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Abstract

To date, Internet banks worldwide have underperformed newly chartered traditional banks mainly because their higher overhead costs. This paper analyses whether this is a temporary phenomenon and whether Internet banks may generate scale economies in excess of those available to traditional banks and/or they (and their customers) may accumulate experience with this new business model, which may allow them to perform as well or even better than their peers, the traditional banks. To this end, we have followed the same analytical framework and methodology used by DeYoung (2001, 2002, forthcoming) for Internet banks in the United States although the limitations in the availability of data as well as the existence of different regulatory frameworks and market conditions, particularly in the retail segment, in the fifteen European Union countries have required some modifications to such methodology. The empirical analysis confirms that Internet banks show technologically based scale economies, while no conclusive evidence exists of technology based learning economies. As Internet banks get larger, the profitability gap with traditional banks shrinks. To the extent that Internet banks are struggling to prove themselves a viable business model, European authorities may encourage a larger number of consumers to use this delivery channel, by tackling consumers´ security concerns. This would allow Internet banks to capture more of the potential scale efficiencies implied in our estimations

1 Introduction

At the time of writing this article, banks worldwide have moved on from the belief that their customers will shift all their banking operations from branches on their transactional web sites. The current conventional wisdom is that the multi channel ("clicks and mortar") banks will prevail, at least in the medium term and this, in turn, has incited Internet only banks to have some sort of physical presence, hence the term "primarily" Internet banks. Nonetheless, the number of on-line banking customers is increasing worldwide although the rate at which consumers are adopting Internet varies enormously, both among countries and among banks within the same country.

For the purpose of this paper, primarily Internet banks are those that rely heavily, although not exclusively (e.g. telephone, ATM), on Internet as a delivery channel. For this reason, some authors refer to Internet banks as being "primarily" Internet banks rather than Internet "only". (For the reminder of this article, the terms "Internet bank" and "Primarily Internet bank" will be used interchangeably). To date, Internet banks have been substantially less profitable than traditional banks both in the United States and the European Union. This is mainly explained by the overhead costs i.e. costs associated with web site development and marketing to gain name recognition, which, contrary to the standard business model often presented by consulting companies, are higher for Internet banks. However, this could be a temporary phenomenon and Internet banks may generate scale economies in excess of those available to traditional banks and/or they (and their customers) may accumulate experience with this new business model, which may allow them to perform as well or even better than their peers, the traditional banks.

We have followed the analytical framework and methodology used by DeYoung (2001, 2002, forthcoming) for the United States Internet banks although the limitations in the availability of data[1] as well as the existence of different regulatory frameworks and market conditions, particularly in the retail segment, in the fifteen European Union countries have required some modifications to such methodology. As in DeYoung´s paper, we have attempted to identify and estimate the magnitude of technology based scale and technology based learning effects of Internet banks that heavily rely on this new technology to develop their business model. These effects are additive to the general scale and experience effects that occur at new banks that use the existing technology (i.e. branches, ATMs). Measuring managerial efficiency or so called X-efficiency is beyond the scope of this study.

We perform regression tests based on pooled annual data sets of Internet and newly chartered traditional banks in Europe, using six financial ratios, representative of the banking financial performance, as endogenous variables. We apply the same two estimation techniques used by DeYoung (2001, 2002, forthcoming): ordinary least squares (OLS) and generalized least squares random-effects (GLS-RE). The results of these tests are in general robust to the estimation technique. According to these results, Internet banks show significant technology based scale economies and their primary source seems to be their ability to control operational expenses even more efficiently than the new traditional banks. However, no conclusive evidence exists that Internet banks access experience effects as a result of the heavy usage of the Internet technology.

This article is divided in six parts in addition to this Introduction. The second part describes the Internet banking landscape in Europe as well as the analytical work on this matter. Special attention is paid to the differences and similarities in performance of Internet

1. More precisely, in this paper annual data from a public financial database is used, whereas DeYoung (2001, 2002, forthcoming) uses quarterly data from a regulatory database.

banks in United States and Europe. Part three presents the financial literature on scale and experience economies on banking in the European Union. Part four describes the objective of the paper and presents the analytical framework of analysis of general and technology based scale and experience economies. Section five describes the data and the sources as well as a preliminary analysis of the performance of three samples of banks: small established banks, newly chartered traditional banks and Internet banks. Section six presents the regression framework and the results of the analysis. Finally, section seven summarizes the article and presents the conclusions.

2 Internet banks in Europe

The United States has led Europe in the speed and extent to which banks have adopted Internet banking as a delivery channel; nonetheless, the number of Internet banks in Europe (approximately 35) exceeded the number of those in the US[2] (20) by mid-2002. However, the market share in terms of deposits of European banks varies significantly per country[3]. Most of the European Internet banks started to operate in the late 90´s but some institutions launched non transactional websites before and/or were using the telephone as a delivery channel. Within Europe, the differences across countries in Internet banking penetration appear to be largely explained by the differences in the availability of access to the Internet. According to an OECD study (2001), France, Spain and Portugal followed by Italy, Germany and Belgium are the group of countries with the lowest rate of Internet penetration[4]. The Scandinavian countries have the highest penetration rates at over 50%, comparable to that in the United States.

In Spain and Portugal, despite the low penetration rate of the Internet, the take-up of Internet banking is at levels above those in countries such as France, Germany, Italy, or even the United States. Scandinavian countries show the highest levels of Internet banking use. The situation in Spain and Portugal compared to that of other countries appears to be somewhat atypical as it shows a level of utilization of this distribution channel above that which would be expected from the level of Internet penetration. Somewhat in contrast, the United States, which has a relatively low level of utilization of this distribution channel for banking in spite of a high Internet penetration rate. This may be due to the lesser importance of the banking sector in financial intermediation and the fact that the Internet has contributed if anything to greater disintermediation via the unbundling of typical banking activities (i.e. micro-payments)[5] [see Delgado and Nieto (2004)]. The technical and financial safety is seen as a crucial factor for the taking-up of Internet banking in Europe. As a matter of fact, the above mentioned penetration rates of Internet banking may overestimate the true utilisation rates since some account contracts may have remained idle, as customers have been sceptical about safety features of Internet banking [see ECB (2001)]. Partly, to respond to those concerns about safety most of the Internet banks have found it necessary to have some form of physical presence and/or use other channels such as the telephone, hence the term “primarily Internet” bank.

In the United States, a considerable number of Internet banks were established as independent start-ups, while in Europe, no meaningful Internet bank has been launched that is independent from an existing financial institutions. This fact is relevant when analyzing the financial performance and business activities of Internet banks in the United States and Europe. In Europe, the long term viability of Internet banks has to be contemplated in the context of the financial group often assuming the specialization of the Internet bank in some market segments (i.e. mutual funds). Moreover, because of early initiatives of the established banks to develop the Internet delivery channels, most of the primarily Internet banks in Europe have been subject to even stronger competition launching offensive strategies based on

2. Sources: ECB and Office of the Comptroller of the Currency. Note, the ECB data also includes dedicated branches (i.e. ING Direct), hence data are not fully comparable.
3. The Internet banks´ deposit share was approximately 0.02% of the French banking market, while it was 1.4% of the Spanish market.
4. The variable representing Internet penetration has been calculated as a percentage of the total population using the Internet in each country. The penetration of Internet banking is the number of customers expressed as a percentage of the total population.
5. Although the development of technology provides many opportunities of entry in the financial services industry, it is not clear that it will remove the central importance of banks by breaking up the present synergies between deposit taking and providing credit lines. Kashyap *et al.* (1999) demonstrate that the need of liquid reserves and other sources would be greater if the two services were produced separately.

pricing aggressively even if it means losing the customer base and profitability of the parent (traditional) bank [Delgado and Nieto (2004) describe the pricing strategy of Spanish Internet banks].

