

An Empirical Investigation of Operating Costs in the new European banking landscape

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Abstract

This paper seeks to investigate operating efficiency in the new enlarged European banking landscape, over the period 1998-2003 and to examine the relationship between operating costs and several banks' characteristics. We compile the variables of our model using accounting data. Subsequently, we investigate the efficiency performance of the banking production costs across the 25 countries of the European Union in terms of total operating costs, personnel expenses and physical capital costs. The empirical evidence reveals that there are substantial differences in the operating costs of the EU-15 countries, while, on the other hand, the ten new EU countries have a more homogeneous cost structure. However, operating costs have declined over time for both EU-15 and new EU countries, verifying that the efforts for a more efficient production for the former and the ongoing restructuring process for the latter are heading at the right direction. Moreover, our results reveal a negative relationship between operating efficiency and the ratio of loan loss provisions to loans, the liquidity ratio, and the loans to assets ratio while, on the other hand, operating efficiency is positively related to the banks' size.

EFM Classification Codes: 510, 620

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1. Introduction

The European financial landscape has experienced substantial changes over the last couple of years and the pace of change appears to have moved into a higher gear with the recent EU enlargement. In addition, the European financial system has witnessed a number of remarkable structural changes, that partially can be considered as related to the European financial integration process (e.g. regulatory reform and liberalisation), but to some extent are part of global developments (e.g. advances in information technology, disintermediation). These developments have accelerated concentration, raised competition, and pressures for efficiency. Particularly, according to ECB (2003) banks stepped up their cost-saving efforts in 2002 by introducing organizational changes (such as outsourcing) and reducing both their branch networks and the number of employees, scaling back plans/ambitions to a certain extent, particularly in terms of mergers and acquisitions, and by concentrating more on their core business.

Hence, the efficiency of financial institutions has emerged as a ‘hot’ issue now than ever before, and has received a substantial amount of academic research and attention. This is primarily due to the fact that efficiency is of particular interest for both managers, whose aim is to improve the performance of their financial firms by identifying “best practices” and “worst practices” associated with high and low measured efficiency respectively, and policy makers, whose task is to assess the effects of deregulation, mergers, or market structure on efficiency and to safeguard the stability of financial systems.

Several studies attempt to relate efficiency with various bank, market and regulatory characteristics, so as to explain the observed large differences in efficiency estimates found in the empirical literature. Moreover, most studies use a two-step procedure, whereby as the first step firm’s efficiency is estimated (using some technique from the following; Data Envelopment Analysis, Stochastic Frontier Approach, Distribution-free Approach, Thick Frontier Approach), while in the second step it is regressed on or tested for correlation with a set of variables describing different bank and market characteristics. One of the most comprehensive studies in this field was conducted by Berger and Mester (1997), who estimated the efficiency of almost 6,000 U.S. commercial banks for the period 1990-1995 using different methodologies and various efficiency concepts, and then tried to relate efficient estimates to various bank, market and regulatory characteristics. Other studies include among others, Kalish and Gilbert (1973), Aly et al. (1990), Berger, Hancock, and Humphrey (1993), Cebenoyan et al. (1993), Mester (1993, 1996 and 1997), Pi and Timme (1993), Hermalin and Wallace (1994), Kaparakis et al. (1994), Spong, Sullivan, and DeYoung, (1995), Allen and Rai (1996), Berger and Hannan (1996), Goldberg and

Rai (1996), Kwan and Eisenbeis (1996), Miller and Noulas (1996), Berger and DeYoung (1997), Peristiani (1997), Chen (1998), DeYoung and Hasan (1998), DeYoung, Hasan and Kirchhoff (1998), Kraft and Tirtiroglu (1998), Eisenbeis, Ferrier and Kwan (1999), Altunbas et al. (2000), Berger and DeYoung (2001), Kwan (2001), Limam (2001), Mertens and Urga (2001), Sathye (2001), Christopoulos et al. (2002), Isik and Hassan (2002), McKillop, Glass and Ferguson (2002), Akhigbe and McNulty (2003), and Rime and Stiroh (2003). However, a comparison across studies is hampered by the fact that different samples, efficiency concepts, and measurement techniques were used, and therefore, no consistent picture emerges for the relationship between efficiency and several bank characteristics.

