Russia. The central bank has become aware that rapid growth in lending can accumulate risks, and therefore a study of productivity growth trends in Russian banking is timely. A central finding of this paper is that when productivity growth results for the Russian banking system are decomposed into the components of technical change, efficiency change, and scale efficiency change, it is the third of these factors which has accounted for the major part of the measured productivity growth. We shall show in this paper that the scale efficiency change component of a productivity growth decomposition analysis can be most easily linked to output growth when other factors such as input growth, frontier shift and frontier catching up have been netted out. Consequently, we shall argue that it is possible to see in the measured productivity growth estimates for the Russian banking system, the signs of the lending boom which has characterised so many other countries as well and which has led to the credit crisis of 2008.

14.2. MODELLING THE TECHNOLOGY OF BANKING SYSTEMS

To capture the performance of the banking system we focus on the idea of the banking firm transforming inputs to outputs through the income account and the balance sheet activities of the bank. The outputs are $\boldsymbol{y} \in R_+^R$ and the required inputs are $\boldsymbol{x} \in R_+^K$, and we represent the technology at time t by the input distance function, $D_I(\boldsymbol{y}, \boldsymbol{x}, t)$, McFadden (1978). Since the value of the input distance function equals one if a producer is on the efficient production frontier, and exceeds one where the producer is inefficient, $D_I \geq 1$, we write

$$\ln D_I(\boldsymbol{y}, \boldsymbol{x}, t) - u = 0, \qquad u \geq 0$$

The non-negative variable $u \geq 0$ corresponds to the inefficient slack in the use of inputs by each producer; it is the feasible contraction in inputs which will project an inefficient producer on to the efficient frontier of the input requirement set. In the econometric approach to inefficiency measurement u is treated as a random variable distributed across producers with a known asymmetrical probability density function, as described below. McFadden (1978:26) and Kumbhakar and Lovell (2000:32) state that properties of the input distance function include:

(i) non-decreasing in x, $\partial \ln D_I / \partial \ln x_I \equiv ex_k \geq 0, k = 1 \ldots K$

(ii) homogeneity of degree one in x, $D_I(\boldsymbol{y}, \boldsymbol{x}/x_K, t) = D_I(\boldsymbol{y}, \boldsymbol{x}, t)/x_K$

(iii) concave in x

(iv) non-increasing in y, $\partial \ln D_I / \partial \ln y_I \equiv ey_k \geq 0, r = 1 \ldots R$

(v) scale elasticity of the production technology is measured by:

$$E^t = -\left(\sum_{r=1}^{r=R} \partial \ln D_I / \partial \ln y_r\right)^{-1} = -\left(\sum_{r=1}^{r=R} ey_r\right)^{-1}$$

Applying the property in (ii), and using the input distance definition, provides an equation for estimation purposes:

$$-\ln x_K = \ln D_I(\boldsymbol{y}, \boldsymbol{x}/x_K, t) - u$$

Three elements can make this equation operational in a setting of panel data, $i = 1, \ldots, N; t = 1, \ldots, T$:

$$-\ln x_{Kit} \approx TL(\boldsymbol{y}, \boldsymbol{x}/x_K, t)_{it} + \pi' \boldsymbol{z}_{it} + v_{it} - u_{it}$$

In this model $TL(\boldsymbol{y}, \boldsymbol{x}/x_K, t)_{it}$ represents the technology as the translog approximation to the log of the distance function containing the inputs normalised by the input on the left hand side of, $\pi' \boldsymbol{z}_{it}$ is the inter-bank heterogeneity that is separate from inefficiency and includes the exogenous operating characteristics, and v_{it} is the conventional idiosyncratic error term incorporating sampling error, measurement error and specification error. The remaining term, *i.e.* $(-u_{it})$, is the inefficiency component of the disturbance error. The formulation is less general than it could be however since it imposes separability of the distance function in operating characteristics. With non-separability, the exogenous characteristics can be modelled as if they enter the y vector directly so that they appear with second order and cross-product terms interacting with the other outputs, inputs and time to reflect the intrinsic nonlinearity of their impact on production technology

The TI (*i.e.* time invariant) model used in the paper is the original random effects stochastic frontier analysis (RE-SFA) model with specified inefficiency distributions suggested by Pitt and Lee (1981). This model emphasises the persistence of inefficiency over time for each firm. The joint probability density functions of the error components u_i and $v_{i1} \ldots v_{iT}$ are as follows (Pitt and Lee (1981)):

$$f(u_i, (v_{i1} \ldots v_{iT})) = \left(\frac{2}{(2\pi)^{T+1/2} \sigma_u \sigma_v^T}\right) \exp\left[\frac{-u_i^2}{2\sigma_u^2} - \frac{\sum_{t=1}^{t=T} v_{it}^2}{2\sigma_v^2}\right]$$

Here the inefficiency persists in a constant form.

In the TVD (time varying decay) model the persistence of inefficiency is a function of time common across all firms (Battese and Coelli (1992)):

$$u_{it} \geq 0$$
$$u_{it} = u_i h(t)$$
$$h(t) = \exp(-\eta(t-T))$$
$$u_i \sim Nid^+(\mu, \sigma_u^2)$$
$$v_{it} \sim Nid(0, \sigma_v^2)$$

In TI and TVD models the effect of firm heterogeneity is assumed to affect production technology of the firms. Therefore, firm specific z-variables appear on the RHS of the regression as a set of regressors. In next three models (UHET, VHET and CM), on the other hand, it is assumed that the bank-specific factors affect the inefficiency or idiosyncratic error directly. The regression equation in these models is defined as

$$y_{it} = \alpha + \beta' \boldsymbol{x}_{it} + v_{it} - u_{it} \tag{1}$$

In UHET model the variance of the inefficiency term is parameterised as suggested by Reifschneider and Stevenson (1991) and Caudill and Ford (1993), *i.e.*

$$\sigma_{u_{it}}^2 = \exp(\delta' \boldsymbol{z}_{it}) \quad ,(2)$$

where z_{it} is the vector of bank-specific and heterogeneity factors influencing technical inefficiency and δ is the vector of parameters to be estimated. In CM model, the exogenous influence on inefficiency is captured by the parameterised mean of the pre-truncated inefficiency distribution $u_{it} \sim N^+(\mu_{it}, \sigma_{it}^2)$ (Battese and Coelli (1995)). In particular, the mean of inefficiency term is equal to $\mu_{it} = \varphi' \boldsymbol{z}_{it}$.

We parameterise the variance of the idiosyncratic component in a similar way as the variance of the technical inefficiency (Caudill *et al.* (1995) and Hadri (1999)) in VHET model:

$$\sigma_{v_{it}}^2 = \exp(\gamma' \boldsymbol{z}_{it}) \tag{3}$$

The advantage of the modelling specifications utilised in this paper is that they allow us to assess the influence of the operating environment of the banks on the production efficiency of the banking system, as well as to incorporate into the model inter-bank heteroskedasticity in inefficiency u_{it} or idiosyncratic error v_{it}. Although our model incorporates bank-specific factors, the models based on maximum likelihood estimation are estimated in a single 'step'. Hence the bias problems associated with two-step parametric frontier models with z are eliminated (see, Wang and Schmidt (2002)). In addition, the UHET model satisfies the 'scale property' of u_{it} described by Wang (2002), Wang and Schmidt (2002) and

Alvarez et al (2006) because the distribution of u_{it} is $N^{+}[0, \exp(\delta' z_{it})]$ which is equivalent to $\exp(\delta' z_{it}) \cdot N^{+}(0, 1)$.

Making use of the notation: $\tilde{x}_k \equiv x_k / x_K$, $\boldsymbol{ly}' = (\ln y_1 \ldots \ln y_R)$ and $\boldsymbol{l\tilde{x}}' = (\ln \tilde{x}_1 \ldots \ln \tilde{x}_{K-1})$, the translog input distance function $TL(\boldsymbol{y}, \tilde{\boldsymbol{x}}, t)$ is:

$$TL(\boldsymbol{y}, \tilde{\boldsymbol{x}}, t) = + \boldsymbol{\alpha}' \boldsymbol{ly} + \boldsymbol{\beta}' \boldsymbol{l\tilde{x}} + \frac{1}{2} \boldsymbol{ly}' A \boldsymbol{ly} + \frac{1}{2} \boldsymbol{l\tilde{x}}' B \boldsymbol{l\tilde{x}} + \boldsymbol{ly}' \boldsymbol{\Gamma} \boldsymbol{l\tilde{x}} + \delta_1 t + \frac{1}{2} \delta_2 t^2 + \boldsymbol{\mu}' \boldsymbol{ly} t + \boldsymbol{\eta}' \boldsymbol{l\tilde{x}} t$$

The property of continuity of the function requires the symmetry restrictions on the elements of the matrices A, B: $\alpha_{rs} = \alpha_{sr}$ and $\beta_{jk} = \beta_{kj}$. The empirical elasticities needed for the productivity index calculations are $ey_r = \partial \ln D_I / \partial \ln y_r, r = 1 \ldots R$, $ex_k = \partial \ln D_I / \partial \ln \tilde{x}_k, k = 1 \ldots K-1$, and $e_t = \partial \ln D_I / \delta t$. These can be solved in terms of the coefficients of the fitted translog distance function as:

$$\begin{pmatrix} \mathrm{e}_y \\ \mathrm{e}_x \\ e_t \end{pmatrix} = \begin{pmatrix} \alpha & \mathrm{A} & \Gamma & \mu \\ \beta & \Gamma' & \mathrm{B} & \eta \\ \delta_1 & \mu' & \eta' & \delta_2 \end{pmatrix} \begin{pmatrix} 1 \\ \mathbf{ly} \\ \mathbf{l\tilde{x}} \\ t \end{pmatrix}$$

Here $\boldsymbol{e}_y$ is the column vector of output elasticities, $\boldsymbol{e}_x$ is the column vector of input elasticities. The normalising input and therefore the dependent variable in the regression analysis is $-\ln x_K$; in the sample used here, this will be the (negative log of) fixed assets in production and intermediation models of bank activity, and the (negative log of) variable costs in the profits approach to modelling bank behaviour. Consequently, intuitive interpretations of the approach are as follows. In the production and intermediation approaches, the regression explains the demand for fixed asset capital in terms of outputs, other (normalized) inputs and the operating characteristics variables. In the profits approach, the regression explains the behaviour of variable costs in terms of outputs, other (normalized) inputs and the operating characteristics variables. Although the structural interpretation of the fitted regressions differs among the different approaches, the interpretation of the inefficiency component is the same since it is directly inferred from the behaviour of the maximum likelihood residuals.