Some of the conditions that cause commercial banks to adopt Internet as a delivery channel seem to be similar on both sides of the Atlantic. In the United States, Furst et al. (2000 and 2002) found that national banks in 1998 were more likely to offer Internet banking if they had large size. In Europe, anecdotal evidence seems to show a similar pattern in some countries, Delgado and Nieto (2004) find that large banks and savings and loans have the largest adoption rates in Spain. However, according to a consulting company (2001) smaller European banks convert existing customers and acquire new ones more actively than their larger counterparts among people who switch banks to use the Internet delivery channel. Brokerage is one of the main drivers used for these banks for acquiring new customers. This is one key difference in Internet bank adoption rates in the United States and the European Union. The take-up of online brokerage in the United States was very rapid [see Furst et al. (2000)] but this did not flow through banks, because they were restricted in the degree to which they could engage in securities activities. Even after the passage of the Gramm-Leach-Bliley Act in November 1999, United States banks are still more restricted in the securities activities they can engage in, as compared with European banks [see Barth et al. (2003) for comparisons of the permissible range of banking activities across countries]. Another important reason for the difference in adoption rates is the continued reliance of United States households on paper checks rather than electronic payments. Paper checks are less compatible with Internet banking, and require physical bank offices for the collection and clearing of checks. Moreover, European Union banks´ familiarity with other kinds of electronic banking (i.e. electronic funds transfers –EFTs–; electronic data interchange –EDI–; electronic benefits transfers –EBTs–; and electronic trade confirmations –ETCs–.) does help banks to move current customers on line.

The profitability (Return on Assets –ROA–) of the European Internet banks was negative on average over the period 1994 to 2002, although about half of those included in this study were showing profits as of end 2001. This finding is consistent with the fact that no matter what technology a new bank is relying on, it is likely to perform worse than a mature bank for a number of years. A common element arises when analysing the non-interest expenses of Internet banks both in the United States [see Sullivan, (2000)] and Europe [see ECB (2001)]: Costs associated with web site development (i.e. software research and development expenses, amortization of purchased software, data processing) and promotion (i.e. marketing) to gain name recognition are higher in the case of primarily Internet banks, due to the fact that they have been recently created, and to the nature of the distribution channel itself [see Delgado and Nieto (2004) for evidence in Spain]. Moreover, the oldest Internet banks that have already been in operation for over three years show a better performance both in terms of ROA and efficiency[6] than the rest of the Internet banks, although their performance still lags that of the average traditional mature bank.

As well as offering advantages, providing banking services over the Internet implies potential risks. Although it is true that the most important risks involved in Internet banking are not new, when compared with traditional banking, Internet banking potentially increases and modifies traditional banking risks and influences their risk profile [see BIS (1998) and (2000); Ciciretti *et al.*[7] (2004)]. A major source of risk for banks is credit risk, however as it is described in part 5-2, net lending over total assets is lower for Internet banks as compared with mature traditional banks [see Delgado and Nieto (2004) for evidence in Spain]. Generally

6. Measured in terms of overhead expenses over average assets.
7. The authors have found, for a sample of Italian banks, a significant positive relationship between offering of Internet banking activities and bank profitability but a negative (but only marginally significant) association between the adoption of internet banking and different proxies of bank risks.

speaking market risk and liquidity risk are greater when customers can transfer their deposits from one institution to another rapidly to take advantage of higher interest rates as it is sometimes the case in Internet banking in Europe [see Delgado and Nieto (2004) for evidence in Spain]. At the same time, strategic and operational risks (which include legal and security risks), as well as reputational risks are potentially greater and differ somewhat from those faced by traditional banks.

The changes in financial institutions' risk profiles that are taking place as a result of the adoption of Internet demand a new approach from regulators if they are to achieve their two main objectives: financial stability and protection of consumers and investors. As regards protecting consumers, regulators are facing greater challenges to the preservation of transaction security and data privacy. These are two of the major concerns of consumers of Internet banking at both sides of the Atlantic, which highlights the growing need for closer coordination between prudential regulation and consumer and investor protection in the banking services area.

For the purpose of our study, the regulatory approaches to deal with consumer protection in general and technical and financial safety of Internet banking in particular, are most relevant since safety is seen as a crucial factor for the taking-up of Internet banking in Europe. Regulators are encouraged to deal with these concerns according to the principle of neutrality with regard to the distribution channel [see Nieto (2001)]. This principle implies that rules on transparency of operations, data privacy, accountability and on consumer protection in general should be neutral to the distribution channel.

By tackling consumers´ security concerns in this "technology neutral" fashion, European authorities may encourage a larger number of consumers to use this delivery channel on a long term basis. This would allow Internet banks to capture more of the potential scale and learning efficiencies that these banks may generate in excess of those available to traditional banks. In turn, those efficiencies may allow them to perform as well or even better than their peers, the traditional banks.

3 Financial literature on scale and experience economies

The bulk of the research on experience and bank scale effects has taken place in the United States. The main reason for the paucity of studies on costs on European banking relates mainly to data availability problems in the European Union. Moreover, it was not until the full implementation of the Second Banking Directive (1993) as well as a number of other relevant Directives on capital adequacy consolidated banking supervision and deposit guarantee schemes cleared the way for cross-border banking when the European banking sector became an integrated market. The introduction of the Euro in January 1999 removed one of the last obstacles for a competitive single banking market.

The concept of *scale economies, or returns to scale*, refers to the rate at which output changes as all factor quantities are varied. The existence of scale economies means that the average cost of producing a product, in the long run, *cetereis paribus*, decreases as more of the output is produced. DeYoung (2001, 2002, forthcoming) uses "total assets" as a measure of banks´ output. Although the majority of studies refer to the empirical evidence in the United States, a considerable body of research has been done on European banks [see Molyneux *et al.* (1996) for a detailed description of the literature]. In Spain, Fanjul and Maravall (1985) find significant economies of scale with respect to accounts per branch and deposits per account. Rodríguez *et al.* (1993) find scale economies for medium-sized savings banks and diseconomies of scale for larger institutions. Maudos (1996) estimates significant economies of scale for saving banks, independently of their size, and for smaller commercial banks (those with total assets below 150 thousand million pesetas). In the UK, Hardwick (1989, 1990) and Drake (1992) find scale economies predominantly for small and medium sized building societies. Kolari and Zardkoohi (1987) find also scale economies for medium sized Finish savings banks. In Ireland, McKillop and Colin (1994) find diseconomies of scale for the largest banks. Altunbas and Molyneux (1996) examine the cost structure of four European banking markets (France, Germany, Italy and Spain). The results indicate that scale economies are only statistically significant across all output[8] ranges in the case of Italy. In Spain, overall scale economies are only statistically significant for smaller banks with total asset size under $100 million. In France, statistically significant scale economies appear to exist across a broader output range of banks, up to $3 billion asset size. In Germany, the estimates for smaller banks suggest evidence of diseconomies of scale although the result is not statistically significant. The evidence of scale economies across European countries is even more mixed. Schure and Wagenvoort (2001) studied the cost structure and financial performance of about 2000 credit institutions across the fifteen members of the European Union and did not find major economic gains from "positive economies of scale" for the overall European banking industry. In particular for commercial banks, the optimal size picture is less transparent than for saving banks, which is possibly due to the fact that commercial banks are highly diverse. Furthermore, the authors find considerable differences in cost efficiency across Europe.