It should be noted, though, that any statistical relationship between efficiency and various bank characteristics does not necessarily imply causality. That is, any uncovered relationship does not mean that these characteristics cause banks to be inefficient. It rather suggests that these characteristics could play a dominant role among inefficient banks. After all, inefficiency may be endogenous to unknown variables of banks' performance, resulting in bias on coefficients' estimates. In addition, Berger and Mester (1997) outline that there exist a measurement issue that could potentially lead to bias estimates¹. Therefore, as an alternative to regression analysis, simple correlations are provided in some papers to underscore the fact that causation may run in both directions.

Kwan (2003), due to data non-availability, used simple accounting measures (instead of the commonly used frontier methodology) to investigate differences in operating efficiency in seven Asian banking systems after controlling for loan quality, liquidity, capitalization and output mix. His findings indicate that retail deposits are more costly to service than wholesale deposits, and that loans are more costly to produce than other earning assets. On the other hand, banking production costs were not found to be related to loan quality nor capitalization. Overall, the results suggest that there exist systematic differences in bank operating efficiency across Asian countries, and that operating costs declined over the period 1992 to 1997, prior to the Asian crisis, but rose afterwards.

However, the majority of the literature has focused on the US banking market, and to a much lesser extent on European banking sectors. Arguably, a comparative analysis of operating efficiency of EU-15 and new EU countries is of particular interest, given that, despite the increasing level of financial integration, the latter has several distinct features from the old EU

¹ For these reasons, Berger and Mester (1997) provide both univariate and multivariate estimates of the explanatory variables and only make conclusions if the explanatory variable has the same sign and is significant in both specifications.

countries, with the most distinctive characteristics being the strong dominance of the banking sector, the low level of financial intermediation and the high degree of foreign involvement. Particularly, the dominance of the banking sector is explained by the following factors: the relatively important position held by banks compared with other financial intermediaries during the central-planned economy period, the underdevelopment of capital markets and the high risks associated to the transition period, from a central based economy to a market oriented economy, that makes it difficult for enterprises to raise funds by directly tapping the capital markets. All these differences between the old and new EU countries make the analysis of operating costs (and the factors related to it) in these countries, a very interesting issue.

This paper seeks to amend the literature with an investigation of operating banking efficiency for the 25 European Union countries over the period 1998-2003 by estimating the interaction between operating costs and various bank and market characteristics. As in Kwan (2003), we employ accounting measures to compare operating efficiency across countries. Thus, the purpose of the paper is threefold; first, to extend previous studies on operating efficiency by studying the issue of cost efficiency (and the factors related to it) for EU-15 and new EU countries comparatively; second, to deal with the underlying aggregation bias by opting for two components of operating costs, that is personnel expenses and physical capital cost, and third, to exploit recently available data for the region, corresponding to an era characterized by substantial changes, and particularly the European Union enlargement.

The rest of the paper is organized as follows. Section 2 describes the data. Section 3 analyses the empirical model and presents the results, for total operating costs, personnel expenses and physical capital costs. Finally, some conclusions are drawn in the last section.

2. Data Description

The data for this study comprises the population of commercial, savings and cooperative banks in the 25 European Union countries that are listed in the IBCA Bankscope database and cover the period 1998-2003. The annual balance sheet and income statement data are comparable across countries and therefore suitable for a panel study. The data were reviewed for reporting errors and other inconsistencies. Starting from a large dataset of banks, we arrive, after removal of outliers, at a sample of 2048 banks in 1998, 2036 in 1999, 2317 in 2000, 2496 in 2001, 2531 in 2002, and 1433 in 2003, which captures a very large portion of banks in terms of financial institutions operating in these countries, but mainly in importance based on balance sheet aggregates. Table 1 lists the number of banks in the sample by country and financial year.

(Insert Table 1 about here)

Tables 2 and 3 provide descriptive statistics by country for the period 1998-2003. It becomes apparent that the average bank size in Netherlands is the largest among EU-15 countries, with the one of Germany being the smallest. For the 10 new EU countries, the average bank in Cyprus is the largest, while the smallest is located in Latvia. Overall, the banking markets of the ten new EU countries are still characterized as emerging, as they are dominated by relatively small financial institutions compared with the EU-15 countries. This point is further confirmed by the ratio of loans to total assets, which stands at an average of 47.5 per cent for new EU countries over the examined period, which is much lower than the ratio for EU-15 (which stands at about 59%). Only Cyprus displays a ratio comparable with the euro area average (at 58.58%). Although banks are by far the most important pillar in the financial sector of the new EU countries, the degree of financial penetration through assets and loans is much lower than in the euro area. This observation is consistent with the ECB Report (July, 2002) mentioning that even after one decade of transition and successful bank restructuring, the level of financial intermediation in the 10 new EU countries (at that point of time “accession” countries) remains relatively low. The only exceptions are Cyprus and Malta, the two non-transition economies.