Concavity of the input distance function in x can be expressed in terms of the Hessian, by applying the arguments of Diewert and Wales (1987) for the cost function. The Hessian of the input distance function with respect to x is:

$$H(\boldsymbol{x}) = \boldsymbol{B} - \hat{\boldsymbol{e}}_x + \boldsymbol{e}_x \boldsymbol{e}'_x$$

Here, $\hat{\boldsymbol{e}}_x$ is a diagonal matrix with the input elasticities ex_k, $k = 1 \ldots K-1$ on the leading diagonal, and zeros elsewhere. $\boldsymbol{B}$ is the matrix of second order coefficients on the input terms in the translog function. Concavity requires that $H(\boldsymbol{x})$ be negative semi-definite[1]. At the sample means with mean corrected data, these first and second order derivatives simplify to:

$$\begin{pmatrix} \mathbf{e}_y \\ \mathbf{e}_x \\ e_t \end{pmatrix} = \begin{pmatrix} \alpha \\ \beta \\ \delta_1 \end{pmatrix}$$

$$H(\overline{\mathbf{x}}) = \mathbf{B} - \hat{\beta} + \beta\beta'$$

14.3. PARAMETRIC TOTAL FACTOR PRODUCTIVITY GROWTH

Productivity growth is the growth of output less the growth in input. Total factor productivity is the rate of growth in a multiple output quantity index minus the rate of growth in a multiple input quantity index. Orea (2002) states that there is a wide consensus that a total factor productivity index which is generalised from the case of one input and one output should satisfy four properties:
1) identity;
2) montonicity;
3) separability;
4) proportionality.

Identity requires that if inputs and outputs do not change, the TFP index is unity, and monotonicity requires that the weighted output growth rates and input growth rates are chosen so that higher output and lower input unambiguously improve TFP. Separability, a property of the chosen technology set, permits the generalisation to the multiple-output, multiple-input case. Proportionality requires that the weights in the output and input growth indices add to unity.

Orea (2002) (in the output orientation) and Coelli, Estache, Perelman and Trujillo (2004) (in the input orientation) demonstrate that such an index of total factor productivity can be constructed from the translog approximation to the distance function. In particular, since the negative log of the input distance is input based technical efficiency, *i.e.* $-\ln D_I(t) = \ln TE_I(t)$, then,

[1] Negative definiteness can be checked from the sign pattern of the principal minors of the Hessian.

$$\ln TFP = [\ln TE_I(t+1) - \ln TE_I(t)] + \frac{1}{2}[(\partial \ln D_I(t+1)/\partial t) + (\partial \ln D_I(t)/\partial t)]$$
$$+ \left[\frac{1}{2}\sum_{r=1}^{r=R}((ey_{rt+1}SF^I_{t+1}) + (ey_{rt}SF^I_t))(\ln(y_{rt+1}/y_{rt}))\right]$$

Here use has been made of the quadratic identity lemma of Caves Christensen and Diewert (1982), and the scale factor notation in Saal et al (2007):

$$SF^I_t = \left(\left(\sum_{r=1}^{r=R} ey_{rt} + 1\right) / \left(\sum_{r=1}^{r=R} ey_{rt}\right)\right) = 1 - E^t$$

with E^t as the elasticity of scale at time *t*.

Consequently, the three terms in square brackets in the expression for $\ln TFP$ represent the familiar decomposition of total factor productivity change, *TFPC*, into efficiency change, *EC*, technical change, *TC*, and scale change, *SC*:

$$TFPC = EC + TC + SC$$

In summary, the purpose of the modelling exercise is twofold: firstly, to calculate relative firm inefficiency by estimating the translog input distance function and, secondly, to measure relative total factory productivity change and its decomposition by computing $TFPC = EC + TC + SC$, using the first order and second order elasticity and scale parameters from the fitted input distance function for the computation. An intuitive interpretation of this productivity decomposition in the case of the input distance function is interesting. From the expression above, we see that total factor productivity change comprises, *ceteris paribus*, inefficiency change (catching up with the frontier), pure technical change (the shift in the frontier over time) and the returns to scale component. This returns to scale component is measured by the rate of change of outputs after allowing for input change weighted by the output elasticity of the input distance function. In simpler terms, the returns to scale component represents pure volatility in output growth after allowing for input requirements.

14.4. DATA

As we stated above, we utilize three different input/outputs approaches to describing the banking production process, namely Intermediation, Production and Profit/Revenue. In our model specifications, the Profit/Revenue approach captures profit maximization goal of bank management; service/utility production bringing together elements of service provision and utility provision (Production approach); and finally the intermediation of deposits to loans (Intermediation approach).

To develop our modelling methodology, in the Intermediation approach we use: 'deposits' (deposits and short term funding), 'labour' (personnel and administrative expenses) and 'capital' (total fixed assets) as inputs. With respect to outputs we use: 'loans' (total customer loans), 'other earning assets' (total other earning assets), and 'other income' (other net operating income, net income from one-time transactions, net income from foreign currency revaluation).

In the case of the Production approach, we have four outputs and two inputs. The outputs are: 'loans' (total customer loans), 'other earning assets' (total other earning assets), 'other income' (other net operating income, net income from one-time transactions, net income from foreign currency revaluation), and 'deposits' (deposits and short term funding). The two inputs are 'labour' (personnel and administrative expenses) and 'capital' (total fixed assets).

Finally, three outputs are utilised in the Profit/Revenue approach: 'Interest revenue', 'other income' (other net operating income, net income from one-time transactions, net income from foreign currency revaluation) and 'net commission, net fee and net trading income'. The inputs are 'labour' (personnel and administrative expenses), 'interest expenses' and 'provisions for losses'.

The unbalanced panel data set of commercial banks utilised in this study is drawn from the Bank of Russia (2008a), *i.e.* The Central Bank of the Russian Federation. The data are available online in the Russian language and the dataset includes banks that were in operation over the period 1997-2005. It should be noted that the sample used for estimation represents the surviving banks over the whole period. Banks which enter the sample during the sample period and have zero values for 'deposits' (deposits and short term funding) and 'loans' (total customer loans) are excluded from the sample on the year of entry. The distribution of the banks across the years and their percentage share of total assets as a proportion of the country's banking system are presented in Table 1, and the summary statistics for the overall sample is presented in Table 2.

Table 1: Distribution of Banks During the Analysed Years (1997-2005) and Assets of Sample Banks as Percentage of Total Banking System Assets

	Number of banks in the banking system (BS)	Number of banks in the sample	Sample banks' total assets (TA) to BS TA
1997	1675	833	
1998	1447	854	
1999	1315	851	
2000	1311	865	57.4%
2001	1319	875	77.5%
2002	1329	897	82.1%
2003	1329	913	84.7%
2004	1299	920	88.0%
2005	1253	925	90.7%

Source: Bank of Russia, authors' calculation.

Table 2: Summary Statistics for Eastern European Banks' Inputs and Outputs

Variable	Mean	Std.Dev.	Minimum	Maximum
Inputs				
Deposits and short term funding (I)	3293293	58533135	1	3783285875
Personnel and administrative expenses (I), (PR), (P)	156316	2347029	13	116699158
Total Fixed assets (I), (P)	120584	2287572	1	136486702
Interest expenses (PR)	155022	2008843	0	91556138
Provisions for losses (PR)	6379	586821	-36103582	16025673
Outputs				
Total customer loans (I), (P)	2360360	31493958	1	1923071291
Total other earning assets (I), (P)	419938	7125094	0	300913078
Interest Revenue (PR)	299553	4252679	0	241393818
Other Income (I), (P), (PR)	79730	1208294	-7067713	49956635
Net commission, net fee and net trading income (PR)	103298	1345010	-2065801	59142956
Deposits and short term funding (P)	3293293	58533135	1	3783285875

Note. Figures are presented in 000s Russian Rubles. (I) Intermediation Approach, (PR) Profit/Revenue Approach, (P) Production Approach.

We consider several bank-specific variables which potentially affect the performance of the banks. Given that the banks in Russia can either engage in business banking or retail and business banking, the dummy variable for retail banking is used in the analysis. The branching network system is also taken into account by inclusion of such variables as number of branches in Russia and abroad, number of representatives, additional offices and operating cash points, and dummy variable for branch/headquarter in Moscow. Due to the unavailability of relevant data, the only ownership variable we include is the dummy variable for 100% foreign ownership. To investigate the impact of the financial crisis of 1998, we introduce the dummy variable for that year. Two dummy variables for the year 2004 and 2004-05 are designed to capture the impact of deposit insurance scheme introduced by the Federal Law Nr. 177-FZ of December 23, 2003. Additionally, to capture the effects of scale we included the SIZE variable (log of total assets). This variable also indirectly captures the impact of state control of the banks, given that as of January 1, 2006 40.7% of aggregate banking sector assets are attributed to 32 state-controlled banks (Bank of Russia 2005, p.19).

14.5. RESULTS

The estimation results for the intermediation approach are given in Tables 3, 4 and 5, for the production approach Tables 6, 7 and 8 and for the profit approach in Tables 9, 10 and 11.

Table 3: Summary of Efficiency Levels of Russian Commercial Banks Across Utilized Efficiency Measurement Techniques During 1997-2005 for 833 – 925 Banks (Intermediation Approach)

	TVD	TI	VHET	UHET	CM
Mean	0.106	0.044	0.806	0.875	0.806
Min	0.025	0.007	0.284	0.017	0.004
Max	0.823	0.523	0.973	1.000	1.000
St. Dev	0.051	0.030	0.040	0.089	0.114
H(mean)					
1st order	-0.151	-0.149	-0.121	-0.132	-0.141
2nd order	0.006	0.006	-0.009	-0.007	-0.006
H(sample)					
1st order (% with correct sign)	94.96%	94.42%	86.49%	89.83%	92.08%
2nd order (% with correct sign)	80.81%	85.18%	15.59%	16.36%	19.37%

Table 4: Average Generalised Malmquist Productivity Indices and its Components for Russian Commercial Banks Across Utilized Efficiency Measurement Techniques During 1997-2005 for 833 – 925 banks (Intermediation Approach)

	TVD*	TI	VHET	UHET	CM*
GPMI	0.673	0.792	0.905	0.898	0.794
TC	0.744	0.885	0.920	0.913	0.924
EC	1.000	1.000	1.002	1.015	1.004
RTS	0.904	0.895	0.991	0.971	0.857

*Note: * For these models results cover trimmed sample results of 95 percentile (covering range from 2.5 to 97.5 percentiles) due to outliers.*

Table 5: The Observed Influence of the Bank Specific Factors on Russian Commercial Banks Across Utilized Efficiency Measurement Techniques During 1997-2005 for 833 – 925 Banks (Intermediation Approach)

	TVD	TI	VHET	UHET	CM
Retail banking	-0.405***	-0.444***	-0.762***	32.322	0.354***
Number of branches in Russia	-0.020***		-0.039***	0.056***	0.013***
Number of branches abroad	-0.277	-0.465**	-0.098	-0.247	0.059
Number of representatives	-0.009**	-0.004	-0.023***	-0.207*	0.0002
Number of additional offices	-0.001	-0.002***	-0.0005	-0.002	-0.0001
Number of operating cash points	0.002***	0.001**	0.003***	-0.002	-0.0004**
Branch/headquarter in Moscow	-0.031	-0.018	0.325***	-1.858***	-0.192***
100% Foreign	-0.305***	-0.316***	0.469***	3.510***	0.317***
1998	0.129***	0.132***	0.317***	-0.385	-0.112***
2004	-0.107***	-0.101***	0.235***	1.569***	0.075**
2004-05	0.132***	0.118***	-0.795***	-2.078***	-0.030