Newer empirical models based on more sophisticated cost functions than the traditional Cobb-Douglas, allow for the study of scale economies by different asset size cohorts. Also, the new cost functions allow for the interplay between bank capital, bank risk levels and investment diversification. Using these empirical models, Hughes *et al.* (2001) have found scale economies for the largest banks in the United States. However, caution should be taken in extrapolating these results to the European market where no empirical evidence exist as of yet [see Carbó and Humphrey (2002)].

8. Bank outputs are measured as total loans and securities.

The concept of *experience economies* refers to the rate at which unit costs fall as a firm accumulates experience using the technology, holding firm size constant, where experience is defined [see Ghemawat (1985)] as a 100% increase in accumulated production between two points in time. This concept was developed to explain the difference in performance between British and United States manufactured airframes of similar quality at the end of World War II [see Asher (1956), Arrow (1962) and Alchian (1963)]. However, using accumulated production as a measure of firms´ stock of experience may be deceiving partly because firms gain knowledge not only from their own production but also from other sources such as market participants and universities [see Griliches (1979) and DeYoung (2001, 2002, forthcoming)]. On this ground, DeYoung argues in favor of using "age" as a proxy for a newly chartered bank's stock of experience. Experience economies have not been extensively measured in banking and the small number of studies available refers to the experience of the newly chartered banks in the United States.

Against this background, the question that DeYoung (2001, 2002, forthcoming) tries to respond in his paper is whether United States banks that heavily rely on Internet in their business models have access to deeper scale and experience economies than the traditional banks of similar age and size. This paper tries to respond to similar questions for primarily Internet banks in the European Union.

4 Scale and experience effects of primarily Internet banks in Europe

The purpose of this study is to test for the existence of four distinct but simultaneous performance processes at primarily Internet banks in the European Union. To this end, we have followed the same analytical framework and methodology used by DeYoung (2001, 2002, forthcoming) for the United States banks although the limitations in the availability of data as well as the existence of different regulatory frameworks and market conditions, particularly in the retail segment, in the fifteen European Union countries require some modifications to such methodology.

The analytical framework used by DeYoung is common to any industry in which new firms enter the market using a business model or production technology that it is distinctly different from that employed by the already existing firms. The entrance of new market players in the commercial banking industry, whose business models are heavily reliant on Internet for their production function, renders this analytical framework most relevant for the banking industry. The four performance processes to be tested in this study are as follows: General scale and experience effects, which are common to all new chartered banks, regardless of their business models, and technology based scale and experience effects which are specific to new banks that use primarily Internet as delivery channel.

General scale effects imply better financial performance of banks as their output grow (asset size is a proxy for output), mainly through lower per unit costs. While, *general experience effects* occur as young banks accumulate experience (age is being used as a proxy) and improve their financial performance through learning-based improvements in cost control, risk management and investment diversification among others. However, because age and size are positively and significantly correlated at young banks, both experience and scale effects overlap.

To the extent that Internet technology is scalable and certain banking activities become more scalable as they incorporate it (e.g. credit scoring models to evaluate credit risk of SMEs) [see DeYoung (2001, 2002, forthcoming) and Sato and Hawkins (2001)], *technology-based scale effects* imply even better financial performance of primarily Internet banks as size increases. *Technology-based experience effects* explain better performance of Internet banks as they age and customers[9] accumulate experience in transacting over the Internet as well as managers better understand the capacities of the new technology. Technology-based scale and experience effects are additive to the general scale and experience effects.

If only significant general experience and scale effects exist in meaningful magnitudes, then the performance of new traditional and Internet banks will improve at similar rates as both types of banks increase in size and age. However, if significant technology based scale and experience effects do exist, then the financial performance of primarily Internet banks will improve more quickly than new traditional banks.

As explained by DeYoung (2001, 2002, forthcoming), the measure of accumulated production traditionally used to measure experience effects in the economic literature is problematic in the case of banks, which are by definition multiple-product firms and often provide fee-based services that are not shown in the balance sheet as it is often the case for primarily Internet banks. As in DeYoung´s paper (forthcoming), this study uses banks age as a proxy of experience holding size constant and, as in his paper, the two samples (new traditional established banks and primarily Internet banks) are approximately of the same size

9. A recent ECB survey on E banking activity in the European Union (2002) shows that one of the explanatory factors for the low penetration rate of Internet banking seems to be the safety concerns of customers.

range, so that elapsed time provides a good approximation of output-based experience. The size range of newly chartered European banks may vary from country to country as a result of the different minimum capital requirements[10] for licensing purposes across the European Union In order to control for country specificities, country dummies variables are included in the regressions in which experience and scale effects are estimated (see equation in part 6).

10. Directive 2000/12/EC of the EU Parliament and the Council of 20th of March of 2000 relating to the taking up and pursuit of the business of credit institutions. Official Diary of the European Communities L. 126/1 of 26.5.2000. This Directive requires €5 mill for general operations banks and €1 mill for minor banks. These are, however, minimum requirements and individual countries may demand higher thresholds. Moreover, existing banks at the time of the approval of the Directive maintained their existing levels of capital unless they have undergone significant changes in their shareholder structure.

5 Data and financial analysis of primarily Internet banks in Europe

5.1 The data

In this study, we have used annual audited public financial data from BankScope[11] between 1994 and 2001 corresponding to three samples of banks chartered in the European Union: Primarily Internet (13 banks), small established traditional (335 banks) and newly chartered banks (45 banks, a subset of the previous sample).

The *primarily Internet banks* are separately chartered individual (non-consolidated) institutions (i.e. neither a trade name -a non-separate entity that uses a commercial name- nor a dedicated branch) that reported to the European Central Bank[12] to have business models heavily reliant on Internet as most important delivery channel. All of these banks were active at the end of 2002 and fulfill the following two conditions: (a) to offer mainly although not exclusively, basic banking services including taking deposits and granting credits[13] and (b) to be a new start-up or an existing bank that changed its business model in order to operate primarily by Internet[14]. All thirteen primarily Internet banks[15] (four German, three Spanish, two Swedish, two Danish, one British and one French) belong some financial group. The banks that constitute this sample are listed in Table 1. The average age of the Internet banks sample is 5 years.

The *small established banks* are also separately chartered individual (non-consolidated) institutions which fulfill the following conditions: (a) their business models rely mainly, although not necessary exclusively, on traditional delivery channels, (b) they are also commercial banks and (c) their asset size is in the same range as that of the primarily Internet banks (see Table1). The sample of established banks includes three hundred thirty four banks. Within this sample, a subset of banks was created (*newly chartered traditional banks*) that, in addition to these conditions, were launched in or after 1990. This sample of *newly chartered traditional banks* consists of forty five entities and it is used as a performance benchmark. As it is the case for the Internet banks, the *newly chartered traditional banks*[16] belong to some financial group. The average age of the newly chartered traditional banks is 6.1 years. If technology-based scale and experience effects exist, they will probably occur with lower intensity at the *newly chartered traditional banks* that at *the primarily Internet banks.* To the degree that the *newly chartered traditional banks* sample contains banks that use Internet to some extent as a delivery channel, it will be harder to find evidence in favor of the existence of technology-based experience effects and technology based scale effects at the *primarily Internet banks* [see DeYoung (2001, 2002, forthcoming)].

The combined data set (*primarily Internet banks* plus *newly chartered traditional banks*) is an unbalanced panel of 378 observations of 58 banks, over a nine year period starting in 1994. The banks´ age is in years and the first year of operation has been considered entirely even if the bank has not been fully operating for the whole year. The data panel is unbalanced mainly for two reasons: (1) the newly chartered banks (both traditional

11. BankScope is a financial database covering 10,500 World Banks on CD-ROM with financial analysis software. It offers subscribers data up to 8 years of detailed spreadsheet information, compiled by FITCHIBCA mostly from the balance sheet, income statement and applicable notes found in audited annual reports. It also includes data details on ownership, produced by Bureau Van Dijk, such as lists of shareholders and lists of banking subsidiaries.
12. The ECB launched a survey on E banking activity in the European Union in 2002. The survey is not public.
13. Entities whose single activity is brokerage (e.g. Comdirekt) have been excluded. However, brokers that also accept demand deposits are also included (e.g. Consors Discount Broker).
14. In the event of a change in business model (e.g. Patagon), two different banks have been considered: "Before" as a traditional bank and "after" as an Internet bank.
15. Other limitations on the quality of the data stem from the fact that BankScope does not provide information on the exact date in which the banks start operating over the Internet and not only providing informational web sites and/or using the telephone as a delivery channels.
16. Three of these banks do not provide shareholding information to BankScope.

and Internet) started at different years and (2) the BankScope database does not include financial data for all the banks for all the years.

Eleven financial performance ratios have been used to perform financial analysis of these three groups of banks as described in the next section 5-2. Table 2 shows, means, medians and standard deviations of these ratios as well as the statistical significance of the differences between the means and medians for *small established* and *newly chartered banks* as well as that of the differences between the latter and *primarily Internet banks*[17]. Those eleven ratios measure operational performance (Return on Assets –ROA–, Non Interest Expenses over Total Assets[18]), profitability (Return on Equity –ROE–, Net Interest Financial Margin over Earning Assets), capitalization (Capital Adequacy and Equity over Total Assets) and leverage (Equity over Liabilities), as well as business activity (Net Lending over Total Assets and Net Lending over Deposits and Short Term Debt) of the three bank samples. Among these ratios, a subset of six financial ratios that summarize the financial performance of the three groups of banks are used as endogenous variables in the regressions tests based on panels of yearly data from 1994 to 2002. The six ratios are Equity over Liabilities, Net Lending over Total Assets, Net Interest Financial Margin over Earning Assets, ROA, ROE and Non Interest Expenses over Total Assets.

5.2 The financial analysis of the data

5.2.1 SMALL ESTABLISHED TRADITIONAL AND NEWLY CHARTERED TRADITIONAL BANKS

The performance of the newly chartered traditional banks falls somewhat short of the small established traditional banks. Although this difference is neither substantial nor statistically significant in terms of average ROA (16 basis points), it is in terms of median ROE[19] (187 basis points), while overhead expenses are somewhat lower (49 basis points) being the results statistically significant in terms of average and median. The newly chartered traditional banks have difficulty generating business volume, as evidence by lower levels of net lending over total assets and net lending over deposits and short term debt[20] which, in turn, seems to explain their lower net financial margin (89 basis points) being the results statistically significant in terms of median and average. The very sparse data on the level of nonperforming loans available in the BankScope data base has not allowed comparing the credit quality of the loan portfolios among bank samples. However, the low level of loan loss reserves over gross loans of newly traditional banks seems to indicate low levels of substandard loans.

Figures 1 (a) and (b) map out size performance paths of these two samples of banks in terms of ROA (a) and overhead expenses (b), where the banks´ size is measured discretely along the horizontal axis in ten asset size categories. None of the two samples of banks shows a clear relationship between performance and asset size. Figures 2 (a) and (b) map out time performance paths of these two same groups of banks also in terms of ROA (a) and overhead expenses (b), where the banks´ age is measured in years along the horizontal axis. The differences between the established banks and the new chartered traditional banks both in terms of ROA and of overhead expenses are of a small magnitude for age ranges.

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17. As in DeYoung (2001, 2002, forthcoming), the difference of means tests are generated from regressions that pool the data from the two groups of banks being compared. These regressions are specified as: $X_{it}=a+b*D_{it}+e_{it}$, where X_{it} is the variable being tested, D_{it} is a dummy equal to 1 for banks in the second of the two pooled samples, and e_{it} is a random disturbance term with zero mean. The statistical difference of b from zero provides the test of statistical significance for the difference of means. In turn, the difference of median tests are non-parametric two-sample tests for the null hypothesis that the two samples of banks being compared were drawn from populations with the same median.
18. Non interest expenses include mainly overhead expenses. The terms "overhead" and "non-interest" expenses will be used interchangeably for the reminder of this article.
19. The high leveraged balance sheet of some of the newly chartered traditional banks may be distorting the average ratio. For this reason, the median is more representative of the return on shareholder funds.
20. Both ratios are statistically significant in terms of average and median.

5.2.2 NEWLY CHARTERED TRADITIONAL BANKS AND PRIMARILY INTERNET BANKS

Profitability of Primarily Internet Banks is significantly lower in terms of ROA (315 basis points) and ROE (2,702 basis points), this result being statistically significant both in terms of ROA and ROE. Figure 1 (a) maps out size performance paths of these two samples of banks in terms of ROA. Internet banks´ performance lies below both the newly chartered traditional banks and the small established banks for all size categories but this performance gap diminishes for larger Internet banks. This difference in performance seems to be mainly explained by higher overhead spending of Internet banks (488 basis points). This category includes general expenses on contracts with vendors to service and maintaining the website and, most importantly, marketing expenditures to gain name recognition [see Delgado and Nieto. (2004) for empirical evidence in Spain]. Figure 1 (b) maps out size performance paths of these two samples of banks in terms of overhead spending. Internet banks show higher but significantly decreasing costs as banks´ asset size increases. All of which seem to provide some evidence of cost related technology based scale effects. Furthermore, Primarily Internet Banks show, contrary to what could be expected, higher financial margins over earning assets (109 basis points) than their peers, this result being statistically significant. However, this ratio may be distorted by the low level of earning assets of Internet banks. As is the case with their peers, Internet banks have difficulty generating business volume, as evidenced by comparable levels of net lending over total assets and net lending over deposits and short term debt. However, none of these two ratios is statistically significant.

Figure 2 (a) maps out ROA time paths in years of these two samples of banks. Again, the Internet banks performance lies below both the newly chartered traditional banks and the small established banks but this performance gap diminishes with age. Figure 2 (b) maps out time performance paths in terms of overhead spending. Internet banks show higher but significantly decreasing non-financial costs as they age although this pattern is only clearly observed until 5 years of age. These results provide, in principle, some evidence in favor of the existence of technology based experience effects. However, each of these effects is best represented by the estimated coefficients in the regression analysis below. The regressions control for other effects, so the estimated coefficients are much better indicators of experience and scale effects than the summary statistics displayed in the figures.

The regression analysis in part 6 attempts to identify and discriminate between the technology based scale effects and the technology based experience effects, showing whether the above described profitability gaps disappear as Internet banks grow larger and capture economies of scale and as they gain experience with the new business model.

6 Regression analysis

6.1 Regression framework

The regression analysis of scale and experience effects consists of one equation in which we allow for the simultaneous existence of both technology-based scale effects (*INTERNET*Ln ASSETS*)[21] and technology-based experience effects (*INTERNET*Ln AGE*). As noted by DeYoung (2001, 2002, forthcoming) empirically separating both types of technology-based effects may be difficult as a result of the colinearity between AGE and ASSETS[22] for all the newly chartered banks both Internet and traditional. For that reason, two equations[23] have been run in parallel that test for technology-based scale and technology-based experience effects in isolation without restricting the primarily Internet banks to follow the same performance size and time paths as the newly chartered traditional banks. These two equations serve as a robustness test of the equation below to investigate the potential effects of colinearity on the parameter estimates.