*Notes. *,**,*** – significance from zero at 10%, 5%, 1% level.*

Table 6: Summary of Efficiency Levels of Russian Commercial Banks Across Utilized Efficiency Measurement Techniques During 1997-2005 for 833 – 925 Banks (Production Approach)

	TVD	TI	VHET	UHET	CM
Mean	0.046	0.059	0.999	0.842	0.516
Min	0.013	0.012	0.999	0.0003	0.000
Max	0.330	0.520	0.999	1.000	0.994
St. Dev	0.023	0.035	0.000	0.124	0.224
H(mean)					
1st order	-0.109	-0.109	0.040	0.019	-0.006
H(sample)					
1st order (% with correct sign)	99.80%	99.84%	26.79%	36.82%	51.05%

Table 7: Average Generalised Malmquist Productivity Indices and its Components for Russian Commercial Banks Across Utilized Efficiency Measurement Techniques During 1997-2005 for 833 – 925 Banks (Production Approach)

	TVD*	TI*	VHET*	UHET	CM*
GPMI	0.682	0.772	0.825	1.492	0.862
TC	0.791	0.904	1.006	0.985	0.947
EC	1.000	1.000	1.000	1.028	1.025
RTS	0.859	0.852	0.819	1.201	0.883

*Note: * For these models results cover trimmed sample results of 95 percentile (covering range from 2.5 to 97.5 percentiles) due to outliers.*

Table 8: The Observed Influence of the Bank Specific Factors on Russian Commercial Banks Across Utilized Efficiency Measurement Techniques During 1997-2005 for 833 – 925 Banks (Production Approach)

	TVD	TI	VHET	UHET	CM
Retail Banking	-0.376***	-0.429***	-0.415***	30.568	0.274***
Number of branches in Russia	-0.030***		-0.007	0.062***	0.026***
Number of branches abroad	-0.329	-0.634***	0.285	-0.143	0.113
Number of representatives	-0.011**	-0.007	0.004	0.012	0.005***
Number of additional offices	-0.001*	-0.003***	0.001	0.001	0.000
Number of operating cash points	0.002***	0.001***	0.0002	-0.004***	-0.001***
Branch/headquarter in Moscow	0.121***	0.135***	0.461***	-2.213***	-0.328***
100% Foreign	-0.230**	-0.124	-0.038	0.777*	0.135**
1998	0.145***	0.149***	0.057	-1.037***	-0.156***
2004	-0.284***	-0.278***	-0.064	1.928***	0.329***
2004-05	0.613***	0.601***	-0.482***	-3.652***	-0.665***
Size			-0.009	0.274***	0.226***

*Notes. *,**,*** – significance from zero at 10%, 5%, 1% level.*

Table 9: Summary of Efficiency Levels of Russian Commercial Banks Across Utilized Efficiency Measurement Techniques During 1997-2005 for 833 – 925 Banks (Profit Approach)

	UHET	CM
Mean	0.994	0.991
Min	0.006	0.355
Max	1.000	1.000
St. Dev	0.033	0.018
H(mean)		
1st order	-0.003	-0.002
2nd order	1.003e-06	2.660e-07
H(sample)		
1st order (% with correct sign)	99.97%	99.95%
2nd order (% with correct sign)	49.30%	34.84%

Note: For these models results cover trimmed sample results of 95 percentile (covering range from 2.5 to 97.5 percentiles) due to outliers.

Table 10: Average Generalised Malmquist Productivity Indices and its Components for Russian Commercial Banks Across Utilized Efficiency Measurement Techniques During 1997-2005 for 833 – 925 Banks (Profit Approach)

	UHET	CM
GPMI	1.023	4.216
TC	1.000	1.000
EC	1.003	1.000
RTS	1.024	3.725

Table 11: The Observed Influence of the Bank Specific Factors on Russian Commercial Banks Across Utilized Efficiency Measurement Techniques During 1997-2005 for 833 – 925 Banks (Profit Approach)

	UHET	CM
Retail banking	-2.426***	-0.126***
Number of branches in Russia	0.154***	
Number of branches abroad	-0.260	0.003
Number of representatives	0.061***	0.0004
Number of additional offices	0.019***	0.001***
Number of operating cash points	-0.022***	-0.001***
Branch/headquarter in Moscow	0.730***	-0.064***
100% Foreign	1.841***	0.013
1998	-0.551***	-0.063***
2004	-0.378***	0.052***
2004-05	-0.505***	-0.157***

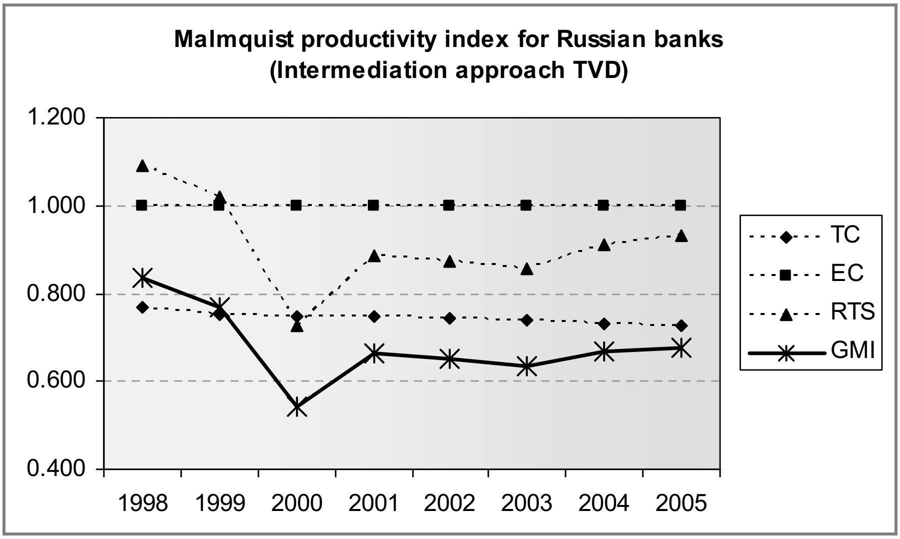
*Notes. *,**,*** – significance from zero at 10%, 5%, 1% level.*

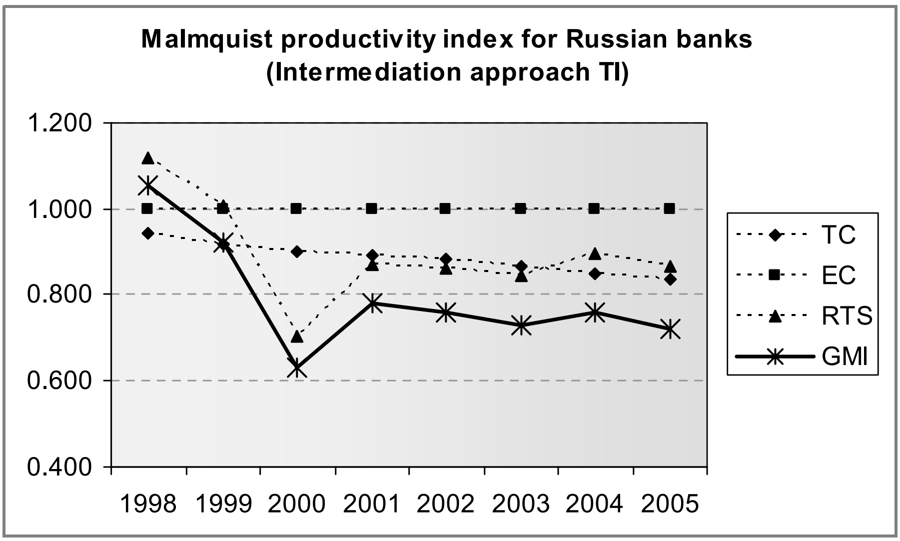
According to the results, the efficiency estimates are sensitive to the choice of frontier construction technique. Interestingly, in the models where the bank-specific characteristics affect the production technology (TVD and TI), the average efficiency score is under 0.11. However, the average efficiency results are over 80% in the models which assume that the bank-specific factors have direct impact on inefficiency or idiosyncratic error. The exception is the CM model for the production approach where the average efficiency is 51.6%.

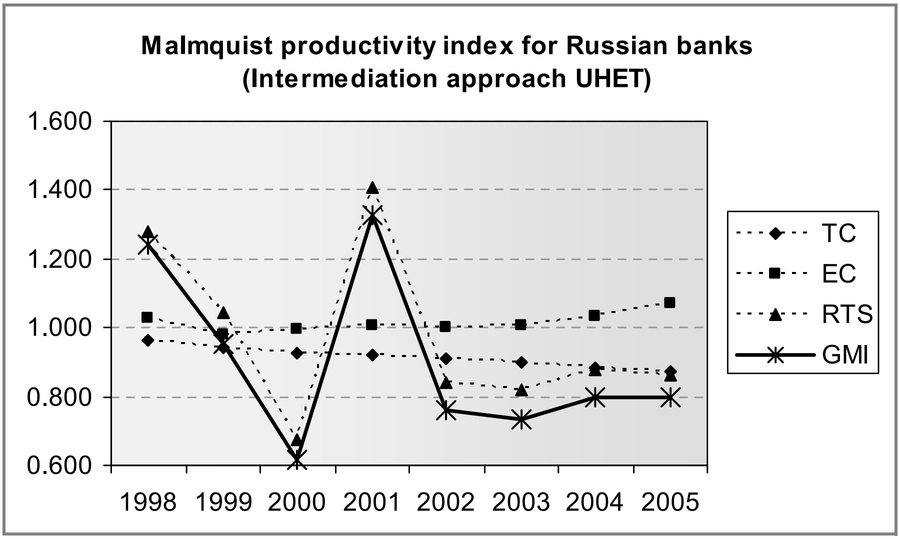
The generalised Malmquist productivity indices suggest that Russian banks experienced a productivity decline in their financial intermediation and service producing activities. As can be seen from Figure 1, the highest intermediation and production productivity levels were observed in the period between 1997-1998, with the sharp decline of productivity in the period between 1998 and 2000 followed by a slight improvement in productivity in 2001. However, from 2001 till the end of the considered period the gradual productivity regress of financial intermediation and service production activities of Russian banking is observed.