In the regression analysis of scale and experience effects, we allow for the simultaneous existence of both technology-based scale effects and technology-based experience effects. Real GDP growth (*DRGD*) and inflation rate (*INFL*) are included to control for the effects of macroeconomic conditions over the data sample period (1994-2001) on the performance variables. Dummy variables for each of the fifteen European Union countries ($\sum_{j=1}^{j=15} DUMC_j$) are also included to control for the effect of banks nationality on the performance variables (e.g. different absolute minimum capital requirements for licensing purposes across the European Union).

Equation:

$$PERFORMANC\ E_{i,t} = \alpha + \beta * INTERNET_i + \delta * LnAGE_{i,t} + \lambda * LnASSETS_{i,t} +$$
$$+ \gamma * INTERNET_i * LnAGE_{i,t} \eta * INTERNET_i * LnASSETS_{i,t} + \sigma_1 DRGD_{j,t} + \sigma_2 INFL_{j,t}$$
$$+ \sum_{j=1}^{15} DUMC_j + \varepsilon_{i,t}$$

21. Assets are measured in 2000 Euros.

22. Correlation between Ln ASSETS and Ln AGE for Internet banks is 25.2% (significant at 10% level) while this correlation for newly chartered traditional banks is 17.7% (significant at 5% level).

23. Equations (a) and (b) test for the existence of technology-based-scale effects (*INTERNET*Ln ASSETS*) and technology-based-experience effects (*INTERNET*Ln AGE*) respectively in isolation without restricting the primarily Internet banks to follow the same performance size and time paths as the newly chartered traditional banks.

Equation (a)

$$PERFORMANC\ E_{i,t} = \alpha + \beta * INTERNET_i + \lambda * LnASSETS_{i,t} +$$
$$+ \eta * INTERNET\ * LnASSETS_{i,t} + \sigma_1 DRGD_{j,t} + \sigma_2 INFL_{j,t} + \sum_{j=1}^{15} DUMC_j + \varepsilon_{i,t}$$

Equation (b)

$$PERFORMANC\ E_{i,t} = \alpha + \beta * INTERNET_i + \delta * LnAGE_{i,t} +$$
$$+ \gamma * INTERNET\ * LnAGE_{i,t} + \sigma_1 DRGD_{j,t} + \sigma_2 INFL_{j,t} + \sum_{j=1}^{15} DUMC_j + \varepsilon_{i,t}$$

Where:

PERFORMANCE can be any of the six ratios that summarize the financial performance of the sample banks (Equity over Liabilities, Net Lending over Total Assets, Net Interest Financial Margin over Earning Assets, ROA, ROE and Non Interest Expenses over Total Assets).

The subscript *i* indexes bank-level observations.

The subscript *t* indexes time in years.

The subscript *j* indexes the EU country.

INTERNET is a dummy variable that equals 1 (Primarily Internet banks) or 0 (Newly Chartered Traditional Banks).

β indicates the different financial performance, at the means of the data, between primarily Internet banks and newly chartered banks when there are no significant technology-based effects. In the more general case, this performance gap would take the following form: $\beta^{*}+\gamma^{*}\overline{LnAGE}_{i,t}+\eta^{*}\overline{LnASSETS}_{i,t}$ where $\overline{LnAGE}$ and $\overline{LnASSETS}$ denote the mean values of the corresponding variables.

η indicates the importance of any technology-based scale effect.

λ shows the importance of general scale effects.

γ indicates the importance of any technology based experience effect.

δ shows the importance of general experience effects.

The regressions performed in this study use pooled data sets that combine the primarily Internet banks with the newly chartered traditional banks in Europe, and are estimated using both ordinary least squares (OLS) and generalized least squares random-effects (GLS-RE) estimation techniques. The random effects approach includes, in addition to the usual random disturbance term, a bank-specific random disturbance term that accounts for unexplained variation in the dependent variable that it is specific to bank *i* during the sample period. As explained by DeYoung (2001, 2002, forthcoming), a fixed effect estimation approach is not feasible here, because the phenomena being tested for are themselves fixed effects. As a consequence, much of the variation necessary to estimate the coefficients β, γ, and η in the equations would disappear in a bank fixed effects model.

Finally, the structure of the disturbance term ε depends on whether ordinary least squares (OLS) or generalized least squares random-effects (GLS-RE) estimation techniques are used to estimate the regression equations.

6.2 Regression results

Regression results for the above defined equation are shown in Tables 3 through 8. As it has been already mentioned, the different financial performance, at the means of the data, between primarily Internet banks and newly chartered banks when there are no significant technology-based effects is given by the following expression: $\beta^{*}+\gamma^{*}\overline{LnAGE}_{i,t}+\eta^{*}\overline{LnASSETS}_{i,t}$, where $\overline{LnAGE}$ and $\overline{LnASSETS}$ denote the mean values of the corresponding variables. According to our results, newly chartered banks that rely on Internet as their main delivery channel show a distinctive performance in terms of ROA, ROE and Operational Expenses over Total Assets as compared to the new traditional banks. In the case of ROA and ROE, the performance gap has a negative sign that reflects the lower profitability of Internet banks. The coefficients are significant in both cases and robust to the choice of estimation technique, although the OLS estimates of the performance gap are smaller in absolute magnitude. In the case of Operational Expenses over Total Assets, the performance gap is positive and significant reflecting the higher overhead (primarily marketing and web development and maintenance expenses) of these banks. These results are largely consistent with the performance gaps inferred by the means test in

Table 2. Regarding Net Interest Financial Margin, the estimate for the performance gap is 1.5% but it is only significant in the case of the OLS estimate. The positive sign of the average difference on the Net Interest Financial Margin between Internet banks and Newly Chartered Traditional banks is largely consistent with the performance gap inferred by the difference means test in Table 2. Finally, no significant performance gap is found for leverage (Equity over Liabilities) and lending activity (Net Loans over Total Assets).

6.2.1 THE REGRESSION ANALYSIS OF THE JOINT EFFECTS OF SCALE AND EXPERIENCE

The regression analysis of the joint effects of scale and experience is shown in tables 3 through 8 that display the regression coefficients (η, γ, λ and δ). The results indicate that *newly chartered traditional banks* show no significant evidence of general scale effects both in terms of ROA and ROE. However, significant evidence of cost related scale economies exists. The regression results also show that the financial margin tends to narrow while leverage increases as new traditional banks get larger. Except for lending activity, no experience based effects are observed, being the outcome generally consistent across estimation techniques. However, newly chartered traditional banks show experience effects of large magnitude and statistical significance in terms of lending activity. *Primarily Internet banks* show significant scale economies in terms of ROA The primary source of the technology based scale seems to be the ability of primarily Internet banks to control operational expenses even more efficiently than the new traditional banks. No conclusive evidence of technology-based experience effects seems to exist in terms of ROA, ROE, operational expenses and leverage when these effects are analyzed jointly with the scale effects. Internet banks do not seem to show a greater capability to increase their lending activity than the traditional banks as they (and their customers) gain experience.