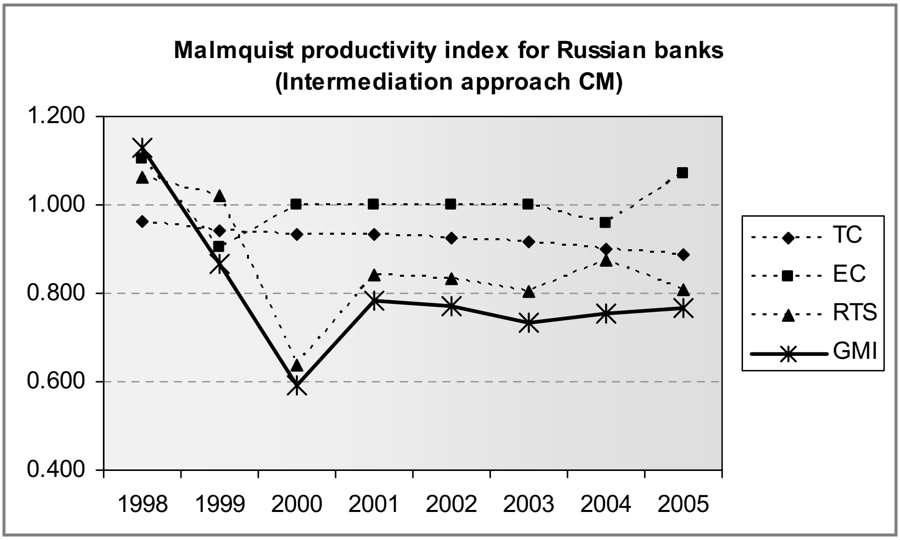
With regard to the profit generation, on average Russian banks were productive throughout the sample period. The common feature of productivity decomposition across all three alternative approaches is that the main driver of banking productivity of Russian banks is their returns profile. A worrying signal is the deterioration in the adoption of new technology which is consistently reported by all models across three utilised approaches.

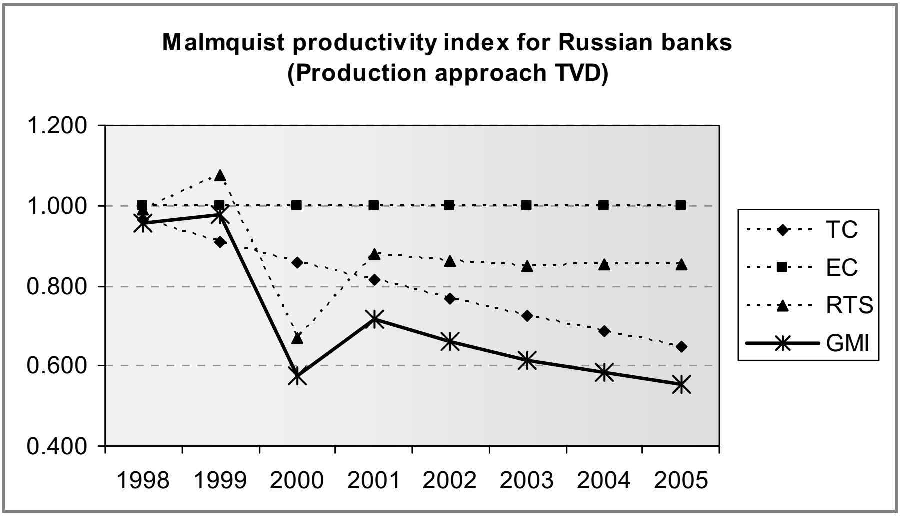
Figure 1: Dynamics of Russian banking Productivity Across Alternative Production Process Definitions: Malmquist Representation






Malmquist productivity index for Russian banks
(Intermediation approach UHET)
1.600
1.400
1.200
1.000
0.800
0.600
1998
1999
2000
2001
2002
2003
2004
2005
TC
EC
RTS
GMI


Malmquist productivity index for Russian banks
(Intermediation approach CM)
1.200
1.000
0.800
0.600
0.400
1998
1999
2000
2001
2002
2003
2004
2005
TC
EC
RTS
GMI


Malmquist productivity index for Russian banks
(Production approach TVD)
1.200
1.000
0.800
0.600
0.400
1998
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2000
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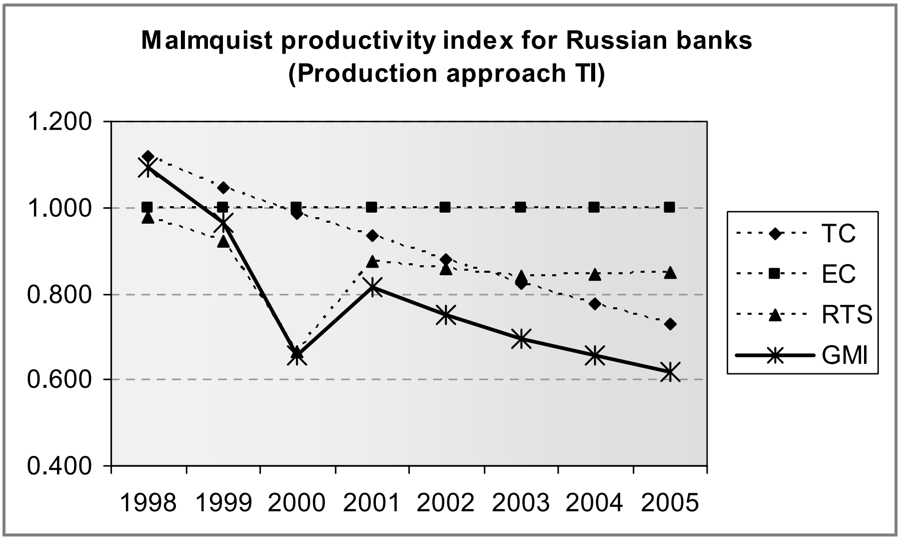
Malmquist productivity index for Russian banks
(Production approach TI)
1.200
1.000
0.800
0.600
0.400
1998
1999
2000
2001
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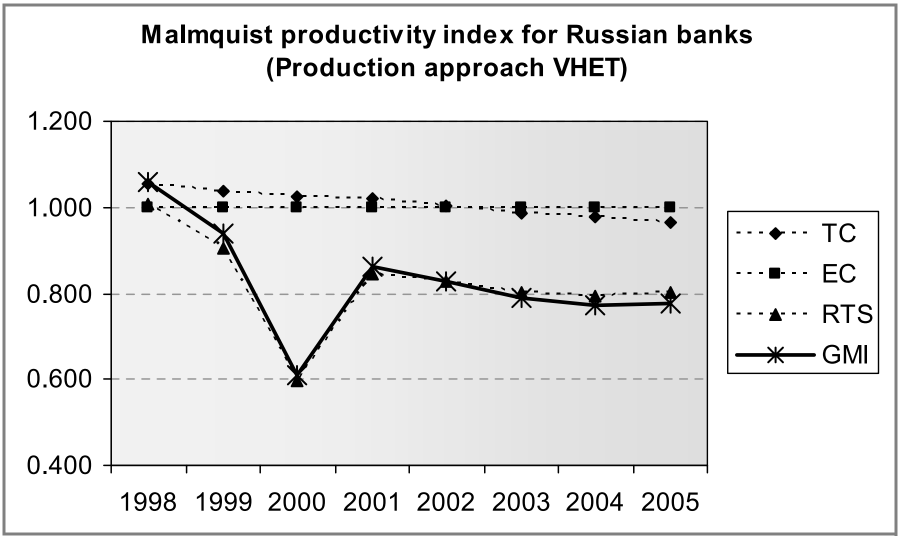
2005
TC
EC
RTS
GMI


Malmquist productivity index for Russian banks
(Production approach VHET)
1.200
1.000
0.800
0.600
0.400
1998
1999
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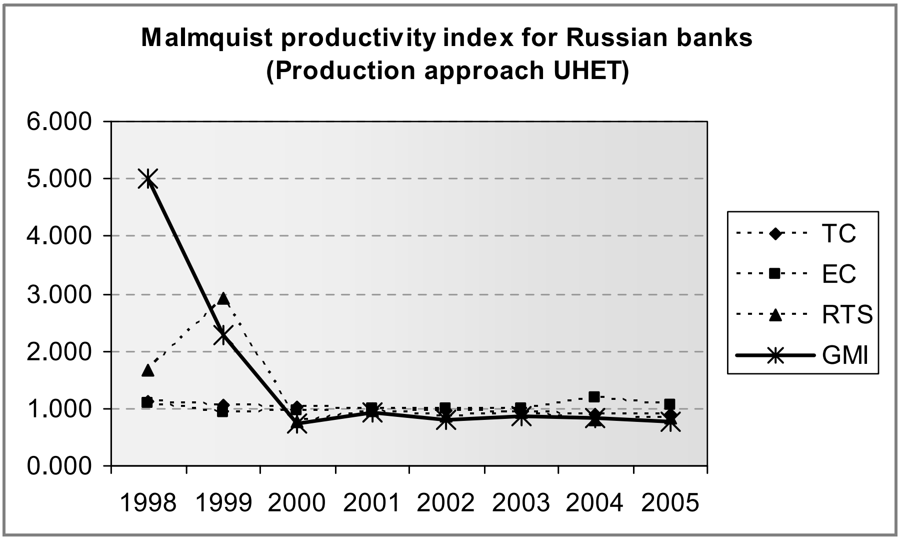
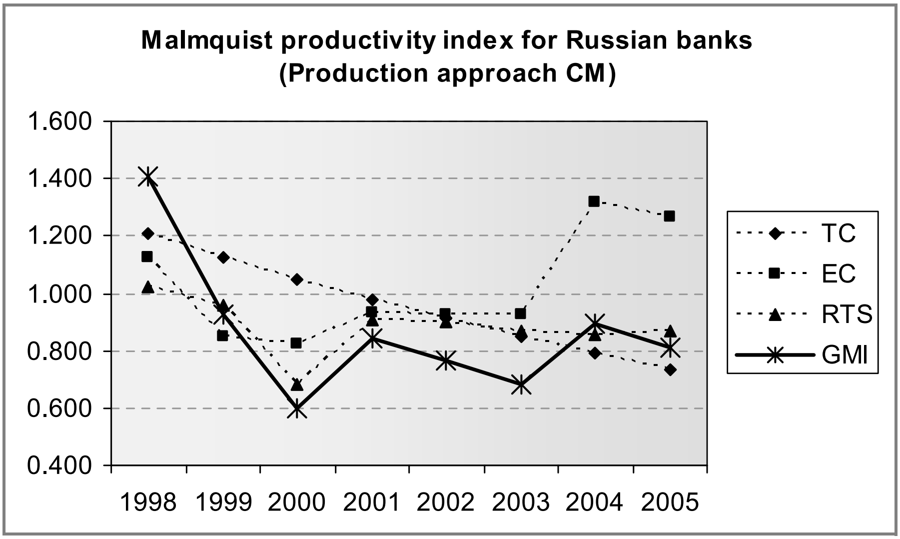
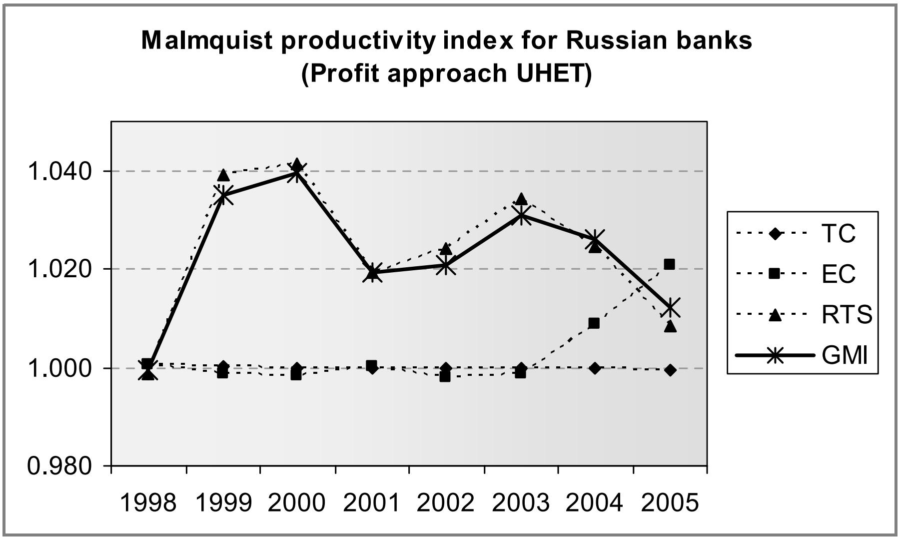
2005
TC
EC
RTS
GMI


Malmquist productivity index for Russian banks
(Production approach UHET)
6.000
5.000
4.000
3.000
2.000
1.000
0.000
1998
1999
2000
2001
2002
2003
2004
2005
TC
EC
RTS
GMI


Malmquist productivity index for Russian banks
(Production approach CM)
1.600
1.400
1.200
1.000
0.800
0.600
0.400
1998 1999 2000 2001 2002 2003 2004 2005
TC
EC
RTS
GMI


Malmquist productivity index for Russian banks
(Profit approach UHET)
1.040
1.020
1.000
0.980
1998 1999 2000 2001 2002 2003 2004 2005
TC
EC
RTS
GMI

We can expand on the finding that the returns to scale profile is the dominating characteristic of productivity growth, by reflecting on the components of the productivity index. The first two components capture the pure catching up and the pure frontier shift aspects of productivity change. We have already identified the fact that efficiency change is virtually non-existent, and that adoption of new technology has been slow and hesitant. The returns-to-scale-effect is computed by weighting the components of individual output change by the shadow price elasticities of the input distance function, *i.e.* after allowing for input change. Consequently, the main driving force in the productivity change can be identified as the volatility of output growth. In the Intermediation and Production approaches therefore, productivity change is essentially a reflection of the volatility of loans in the post crisis era, and in the profits approach, productivity change reflects the volatility of the interest and non-interest income of the banks. In the estimated model, we chose to fit an input distance function which modelled the banks as competitive cost minimisers for whom output demand is exogenous. The fact that productivity change is chiefly driven by output volatility (net of input requirements) is indicative of the highly variable and risky environment in which the Russian banking system was operating in these years.

The analysis of the potential factors affecting the performance of Russian banks suggests that the banks engaged in the retail banking along with business banking under-perform the banks which offer only business banking services in the production and the intermediation approaches. However, according to the profit approach the retail banking is profitable form of banking.

Branching network analysis suggests that it is inefficient tactic for banks to increase the number of their branches, representatives or additional offices. The higher number of operating cash points, on the other hand, has a significant positive effect on production technology as well as on the efficiency. Banks with headquarters or branches in Moscow perform better in their banking services productions than their counterparts with branches and headquarters in regions. However, in terms of financial intermediation perspectives the results suggest opposite. Interestingly, although Moscow banks tend to have lower mean inefficiency, the variance of inefficiency is higher.

The results suggest that the foreign banks are less efficient than their Russian counterparts. Our results are thus different from those pertaining to many studies of banking industries in emerging, transition and developed countries (see Bonin *et al.* (2005), Fries and Taci (2005), Havrylchyk, (2006), Sathye (2003), Sturm and Williams (2004) and Fukuyama *et al.* (1999)). However, they are in line with those of Hasan and Marton (2003), who find evidence in favour of inferior operating performance of foreign banks vis-à-vis their domestic counterparts in their studies of transition banking. In addition, more recently Lensink *et al.* (2008)

provide evidence of a negative effect of foreign ownership on bank efficiency in their analysis of over 2000 banks in 105 countries. In line with these authors, we cite conditions of the banking system and of the economy as reasons for the under-performance of foreign banks. In addition, the size variable has a positive impact on the production inefficiency. Given that most large banks are state-controlled, this results indirectly suggest that state banks lag behind banks with non-state ownership.

According to our results, the year 1998 had a positive impact on Russian banks. Additionally, during 2004 when Russian banks start participating in the deposit insurance scheme the efficiency levels were significantly lower. However, for profit generating activity the introduction of deposit insurance lowered the variance of inefficiency. In 2004-05 the efficiency levels were considerably improved suggesting that the deposit insurance has a significant positive effect on banking system.

14.6. CONCLUSIONS

In this study, we have estimated efficiency scores and generalised Malmquist productivity indices for Russian banks over the period 1997 and 2005 using the parametric stochastic frontier techniques which separate the inter-bank heterogeneity effect from the banking inefficiency. This study considers three different approaches to the input/output specification of bank production modelling; the Intermediation, Profit/Revenue and Production approaches. In general, the results suggest that during the considered period Russian banks experienced productivity decline in financial intermediation and banking service production. However, the profit generating activities of the banks were productive throughout the analysed time span. All models across three alternative approaches suggest that the main driver of banking productivity in Russia is the returns to scale profile. We demonstrated that this reflected the volatility of demand for the banks outputs net of the economic use of inputs. This volatility was reflected both in the balance sheet activities, captured by the intermediation and production approaches, and the income account performance captured by the profit approach.

Results suggest that banks engaged in retail banking are more profit efficient than those which offer only business banking services. Additionally, branching network structure has a significant impact on banking production. As the analysis revealed, the most effective type of network structure for Russian banks is one with high number of operating cash points. Branches, additional offices and representatives, on the other hand, have a negative impact on technology and efficiency. Interestingly, we also find that those banks with 100% foreign stakeholders tend to perform less well than their domestic counterparts. The results also suggest that larger banks lag behind. Given that the largest banks are state-controlled, this indirectly implies that state-controlled banks are less efficient. Finally, our findings support the view that deposit insurance scheme has a positive effect on banking system performance.

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15. Practices as a Business Strategy for Improving Productivity: Summary of a Panel Discussion

Marco Colagiovanni, Martin Czurda and Roger H. Hartmann

15.1. Banking on Lean – Marco Colagiovanni

This presentation is split into three sections – firstly a brief presentation about Dexia, secondly an explanation of the lean methodology used by Dexia and thirdly the lessons learned.

15.1.1. Presentation of Dexia

Dexia has more than 35,000 employees worldwide – Mainly in Belgium, France and Luxembourg.

The strategy of Dexia is based on 2 pillars: firstly, as a retail bank in Europe and secondly offering Financial Services for the Public Sector worldwide.

As a retail bank, the revenues come mainly from Europe. Dexia has more than 6 million retail clients.

For the Public Sector (Government Financing), this is more global. Dexia is present in more than 30 countries.

15.1.2. The Lean Approach at Dexia

Dexia calls its lean approach 'PRISM'. The quality of the refraction depends on the quality of the Prism! The white light (= the product or service delivered to the client) is the result of the association of the basic colours of the spectrum (= the steps of the process delivering this product or service).

Prism is the principle Dexia follows.

As in a factory or in an organization – the quality of an output depends on the quality of the process delivering this output. The response time and quality of the response to the demand of your client is as important as the price or technicalities of the product you offer.

This is why Dexia speaks of an 'end to end' vision: from the need expressed by client to the response he receives. This is how Dexia is improving the level of satisfaction of its clients to differentiate itself from the competition where product in itself becomes more and more a commodity.

There are 3 different steps in the methodology: Listen to your client – Be aware of your competitive position – Apply the principles of the lean methodology.

15.1.2.1. Listen to Your Client

What does your client want?

For credits, he wants a quick decision… What does 'quick' mean? Is it 2 days? Or 3 days? For the delivery of a banking card, he does not necessarily look for speed but for day-certainty.

The client also wants a professional service… What does 'professional' mean? And who should be 'professional': The person behind the counter? The financial advisor? The call centre operative answering his call? The back-office operator writing a letter to explain a mishappening?

Ask the client the right questions in order to know what he really wants! Otherwise you run the risk of improving the process on a dimension that is not the most important for him.

15.1.2.2. Benchmarking

How do we compare to our competitors? Differences of productivity can be detected between 2 or more institutions. It should be noted that benchmarks are not used as absolute targets (because of comparison mismatch) but rather as a question-raising mechanism: where do the differences between Dexia and the benchmark lie? Is this a possible source of improvement for the bank?

These differences can notably be explained by differences in the processes. It is important to say that if you increase the satisfaction of your client, this does not contradict with an increase in productivity. Lean can improve both efficiency for the bank and satisfaction of the clients.

15.1.2.3. Apply the Principles of the Lean Methodology

Now, we know more precisely what the client wants and what our competitors can deliver. The next step is to understand how your department works. What works well? What doesn't work?

A good analysis of waste (*e.g.* redundant steps, idle time, rework, process interruption, unnecessary displacements, systems mismatch, overquality, etc.) will lead to focus on possible cost reduction. It also shows that in most cases, waste happens mostly between departments, not inside it. This helps in convincing the managers to better work together, rather than pressing each manager to do better for its own part of the process. This transversal co-operation between managers allows for a working environment to be created which is favourable for the succesful implementation of the change.

Once you understand the current situation of your organisation, the question is how can you really optimize it? Which decisions do you have to take in order to reach a higher level of Efficiency & Satisfaction from your clients? How can you do that? How can 'Lean' help you? To optimize your processes, you have to search and reduce the waste.

A first analysis is the time analysis: the 'do time' of activities adding value for the client; and the time spent to other activities or no activities. A lot of studies show it's easier to work on the 'waiting time' for 2 reasons:

1) the improvement potential is enormous. The waiting time represents on average 70- 90% of the total time a process takes!
2) if you focus the study more on procedures and systems – and not on people – it's better for the management acceptance – Instead of pressure on the people which gives resistance, it's often better to focus your analysis on the 'waiting time'.

A second analysis is to work on making the process flow by breaking down the barriers between process step, which allow for better load balancing, back-log reduction, flexibility and motivation of the employees. For example, in the domain of credit, the concept 'lean table' allows for an enormous reduction in the duration of the process. In this concept, everybody is around the table!

The control of the file, the analysis and the confirmation of the decision are done by various people around the same table. Everybody has a view on the work and difficulties of each other. Communication is optimal. If some documents (proof of salary) are not present at the moment of the 'check in', it does not have to stop the process – it does not have to create waiting time! The analyst can begin his work without interrupting the process. At this moment, the person responsible for the confirmation of the decision is automatically informed that he will probably not receive this document and that he will send an acceptance letter with a 'conditional agreement'. The advantages of the lean table are evident: better coordination – positive work climate and better productivity.

15.1.3. Lessons Learned

Until a few years ago, the Lean methodology was mainly used in the industries. However, it can also be a reference in the services sector. Not only does it meet the customer's expectations, it also increases the productivity of the process by some 10 to 20% depending on the previous scope.