General Scale Effects. There is no significant evidence of general scale effects in the data, both in terms of ROA and ROE, this outcome being robust to the choice of estimation technique. The coefficient λ ($\lambda * LnASSETS_{i,t}$) of the regressions of Non Interest Expenses over Total Assets and Net Interest Financial Margin, is significant and with a negative sign in all the equations being robust to the choice of estimation technique. This outcome confirms the hypothesis that new banks, regardless of their business model access to mainly cost related scale economies and that the cost economies are somewhat larger in absolute amount when scale and learning effects are considered jointly (λ = -0.81). As per Net Interest Financial Margin, the coefficient (λ = -0.27) is statistically significant and robust to the choice of estimation technique. The coefficient λ of the regression of the leverage ratio (Equity over Liabilities) is highly statistically significant and has a negative sign being robust to the choice of estimation technique. This result shows that leverage of new traditional banks increases as they grow larger in size.

General Experience Effects. The δ coefficients of the regressions ($\delta * LnAGE_{i,t}$) of ROA, ROE, Non Interest Expenses over Total Assets, Net Interest Financial Margin are not statistically significant. Only the regression of Net Loans over Total Assets show a significant δ coefficient with positive sign (δ = 3.69). This outcome seems to indicate that new traditional banks increase their lending activity as they age. The estimate of δ is robust to the choice of estimation technique.

Technology-based Scale Effects. Significant evidence of technology-based scale effects, when considered jointly with the experience effects, exists for primarily Internet banks in terms of ROA. This result is robust to the choice of estimation technique yielding a positive and highly significant coefficient η ($\eta * INTERNET * LnASSETS_{i,t}$) for the regressions of ROA (η = 4.57). Thus, an increase in asset size by 50% results in a 1.85 percentage points increase in ROA at primarily Internet banks[24]. The coefficient η of the regressions of Non

24. This figure is the result of: η*ln(1.5*ASSETS)- η*ln(ASSETS)=η*ln(1.5). Note that λ is not significant.

Interest Expenses over Total Assets (η = -6.95) is significant and with a negative sign being robust to the choice of estimation technique. The sum of $\lambda + \eta$ = -7.76 gives the slope of the performance size path for Internet banks (general scale effects plus technology based effects). On average, an increase in asset size by 50% is associated with a 3.15 percentage points decrease in the ratio of overhead expenses at primarily Internet banks, compared to only a 0.33 percentage point decrease at newly chartered traditional banks[25]. This result confirms the hypothesis that new banks that heavily rely on Internet have access to even larger cost related scale economies that their peers. As per Net Interest Financial Margin, the estimates of the coefficient η are not robust to the choice of estimation technique. The GLS-RE estimate for the coefficient η of the regression of the leverage ratio (Equity over Liabilities) is significant and has a positive sign. The sum of $\lambda + \eta$ = -7.37 gives the slope of the performance size path for Internet banks. This result shows that leverage of primarily Internet banks increases as they become larger but the magnitude of this effect is smaller (approximately 50%) than in the case of the new traditional banks. However, the result is not robust to the choice of estimation technique. The coefficient η in the regressions of Net Loans over Total Assets are not statistically significant.

Technology-based Experience Effects. Although significant, the relation between age and ROA, when considering size and experience jointly, does not display the same signs of the estimated γ´s ($\gamma * INTERNET_i * LnAGE_{i,t}$) across estimation techniques. The regressions of age and ROE do not yield significant coefficients γ. Moreover, the regression coefficients γ of Non Interest Expenses over Total Assets and Net Interest Financial Margin are not robust across estimation techniques. Moreover, experience does not have an impact on the leverage of Primarily Internet banks as shown by the lack of statistical significance of γ in the regression of Equity over Liabilities. The γ coefficient of Net Loans over Total Assets is also not robust across estimation techniques. New banks that heavily rely on Internet as a distribution channel do not increase their lending capability with age as compared to the new traditional banks. The Internet distribution channel does not seem to have an impact on the lending activity of banks which mainly relies on their capability to assess risk credit.

As already mentioned, in order to assess the potential effects of colinearity on ours estimates, in parallel to assessing the joint impact of general as well as technology based both scale and experience effects, we have run the regression analysis of scale and experience effects taken in isolation for each of the six performance variables. The main results indicate that *newly chartered traditional banks* show no significant evidence of either general scale or experience effects when these are considered individually, in terms of ROA and ROE, although significant evidence of cost related scale economies exists. The *newly chartered banks with business models heavily reliant on Internet* show significant technology based scale economies in terms of ROA. The primary source of the technology based scale effects seems to be the ability of primarily Internet banks to control operational expenses even more efficiently than the new traditional banks as shown by the ratio of operational expenses over total assets which, being statistically significant, has a negative sign and whose absolute amount is even larger for the Internet banks. Internet banks show technology-based experience effects in terms of ROA. The primary source of the technologically based experience effects is the access to even greater cost economies as compared to traditional new banks. An overall assessment of these results and those obtained from the joint analysis of the scale and experience effect confirm the existence of significant technology-based scale effect and suggest that the weak evidence obtained for the technology-based experience effect might be partly due to the colinearity between age and size. As an example, technology-based experience effects in terms of ROA are found when experience effects are

25. The first figure is the result of: $\eta+\lambda$ *ln(1.5*ASSETS)- $\eta+\lambda$ *ln(ASSETS)=$\eta+\lambda$ *ln(1.5). Analogously, the second figure is: λ*ln (1.5).

analyzed in isolation whereas these effects are not significant when considered jointly with scale effects.

Finally, it is worth mentioning, that our results are consistent with those obtained by DeYoung (2001, 2002, forthcoming) for a sample of North American Internet banks. This author finds evidence of technology-based scale economies while the evidence on experience effects is rather weak. Nevertheless, the magnitude of the technology-based scale economies we have found is substantially larger than that estimated by DeYoung. Thus, for instance, according to our estimates, an increase in asset size by 50% results in a 1.85 percentage points increase in ROA at primarily Internet banks, while according to DeYoung's results this same increase in size would yield a 0.87 percentage point increase in the same ratio. One partial explanation for the larger magnitude of the scale effects found in our study is the shorter sample period used by DeYoung (1997:Q2-2001:Q2), the end of which corresponds to a marked economic slowdown. Unlike DeYoung, we have not found significant general scale or experience effect, but as we mentioned in section 3, these results are consistent with other studies analyzing the existence of scale economies across European countries (see, for instance, Schure and Wagenvoort, 2001).

7 Conclusions

Although the number of on-line banking customers is increasing worldwide, Internet banks have been substantially less profitable both in the United States and the European Union to date. They generate lower business volumes (e.g. loans) and any savings generated by lower physical overheads appear to be offset by other types of non-interest expenditures, notably costs associated with web site development and marketing to attract new customers. The question that this paper attempts to respond to is whether this is a temporary phenomenon and Internet banks may generate scale economies in excess of those available to traditional banks and/or they (and their customers) may accumulate experience with this new business model, which may allow them to perform as well or even better than their peers, the traditional banks. The fact that the Internet banks in our study belong to financial groups implies that to the extent that those banks are profitable, the parent companies´ investment would be considered worthwhile and those parent companies would have more possibilities to dispose of their stock holdings in the Internet banks at a profit.

Following DeYoung´s (2001, 2002, forthcoming) analytical framewok, this study attempts to identify and estimate the magnitude of technology based scale and technology based learning economies of European Internet banks. The empirical analysis uses public annual audited data from Bankscope between 1994 and 2002 corresponding to thirteen Internet banks and forty-five newly chartered banks of similar size and age as a performance benchmark. In addition, banks in both sets (Internet and benchmark) belong to financial groups. Our conclusions are as follows:

Newly chartered traditional banks do not show general scale or experience effects in terms of ROA and ROE being these results consistent with other studies analyzing the existence of scale economies across European countries.

Newly chartered traditional banks show significant evidence of cost related general scale economies.