The follow-up of the processes' performance processes is very important. The KPI (Key Performance Indicators) must be followed up, however especially assessed compared to the permanent assessment of the clients' expectations as well as to the initiatives taken by the competitors.

Dexia took part in a survey organized by the recognized Belgian Vlerick Management School academy, in order to assess the level of maturity of our organization in the field of process management (BPO – Business Process Organization).

The results are interesting.

In the beginning, return on 'process investment is negative: the organizations start with a low level of process maturity, and the people are not aware of the potential impact of the processes. The level of maturity – as perceived is lower than the already low real level... In other words, the people are not aware of the low investments of the organization in the field of process development.

This is where you decide to either stop or continue to invest, to reach the phase of positive investment: then the company reaches a level – we think that Dexia has passed this mark – where the colleagues are beginning to link every operational improvement to the optimization of the processes. Within these organizations, the colleagues are aware of the importance of the support of the processes in order to carry out the activities they are responsible for.

In some organizations, which are very much ahead in the field of processes, the people's perception of the maturity level of the processes can be higher than the real level.

15.2. CEE BANKING: PRODUCTIVITY GAINS THROUGH M&A – MARTIN CZURDA

15.2.1. Executive Summary

This paper starts by outlining the conditions that had made CEE such a compelling region for banks from the early 90's until mid 2008, followed by a short section dedicated to the effects of the current financial crisis and the changed economic outlook. It will be shown that international banks entered the CEE markets mostly via greenfield operations until 2000, after which acquisitions became more important in the race for market share. In this context, the expansion of Raiffeisen International and the measures it has taken to improve productivity are examined. In the next section, a few examples including the acquisitions of Hungarian OTP and the merger of two Russian regional players to become URSA Bank are discussed to illustrate the potential effects of M&A on productivity. The last section wraps up with some key conclusions. The findings suggest that productivity gains after M&A transactions in CEE have been dependent upon a variety of factors, such as size of the acquisition target, choice of market and the structural overlap between the potential buyer and the bank to be acquired.

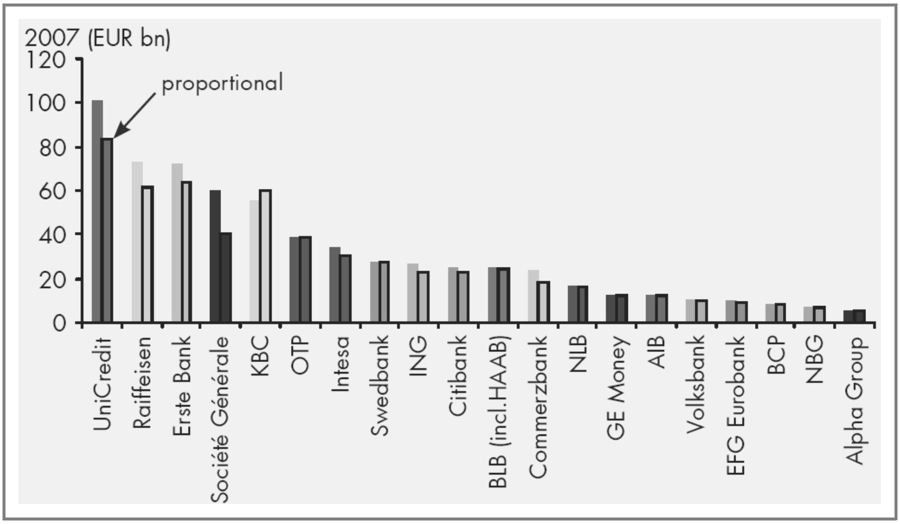
15.2.2. Introduction: The Growing Interlink between Western and Eastern European Banks

Since the 90s, a number of favourable developments in the European macro environment have turned CEE markets into a promising alternative for international banks. While Western European markets had become increasingly competitive and low yielding, financial integration in Europe, economic convergence and privatisation programmes in the CEE countries offered great potential.

The initial 'positioning' phase by the international banks was followed by a phase of expansion sparked by high growth rates and low banking penetration in CEE economies. Acquisitions increased as a means of market entry and later, of increasing market share. Most of the acquisition targets were former state banks operating with relative inefficiency, offering international banks a great potential for productivity gains. According to PWC, European banks spent 27 bn Euro on 89 transactions buying stakes in CEE banks between 1996 and 2006. Between 2004 and 2007, international banks increased their market share in the region from an average 60% to almost 70% (interestingly, private domestic banks lost more ground to them than state owned banks: 6.4% vs. 4.6%)[1].

[1] Source: PricewaterhouseCoopers: European Banking consolidation; April 2006.

Figure 1: International Banking Groups in CEE by Total Assets. 'Proportional': Assets of Majority Owned Subsidiaries do Account Only by the Percentage of Ownership



Source: Raiffeisen Research (2008).

15.2.3. The Impact of the Financial Crisis and the Future Economic Slow-down

While the 'subprime crisis' in 2007 was not severe enough for researchers to fundamentally review their assessment of the CEE banking market, the deepening of the financial crisis through 2008, and the liquidity shortages among the Western banks, especially those with a high leverage factor, has left no doubt that the outlook is deteriorating. However, all of this does not change the fact that the region is still heavily 'underbanked', as signalled by the banking penetration rate (total banking assets/GDP), and therefore the region as such maintains a high potential. Banking penetration, in terms of total banking assets/GDP, has reached 89% in the CE region, 82% in SEE and 63% in CIS in 2007. For comparison, the figure was 251% in the Eurozone[2].

Banking groups in CEE have been relying on growth in their strategies. Growth seemed plausible due to a number of factors. E.g., the assumptions of OTP for their markets in the region included an annual real GDP growth of more than 5%, considerable growth of household consumption and steady export growth. The other two factors listed by OTP are the deepening of financial intermediation, *i.e.* rising demand for financial services and moderate margin compression[3].

2 Source: Raiffeisen International 2008.
3 Source: OTP Investors Day 2008.

Investors in banks were probably too focused on the C/I ratio to be stable or decline. But as data from the 2008 CEE banking report of Unicredit (published before the crisis) illustrate, cost income ratio is of limited effectiveness in predicting the efficiency and financial flexibility of a company[4]: In the CE markets, both costs and profits were expected to grow at the same pace with provisions growing faster than both. In SEE, costs were expected to grow faster, at the expense of profits. 'Broader Europe' (which includes Turkey, Russia, Ukraine, and Kazakhstan according to the Unicredit definition) was expected to face a situation where profits would slow because of increased costs. With revenue growth strongly decreasing in the next years and refinancing costs sharply increased, banks will need to cut costs, especially if they are willing to maintain their profitability targets. According to a recent McKinsey survey, 71% of the companies in financial services will reduce operative costs before 2009, and 20% will also leave certain markets in the rest of 2008[5].

15.2.4. Raiffeisen International in CEE

Raiffeisen International has been one of the true pioneers in the region. The first branch was opened in Budapest as early as 1986, while the first acquisitions were Market Banka in Bosnia Herzegovina in 2000 and the Romanian Banca Agricola in 2001. What exemplifies Raiffeisen's pioneer spirit even better is the fact that the Croatian branch was opened while the Balkan conflict was still raging. The group's preferred channel of market entry was greenfield operations until 2000, thereafter acquisitions proved to be more efficient. The biggest acquisitions to date have been Ukrainian Bank Aval and Russian Impex Bank.

Raiffeisen International created a dedicated staff unit to target gains in efficiency. This was deemed preferable to the hiring of external consultants to identify and execute potential productivity enhancements. This staff unit introduced the Six Sigma standard to increase Raiffeisen International productivity in 2003. Almost every year, further measures have been taken: Procurement was reinforced by introducing BMPS (Business Procurement Management Systems) and proactive management of the purchase base. In 2006, the centralization of back office operations paved the way for shared service centres and capacity management. While all of these measures are ongoing, in 2008 Raiffeisen International's new efforts on the cost side concentrated on regional operations centres.

Most acquisition targets in CEE were former state banks. Usually, these banks had a cumbersome structure with a head office and various regional hubs. These regional hubs operated autonomously and comprised all functional departments

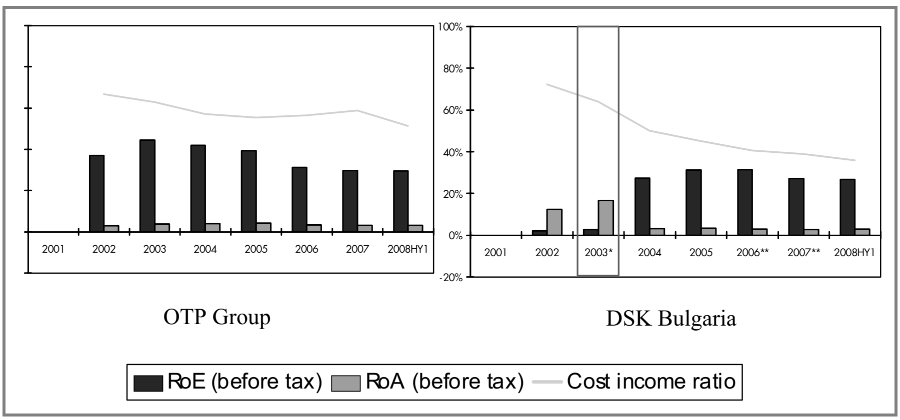
[4] UniCredit Group CEE Research Network: CEE Banking – Still the right bet; July 2008.
[5] McKinsey Global Survey Results: Economic Conditions snapshot, November 2008.

(accounting, transaction management, etc.). Therefore, Raiffeisen basically carried out a total restructuring after each acquisition. All organizational functions except for Sales have been centralized: IT, clearing, admin, back-office and so on. A very prominent outcome of this policy was the construction of a large back-office centre in Kherson, Ukraine, where all back office activities for the Ukrainian retail operations have been bundled. In later steps, back-office activities for branches in other countries will be carried out as well, boosting the number of employees from currently 300 to 1,000.

15.2.5. OTP and the Productivity Development of its Acquisitions

We have examined three of OTP's acquisitions whose performances were either excellent or especially weak on productivity figures. A very positive example was set by their 2003 acquisition of DSK Bulgaria. DSK Bank achieved major successes in its first full financial year as a member of the OTP group. After-tax profit was up 51.1% in 2004 compared to 2003, ROAE was at 19.2% and CIR fell from 64% to 50%. However, DSK was very likely to develop that well as it was the most correlated with the parent bank in scale and structure among the potential targets – the 'OTP of Bulgaria', as Raiffeisen research analyst Akos Hercenik put it. For instance, DSK was already a market leader with a developed network and branding at the time of acquisition. Its efficiency was better than average, especially on the cost side through economies of scale. An experienced and well established management and several development programmes in IT, risk management and other departments were all well developed to the benefit of OTP.