Internet banks show strong evidence of scale economies in terms of ROA. Our results show that an increase in asset size by 50% results in a 1.85 percentage points increase in ROA for these banks.

The primary source of the technology based scale effects seems to be the ability of primarily Internet banks to control operational expenses even more efficiently than the new traditional banks. On average, a 50% increase in asset size is associated with a 3.15 percentage points decrease in the ratio of overhead expenses at primarily Internet banks, compared to only a 0.33 percentage point decrease at newly chartered traditional banks.

There is no conclusive evidence that either new traditional banks or Internet banks enjoy experience economies as they age. However, we find strong evidence suggesting that traditional banks seem to show the ability to increase lending activity as they gain experience, while Internet banks do not show any superior lending capability.

Our results are consistent to some extent with those obtained by DeYoung (2001, 2002, forthcoming), who finds, for a sample of US Internet banks, significant technology based scale economies stemming from the use of Internet while not finding evidence of the existence of technology-based experience effects. Nevertheless, the magnitude of the technology-based scale economies we have found is substantially larger than that estimated by DeYoung.

The empirical test suggests the success of the Internet bank model in Europe relies on the ability of these banks to save in overhead costs from technology-based scale economies and on whether these savings are sufficient to close the remaining profitability gap

with traditional banks. Nonetheless, a note of caution must be introduced given the preliminary character of the findings of this study, which are based on only thirteen European Internet banks. A small sample bias cannot be disregarded, to the extent that banks reporting to Bankscope might display a specific feature that is not independent of the relationship that we are trying to estimate. Nevertheless, a priori, we are not aware of any specific bias in the composition of our sample potentially affecting our results. It is also worth noting that the sample size is a common problem in this type of analysis. For instance, De Young's study is based on information for twelve Internet banks.

Finally, to the extent that Internet banks are struggling to prove themselves a viable business model, banking regulators and supervisors are encouraged to respond to the challenges posed by the incorporation of Internet in accordance with the principle of neutrality with regard to the distribution channel [see Nieto(2001)]. It is in the realm of consumer protection in which, in order to protect consumers' interests, financial regulators are encouraged to specify for this distribution channel the general rules on transparency of operations and customer protection. By tackling consumers´ security concerns, authorities may encourage a larger number of consumers to use this delivery channel, which would allow Internet banks to capture more of the potential scale efficiencies implied in our estimations.

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Table 1

Primarily Internet banks

Bank	Country	Total assets*	Last Year
Activobank SA	Spain	199,286	2,002
Allgemeine D. Direktbank	Germany	21,901,880	2,002
Banque Covefi	France	376,663	2,001
Basisbank	Denmark	77,871	2,002
Consors Discount Broker	Germany	2,247,770	2,002
DAB Bank AG	Germany	1,945,584	2,000
Egg Banking Plc	United Kingdom	11,856,759	2,000
Entrium Direkt Bankers AG	Germany	5,933,551	2,001
HSB Bank AB	Sweden	958,426	2,001
Lansforsakringar Bank AB	Sweden	2,325,144	2,002
Patagon Internet Bank SA	Spain	2,566,061	2,002
SkandiaBanken AS	Denmark	410,997	2,002
Uno-e bank	Spain	1,384,510	2,002

* Total assets in th. USD. Last year available.

Table 2

Summary statistics 1994-2002

	Small Established Banks k = 290			Newly Chartered Traditional Banks k = 45			Primarily Internet Banks k = 13		
	Mean	Median	Std Dev	Mean	Median	Std Dev	Mean	Median	Std. Dev
Loan Loss Reserves / Gross Loans	4.80	2.91	6.46	2.77	1.43	2.87	3.62	1.64	3.88
Capital Adequacy Ratio	18.21	12.90	21.92	14.88	11.67	8.87	20.88	15.55	15.96
Equity / Total Assets	8.53	5.82	11.89	9.84	6.19	11.97	9.44	6.97	8.62
Equity / Liabilities	13.28	7.85	41.72	13.35	8.18	21.60	12.42	7.99	14.64
Net Interest Margin	2.59	2.04	4.27	1.70	1.36	1.39	2.79	1.83	3.10
Return on Assets	0.78	0.44	2.67	0.62	0.36	1.83	-2.53	0.00	7.22
Return on Equity	9.28	7.73	33.09	10.96	5.86	32.64	-16.06	0.03	37.92
Net Loans / Total Assets	46.27	46.98	28.63	35.94	28.35	30.65	40.63	32.41	28.88
Net Loans / Customer and ST fund	61.07	56.69	55.81	50.60	33.80	59.66	46.82	37.64	33.16
Liquid Assets / Customer and ST fund	36.76	28.95	41.76	40.14	30.97	33.72	38.32	33.42	44.74
Non Interests Expenses / Avg. Assets	2.86	2.31	3.08	2.37	1.58	2.70	7.25	5.02	8.87

	Small Estab. vs. Newly Cht. Trad. Banks				Newly Cht. Trad. Banks vs. Prim. Internet			
	Test on Means		Test on Medians		Test on Means		Test on Medians	
Loan Loss Reserves / Gross Loans	2.03	***	1.48	**	-0.85		-0.21	
Capital Adequacy Ratio	3.33		1.23		-6.00	**	-3.88	
Equity / Total Assets	-1.31	**	-0.37		0.40		-0.78	
Equity / Liabilities	-0.07		-0.33		0.93		0.19	
Net Interest Margin	0.89	***	0.68	***	-1.09	***	-0.47	***
Return on Assets	0.16		0.08		3.15	***	0.36	**
Return on Equity	-1.68		1.87	***	27.02	***	5.83	**
Net Loans / Total Assets	10.33	***	18.63	***	-4.69		-4.06	
Net Loans / Customer and ST fund	10.47	***	22.89	***	3.78		-3.84	
Liquid Assets / Customer and ST fund	-3.38		-2.02		1.82		-2.45	
Non Interests Expenses / Avg. Assets	0.49	***	0.73	***	-4.88	***	-3.44	***

***/**/* denote significance at the 1%/5%/10% level.

Capital Adequacy Ratio: This ratio is the total capital adequacy ratio under the Basle rules. It measures Tier 1 + Tier 2 capital which includes subordinated debt, hybrid capital, loan loss reserves and the valuation reserves as a percentage of risk weighted assets and off balance sheet risks. **Net Interest Margin:** This ratio is the net interest income expressed as a percentage of earning assets.

Table 3
Regression analysis of scale and experience effects. Dependent variable: Return on Assets

Variable		Pooling - OLS		Random effects models	
DUMINT	β	-28.08	***	-63.63	***
		(5.95)		(9.63)	
lnASSETS	λ	-0.15		-0.27	
		(0.93)		(1.11)	
lnASSETS*DUMINT	η	1.64	***	4.57	***
		(4.60)		(8.72)	
lnAGE	δ	0.47		0.31	
		(1.63)		(0.97)	
lnAGE*DUMINT	γ	1.37	**	-2.43	***
		(2.04)		(2.82)	
DRGD	σ_1	0.10		0.05	
		(1.03)		(0.62)	
INFL	σ_2	-0.27		-0.15	
		(1.56)		(1.12)	
Performance gap (1)		-3.11	***	-4.11	***

*/** denote significance at the 10%/5%/1% level.
t-statistics in brackets.
Observations: 378 (58 banks)
(1) Performance gap defined as: β+γlnAGE+ηlnASSETS where lnAGE and lnASSETS denote the mean values of the corresponding variables.