Figure 2: OTP Group's and DSK Bulgaria's Performance in Key Financial Indicators

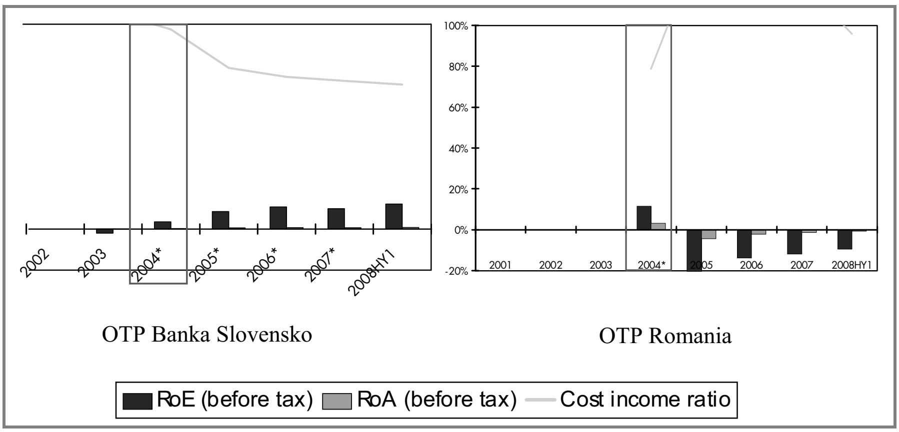


Source: OTP.

In Romania, another high-growth CE market, the original plan of OTP was purchasing one of the bigger banks in order to achieve economic scale and access to a sizable deposit portfolio. However, Robank and its subsidiary, Robinv SA, were officially acquired by OTP Bank on 30 July 2004. Following the acquisition, OTP Bank increased the company's capital by EUR 10 million, almost doubling it to HUF 5.3 billion. Tightening market conditions and worsening profitability in general, paired with an increase in minimum reserves requirements in 2006, interrupted the development of the Romanian operation, causing a negative RoAE. CIR soared to 142.2% in 2005 and was still at 121.7% in 2007.

Also in Slovakia, OTP originally wanted to acquire one of the bigger Slovakian banks. When OTP entered the market by buying IRB, there was already a very competitive environment on the market dominated by few big players. IRB had a small network and low quality portfolio at time of acquisition. The bank had also lost some major state owned corporate clients as they were privatized and the bank was generally operating in the less developed part of the country. OTP considers Slovakia to be a possible divestment at the time of writing. Despite the good overall economic environment, the profitability of the Slovakian banking sector actually deteriorated in 2007, with the average return on equity of the banking sector at 14.2%, which is a rather modest ratio by regional standards. OBS only slightly underperformed against the national benchmark by 2.4%, but by the clear margin of 12.9% against the consolidated group benchmark.

Figure 3: Key Financial Indicators of OTP Subsidiaries Banka Slovensko and OTP Romania

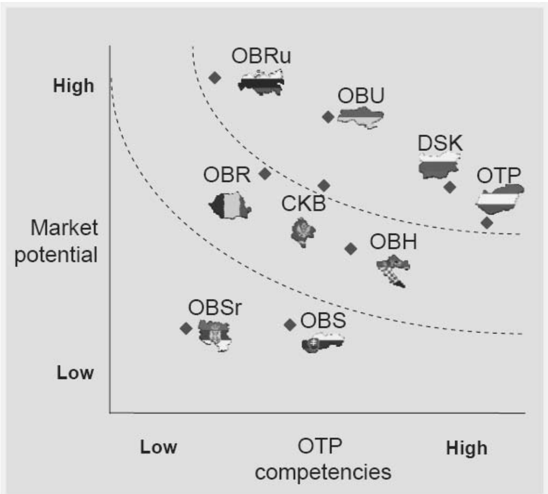


Source: OTP.

15.2.6. A Comparison of the Market Segmentation Approaches

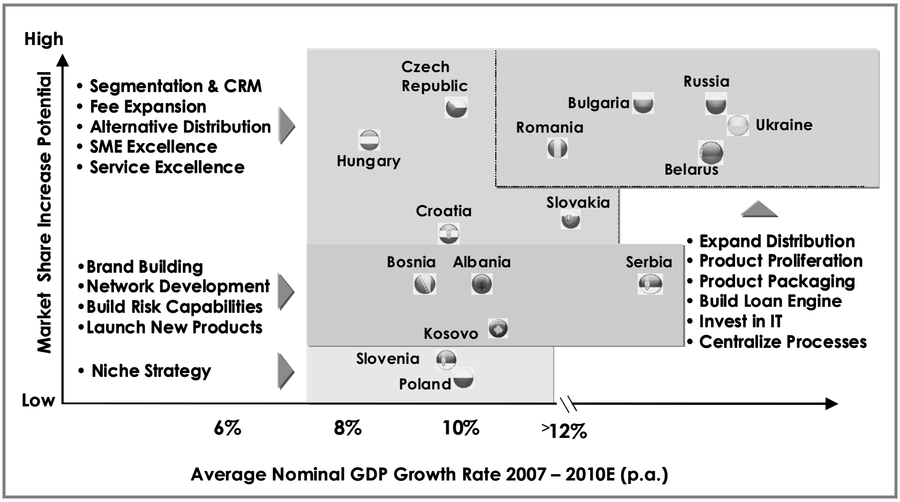
15.2.6.1. Segmentation Approach of OTP

We can observe some fundamental differences in the approach how the two banks segment their markets. These differences reflect to some extent the two companies' strategic approaches. As a general outline, OTP has already started to follow a more selective approach in markets and business segments. This is a result of OTP's recent strategy modification, which considers single markets and business segments as investments and judges them as such. That clearly expresses a need for profitability in each market; underperformers are reduced to a 'portfolio market' status (as opposed to 'strategic market') or in less profitable cases, considered potential divestments. To illustrate the approach, OTP uses the following chart:



15.2.6.2. Raiffeisen's Retail Market Segmentation Approach

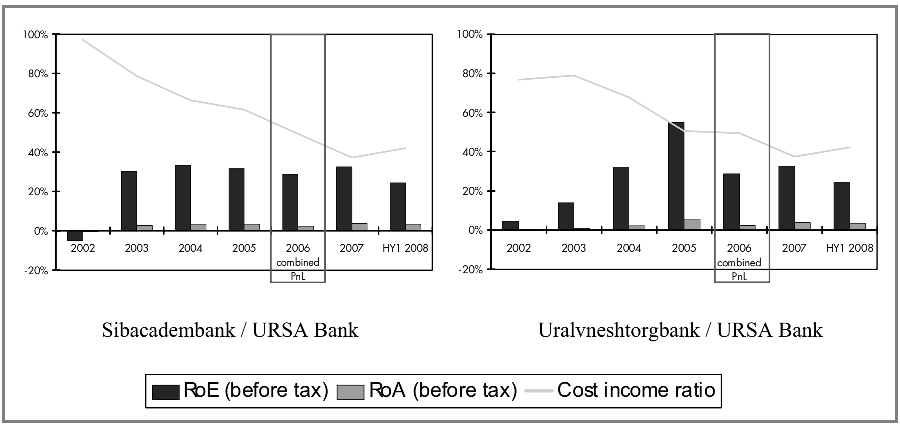
Raiffeisen International has so far embraced a more aggressive approach that relies more on high growth and the long-term potential of the region. The result is a more expansive strategy, which the group shares only with two other competitors, Unicredit and Société Générale. Raiffeisen divides its 15 local retail markets in four segments. These are defined by a combination of expected average GDP growth and the potential to increase market share. (See chart; expected growth estimates reflect pre-crisis assumptions. Mid-term goals will be reviewed.)



15.2.6.3. Russian Regional Player URSA Bank

In 2006, URSA arose from a merger of Uralvneshtorgbank and Sibacadembank. The rationale behind the SAB/UVTB merger was based on advantages such as a larger branch network, better capital position, diversification of the client base, improved ratings, higher league rankings, better efficiency and economies of scale. Before the merger, SAB was a Top 50 bank, and UVTB was a Top 70 bank. Post-merger, the combined bank immediately became the 22nd largest in the country.

Figure 4: Key Financial Indicators of Sibacadembank and Uralvneshtorgbank before and after the Merger



Source: URSA Bank.

The new institution improved its efficiency by cutting a variety of redundant functions – *e.g.* Legal, IT, Treasury, Accounting. There were considerable business synergies, *e.g.* Ural had a strong IT platform, and SAB had extensive retail expertise from being one of the retail banking pioneers in Siberia. The performance gains were immediately reflected in a better CIR (49.4% in the combined bank versus 61.7% in SAB and 50.5% in Uralvneshtorgbank the year before the merger). URSA is now the largest of a group of banks controlled by Mr. Kim and his business partners. In Q1 of 2008, the group dramatically outperformed the Russian average of 19.0% RoAE at 32.6%[6].

On December 3rd 2008, MDM Bank and URSA bank announced their merger to become one of Russia's largest private universal banks. The merged bank will hold assets of RUB 523 bn. Among the benefits are complementary geographic regions, economies of scale and an increased funding base. The combined bank will reach every district of the Russian federation through nearly 500 branches. The merger process is expected to take up to 18 months; meanwhile the bank will continue to operate independently.

15.2.7. Conclusions

From the experiences of RZB's subsidiary Raiffeisen International and the cases of OTP, URSA and others (not included in this paper), we have drawn a number of conclusions regarding the potential for productivity gains through M&A transactions in the CEE banking market:

The right choice of markets. Significant exposure to those markets with the highest growth prospects is necessary for banks to benefit to a certain degree that offsets the cost of entry. The costs for misguided investments into the wrong markets can be very high as these choices can lock in resources that could be put to a more productive use elsewhere.

Size matters. In large and fast growing markets, lack of size can results in missed opportunities. In addition, complementary acquisitions in already covered market can increase an institution's base supporting the structural cost of operations. Size allows for economies of scale, but the efficiency potentials comprised therein need to be actively realized. As margins shrink, acquisitions must allow the execution of synergy potentials in terms of more efficient operations and/or financial synergies.

Small markets, niche strategies and outsourcing to regional hubs. In smaller markets, a minimum size must be reached to offset the cost of acquisition and integration within a reasonable time horizon in order to avoid misapplication of lim-

6 Source: URSA Bank 2008.

ited resources. When acting in such a market with a niche strategy, focus on client categories and transfer of knowledge and technology become even more crucial as economies of scale cannot be exploited to the same extent. Major efficiency enhancements are possible by creating regional and cross-boarder hubs, *e.g.* for back office activities, which can enable cost efficient operations in many smaller markets even when the individual market shares are small.

Fit of competencies and knowledge transfer. Customer and product knowledge is more easily transferable when the acquisition target is already operating in similar business segments. When entering a new market or a new business segment, part of the acquisition price is paid for the knowledge of the target's management of the market or sector. Therefore, staff (and thereby, know how) retention is extremely important. Knowledge transfer to the acquiring company or the existence of applicable knowledge in other divisions of the holding company can serve as strategies to decrease dependence on the local management.

Identifying operational productivity potential. When screening potential acquisition targets, low productivity figures mostly mean potential. Operational productivity ratios that help decision-making are: volume/employee, clients/branch, clients/employee or even calls/hour or transactions/head when *e.g.* assessing call centre or application processing productivity. Automation and straight through processing allow a great deal of operational productivity gains.

Timely restructuring. Most acquisitions happen in a situation where operational expenditures are high (measured against assets), in a market that allows for high margins. After the takeover by an international bank, there is a natural migration in the cost/margin structure as operational efficiency increases while margins usually decrease due to increasing competition. If an institution fails to increase efficiency faster than margins decline, it is trapped in an opportunity cost vs. cost of abandon dilemma. Feasible strategies are therefore needed to cover both the cost and the income side. International banks have an advantage in that they strongly target determined client categories using know-how and technology from other markets.

15.3. IMPROVING PRODUCTIVITY IN WEALTH MANAGEMENT – ROGER H. HARTMANN

15.3.1. What Is Wealth Management?

Wealth management means offering holistic advice and a broad range of wealth management solutions, tailored to the needs of wealthy clients. Wealth Management is used as a generic term for the management of assets. This includes wealth management for private as well as for institutional investors. Wealth Management can be divided into two sub-categories: Private Banking and Institutional Asset Management.

It is a very fragmented financial industry where the largest player, UBS, has a market share of only 3%. The top ten of the industry represent only 15% of the global wealth management market. It is not so much a cost conscious industry as the focus lies really in scalability, volume and high-growth potential. These three elements are deeply linked to the history of wealth management. You cannot really be profitable if your size is suboptimal and this created over the last ten years the first moves towards a concentration process. What we have seen so far in the market are large players buying small players, or small players buying small players. What we have nearly not seen so far, but history could change rapidly due to the financial crisis are large players buying large players. In the wealth management industry you have only two ways to grow: organic growth, which means the establishment of greenfield projects going into new markets, emerging or not, or aggressively hiring client advisors from competitors. The other way to grow is the acquisition process which was and will always be a sensitive process due to the key importance of the human being, a central dimension for this profession. The consolidation drivers are the following: looking for a better scale effect is the primary transaction motive, particularly for smaller banks. Accessing new growth opportunities in new emerging markets is another important driver for consolidation. Finally, accessing new client segments, like Ultra High Net Worth Individuals (UHNWI) or core affluent, are also important parameters. Needless to say that since 1990 the business complexity has increased dramatically driven by more sophisticated clients who are demanding more and more sophisticated solutions and leading-edge investment products. This element was the main driver of a higher cost base in wealth management over the last 15 years. This of course generated since 1995 a battle for scarce resources, as everyone wanted to attract and retain the best highly skilled professionals.

Having all these constraints in mind, the big question is to know how to be more effective and how to improve productivity? There are only two parameters to work on: one is the cost side, where operational efficiency and reengineering could bring a better control over this important dimension, the other one being the income side meaning that we should improve the quality and effectiveness of the client service delivery.

15.3.2. The Luxembourg Private Banking Group: A Best Practice in Terms of Industrial Clustering and a Major Contribution to Enhanced Efficiency

Created in 2007, the Luxembourg Private Banking Group represents more than 60 banks active in the wealth management industry of Luxembourg and representing roughly 95% of the private banking assets under management booked in this financial centre. The driver of this industrial cluster is very much in line with all other experiences, financial or non financial, seen so far over the last 20 years. The main goal is to pool and mutualise where it makes sense, knowing that if every single bank would do it on its own, the global cost for the financial centre would be just simply huge. Seeking better efficiencies as a cluster is therefore a major motivator of this group. Let us go through a certain number of best practices:

- training and education: Probably the most obvious example, as it would not make sense for every bank to put in place its own wealth management education centre. The goal is to cover systematically all the needs from basic Private Banking requirements to PhD and research programmes. The lower levels of delivery are already well in place with a good response from the market and the Private Banking Group is currently working on the superior levels addressing internationally certified education, high-end master programmes and PhD environment;
- benchmarking and peer-comparison: Every cluster needs some basic statistics in order to know where it is positioned. Prior to the creation of the cluster, private bankers were not able to identify their respective positioning towards the financial centre, and have also no clue how the wealth management industry in Luxembourg is positioned towards other competitive financial centres like for example Switzerland, London or Singapore. With the active support of our regulator, CSSF, we are today able to perfectly understand the dynamics of our cluster, the strengths, the weaknesses, the opportunities and the threats;
- tax reporting: Luxembourg's wealth management clients being in most of the cases residents in other countries, the tax reporting is a key element of the delivery to be provided to our clients once a year. If every bank wants to do it for all its clients in all its various markets, the price of such a project would simply be unrealistic due to the enormous resources you need in order to establish such tax reportings. The fact to mutualise the cost in order to establish such tax reportings is the most efficient way to produce quality delivery at a very reasonable cost. Private Bankers are reasonable managers, and they know that you do not compete with a 'must', meaning that the Unique Selling Proposition of a tax reporting disappeared long time ago;

- promotion abroad: In such a small country like Luxembourg, trade missions of LuxembourgforFinance are important. If the fund industry via ALFI has a marvellous track record of professional presence at the road shows organised by the promotion agency, wealth management is today, through the cluster, a new active partner selling our financial centre in Europe and overseas;
- strategy: During these changing and challenging times, it is more than important for such an important cluster, in fact a key player on the Luxembourg financial centre, to have a clear action plan for the mid to long term future of the cluster. It is of utmost priority for the 60 over private bankers to know into which direction we are going in the environment of 2012/2015;
- industrial threats: A key role of the Private Banking Group is to establish a common approach on industrial threats like for example the various pressures exercised on the regulatory side, having particularly in mind the importance of privacy and confidentiality for the wealth management industry in a place like Luxembourg. Coordination on wealth planning innovation is important too as we need to keep in this field our competitive edge looking at attractive tax optimized solutions.

It is important to respect the limits of such a cluster. If we have a look at the 'do's' a common view on our SWOT analysis is central in order to better position Private Banking in Luxembourg with a long term view. Looking at the 'undo's', it is so important to respect the fact that we have individual banking strategies with different focuses, different priorities. The positioning of each bank is decided by their respective executive board. The same is valid for product offering, the different markets to be addressed, the client segmentation to be used and the pricing strategy.

15.3.3. Efficiency Gains in Wealth Management

The most relevant key performance indicator of the operational efficiency of a Private Bank is the so called cost/income ratio (C/I ratio). In Europe this ratio did not stop to decrease since 2003. If we look more in detail what happened, we see that income increased very much above average but the cost side was moving too much in parallel. The scissors are just not open enough. As already said earlier, cost management is not in the portfolio of best practices of the traditional Private Banker. In wealth management, cost is very much related to the performance based remuneration of the personnel, which represents between 60 to 70% of the total cost of a private bank. We need here to emphasize that it is a relationship business where the human being plays a totally critical role, which is less the case in the retail banking business. What is going on now? Since September 2008, income is definitely going down due to a weak market performance, an AuM (Asset under Management) basis which is shrinking, clients moving out of so called sophisticated products, who are all looking for safety and cash, which of course has a clear negative effect on revenues. In this environment, it is totally key to be able to reduce the cost base, meaning to look for a better operational efficiency and reengineer the cost side, if the private bank does not want its C/I ratio to explode again.

Let us have a detailed look how we could work on the C/I ratio in order to avoid a too massive increase of this key performance indicator.

The effect on I: How to minimize the impact on the income in a down turning market? A good customer relationship management (CRM) could be an excellent leverage as we have a much better coverage of all the client information, the information is much more tailor-made with efficient access, the cross-selling is permanently stimulated and it can enhance better synergies with the retail banking part of the financial institution. Important to take note is, that online services can differentiate from competitors but will never replace personal touch. Online is therefore a competitive advantage, internet as a new technology has to be on the map and it can certainly represent an additional choice, but is not a substitute for relationship managers.

The effect on C: How to produce a lower, flexible, more valuable and scalable cost base? In a smart operational business model we have to free up back office resources in order to reallocate them to front office. This would bring lower cost levels and a greater sales force, which would bring additional volumes.

But how to free up back office resources?

We have the following solutions:
– outsourcing: The private bank takes the decision to outsource its back-office to an external service provider situated within the country or outside of the country;
– off-shoring and near-shoring: The idea here is to transfer these back-office resources to service centres situated in places where you find qualified resources at a much lower cost than in your own country. Near-shoring is a word used for low-cost locations situated not too far away from Luxembourg, like for example Central or Eastern Europe. Off-shoring is the concept used for low-cost locations situated overseas, typically in India or in China;
– shared service centres: For example all the back offices resources of a Private Banking Group are centralized into one single service centre. The same could be imagined among smaller players who decide to pool together their back-office resources in a joint venture which will address all these services;
– the ‘bank in a box’ business model managed out of a hub: In this case the private bank is centralizing and pooling all back-office resources for foreign locations which are very lean, having only client advisors and direct support

at their disposal and all the back-offices function are exercised within the hub. This business model is more and more common in Luxembourg as you can fully leverage the strength of the European passporting.

What are the advantages of these smart operational business models:
- you can effectively reduce costs and create a more flexible expense structure;
- you can fully focus on front activities, the ones generating the revenues paying the bonuses of the employees, and paying the dividends to the shareholders;
- you have full access to expertise and scale in these defined back office factories;
- you have enhanced flexibility in order to respond to external changes coming from the market;
- with the increased scarcity of highly skilled staff, these pooling solutions represent a very good solution for a post baby-boom environment. But let us be conscious, this will only work if delivery is of high quality. If not, the business model will never survive.

What about lean operations:

The principles valid in the manufacturing industry are also valid for the wealth management cluster. The techniques of lean banking and Six Sigma are easily implementable in the banking industry in order to create service factories where enhanced efficiency and straight through processing are in operation at each level.

Technology transformation is therefore required in order to move in such waters. Infrastructure, new applications, architecture, all this requires a strong dialogue between the business line (front office) and the IT department and finally it is all about feeling operational excellence at all levels of the private bank and this can only be reached via a relentless focus from the senior management of the private bank.

15.3.4. Conclusion

Let us go back to the very initial question put on the table "How to improve the productivity in wealth management knowing that the human being plays here such a critical role?" Action could be envisaged at different levels:
- important is to begin with some quick fixes, which will at an early stage demonstrate substantial short term impacts demonstrating to all the employees that the cost base has to be managed in a proper way;
- ongoing cost improvement: After the good results of a quick fix we need to work on the institutionalisation of key principals linked to cost savings. They have really to penetrate the culture of the private bank over time;

– fundamental re-design of the cost base: This is definitely a multi-year programme where the goal has to be to realize over time world class performance in cost management.

With the financial crises going on, cost management and cost reduction initiatives are extremely high on the agenda. I strongly believe that in private banking, a good and sound cost management has to be a permanent focus, totally independent from the business cycle we are in. Cost management and operational excellence are not limited to environments where the markets are going down. The years where the Private Banker had little to no focus on cost are definitely over. An active management of the cost base will be his permanent focus, independently of the weather we have outside.

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