Table 4
Regression analysis of scale and experience effects. Dependent variable: Return on Equity

Variable		Pooling - OLS	Random effects models
DUMINT	β	-85.25 *	-118.42 *
		(1.70)	(1.80)
lnASSETS	λ	0.68	2.72
		(0.39)	(1.14)
lnASSETS*DUMINT	η	3.07	6.24
		(0.81)	(1.21)
lnAGE	δ	3.43	-0.98
		(1.10)	(0.29)
lnAGE*DUMINT	γ	7.05	-1.57
		(0.99)	(0.18)
DRGD	σ_1	0.97	0.75
		(0.95)	(0.87)
INFL	σ_2	-2.30	-2.27
		(1.23)	(1.43)
Performance gap (1)		-31.29 ***	-34.34 ***

*/** denote significance at the 10%/5%/1% level.
t-statistics in brackets.
Observations: 378 (58 banks)
(1) Performance gap defined as: β+γlnAGE+ηlnASSETS where lnAGE and lnASSETS denote the mean values of the corresponding variables.

Table 5
Regression analysis of scale and experience effects. Dependent var.: Non Interest Expenses / Avg. Assets

Variable		Pooling - OLS		Random effects models	
DUMINT	β	52.20 (9.19)	***	95.85 (12.58)	***
lnASSETS	λ	-0.74 (3.72)	***	-0.81 (2.99)	**
lnASSETS*DUMINT	η	-3.39 (7.91)	***	-6.95 (11.47)	***
lnAGE	δ	-0.23 (0.64)		0.28 (0.78)	
lnAGE*DUMINT	γ	0.16 (0.20)		4.09 (4.13)	***
DRGD	σ_1	-0.04 (0.34)		0.04 (0.52)	
INFL	σ_2	0.22 (1.05)		0.15 (1.06)	
Performance gap (1)		5.40	***	5.97	***

*/** denote significance at the 10%/5%/1% level.
t-statistics in brackets.
Observations: 374 (58 banks)
(1) Performance gap defined as: β+γlnAGE+ηlnASSETS where lnAGE and lnASSETS denote the mean values of the corresponding variables.

Table 6
Regression analysis of scale and experience effects. Dependent variable: Net Interest Margin

Variable		Pooling - OLS		Random effects models	
DUMINT	β	7.97	***	-1.08	
		(3.94)		(0.54)	
lnASSETS	λ	-0.37	***	-0.27	***
		(5.26)		(4.18)	
lnASSETS*DUMINT	η	-0.71	***	0.14	
		(4.63)		(0.89)	
lnAGE	δ	0.05		-0.07	
		(0.42)		(0.77)	
lnAGE*DUMINT	γ	2.13	***	0.04	
		(7.35)		(0.16)	
DRGD	σ_1	0.01		0.00	
		(0.13)		(0.29)	
INFL	σ_2	0.07		0.08	***
		(0.91)		(2.62)	
Performance gap (1)		1.54	***	0.93	

*/** denote significance at the 10%/5%/1% level.
t-statistics in brackets.
Observations: 374 (58 banks)
(1) Performance gap defined as: β+γlnAGE+ηlnASSETS where lnAGE and lnASSETS denote the mean values of the corresponding variables.

Table 7
Regression analysis of scale and experience effects. Dependent variable: Equity/Liabilities

Variable		Pooling - OLS	Random effects models
DUMINT	β	-6.95	-82.67 **
		(0.24)	(2.08)
lnASSETS	λ	-6.76 ***	-13.44 ***
		(6.56)	(9.28)
lnASSETS*DUMINT	η	0.18	6.07 *
		(0.08)	(1.93)
lnAGE	δ	-4.42 **	-0.10
		(2.45)	(0.05)
lnAGE*DUMINT	γ	2.29	1.73
		(0.55)	(0.33)
DRGD	σ_1	-0.22	-0.27
		(0.36)	(0.58)
INFL	σ_2	1.36	1.36
		(1.25)	(1.59)
Performance gap (1)		-0.76	4.37

*/** denote significance at the 10%/5%/1% level.
t-statistics in brackets.
Observations: 377 (58 banks)
(1) Performance gap defined as: β+γlnAGE+ηlnASSETS where lnAGE and lnASSETS denote the mean values of the corresponding variables.

Table 8
Regression analysis of scale and experience effects. Dependent variable: Net Loans/Total Assets

Variable		Pooling - OLS		Random effects models	
DUMINT	β	12.25		-2.75	
		(0.32)		(0.06)	
lnASSETS	λ	1.67		-0.30	
		(1.24)		(0.21)	
lnASSETS*DUMINT	η	-1.73		0.44	
		(0.61)		(0.13)	
lnAGE	δ	9.61	***	3.69	**
		(4.13)		(1.96)	
lnAGE*DUMINT	γ	8.76	*	-4.23	
		(1.64)		(0.78)	
DRGD	σ_1	0.85		0.43	
		(1.11)		(1.08)	
INFL	σ_2	-1.59		-2.39	***
		(1.14)		(3.26)	
Performance gap (1)		2.34		-3.45	

*/** denote significance at the 10%/5%/1% level.
t-statistics in brackets.
Observations: 377 (58 banks)
(1) Performance gap defined as: β+γlnAGE+ηlnASSETS where lnAGE and lnASSETS denote the mean values of the corresponding variables.

Figure 1

(a) Average ROA vs Asset Size (%), and (b) Average Non-interest Expenses over total assets vs Asset Size (%)

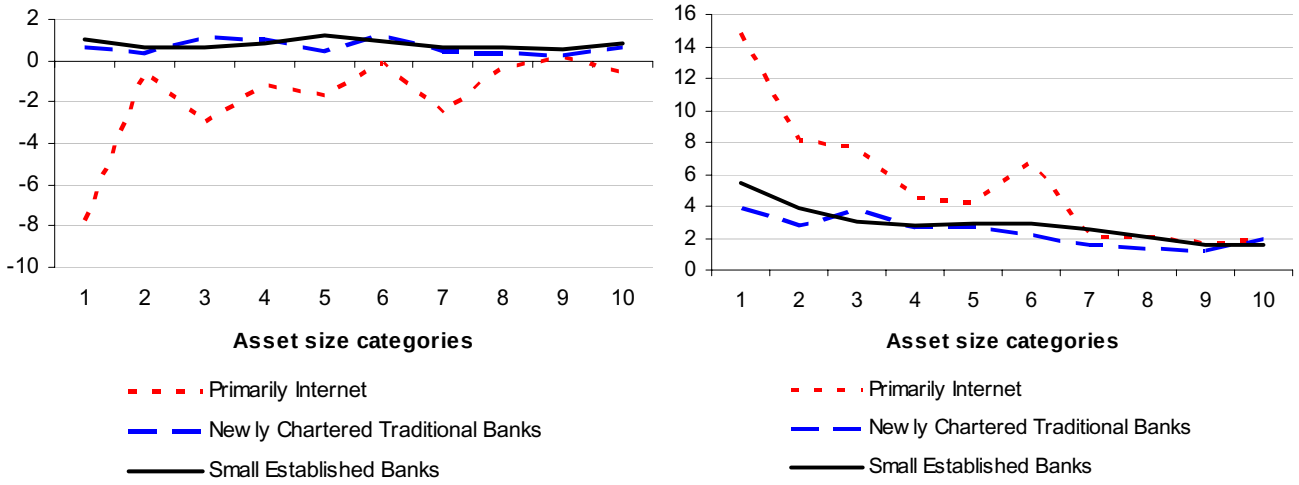

Figure 2

(a) Average ROA vs Age (%), and (b) Average Non-interest Expenses over total assets vs Age (%)