(Insert Tables 2 and 3 about here)

Regarding the quality of credit expansion, despite the improvement in the loan portfolio the share of non-performing loans to the total loan portfolio in the new EU countries is still high relative to the EU-15 average. For the majority of the countries, poor quality was inherited from the old regime, where credit risk evaluation was irrelevant, the regulatory framework was inefficient and the banks’ credit policy was just a government instrument used according to the needs of the centrally planned economy. Particularly, the average ratio of loan loss provisions to loans ranges from 0.68 for Malta to 4.18 for Slovakia and stands at 2.18 for the ten new EU countries as a whole, which is much higher than the respective ratio for the old EU countries, which stands at about 0.86. Denmark has the highest loan loss provisions ratio among the EU-15 countries, while Finland stands at the other end of the spectrum.

The average ratio of equity to total assets, ranges from 4.4 for Luxembourg to 12.7 for Denmark, and stands at an average of 6.97 for the whole EU-15 banking region. On the other hand, new EU countries have on average a higher equity ratio (9.93 for the whole region), with

Lithuania having the highest (14.23) and Cyprus the lowest (6.81) average ratios. This should be expected considering the ongoing restructuring process of these banking sectors, and the crises some of them have experienced as a result of transition.

Finally, Tables 2 and 3 present the cost structures of the 25 banking systems under investigation and show that Denmark has the highest average ratio of total operating expenses to total assets, personnel expenses and physical capital costs to total assets among the EU-15 countries, while Ireland has the lowest personnel expenses ratio and Luxembourg the lowest total operating and physical capital costs ratios. As far as the ten new EU countries are concerned, Lithuania has the highest total operating costs, personnel expenses and physical capital costs ratios, while Czech Republic has the lowest personnel expenses ratio and Malta the lowest physical capital cost and total operating costs ratios. Overall, banks in the new EU countries have on average higher costs than banks in the old EU countries.

3. Empirical Methodology

The first part of our analysis compares the banking production costs across the 25 European Union economies and seeks to relate these costs to various bank and market characteristics that are at least partly exogenous and may explain some of the differences in cost structures of financial institutions.

As a first step, we focus on the operating costs of producing banking output, while in the following section we extend our analysis by separately investigating its two main disaggregated components, personnel costs and physical capital costs. All endogenous variables are expressed as a ration of total assets so as to form a per unit cost measure.

Moreover, the main model of our analysis takes the form of the following simple linear equation:

$$\ln C_{it} = \alpha + \beta \ln X_{it} + \gamma \ln D_{it} + \delta T_{it} + \varepsilon_{it}, \quad (1)$$

where C_{it} is the observed cost for the i th bank at year t ; X_{it} is the vector of control variables; D_{it} is the vector of country specific dummy variables; T_{it} is a time trend. *Equation (1) is estimated for EU-15 countries at the aggregate level and for new EU countries as a whole, separately.*

The dependent variable C consists of three cost measures: total operating costs, labour cost, and physical capital cost, all divided by total assets. Nine control variables are included in the X vector: the ratio of loan loss provisions to total loans, the ratio of cash and due from banks to total assets, the ratio of equity capital to total assets, the ratio of bank deposits to customer and short-term funding, the ratio of loans to total assets, the ratio of off-balance sheet items to total assets, the Herfindahl index, each bank's market share, and the logarithm of total assets so as to

count for size effects (we also include the square of total assets in order to capture potential non-linearities of the size effect).

The loan loss provisions ratio is used as a proxy for output quality². Under the ‘bad management’ hypothesis (Berger and DeYoung, 1997), loan quality is endogenous in the quality of bank management, indicating that managers, who are poor at dealing with day-to-day operations, are also poor at managing the bank’s loan portfolio. Under this hypothesis, we expect a positive coefficient, since an inefficient bank with high operating costs would also have a higher ratio of problem loans, and thus a higher ratio of loan loss provisions. The positive relationship between problem loans and operating costs can also be explained by the ‘bad luck’ hypothesis (Berger and DeYoung, 1997), which assumes that an exogenous increase in nonperforming loans may force even the most cost efficient banks to purchase additional inputs necessary to administer these problem credits. On the other hand, under the ‘skimping’ hypothesis (Berger and DeYoung, 1997) there is a trade-off between short-term operating costs and future loan performance problems, in that, banks that devote less resources on credit underwriting and loan monitoring may appear to be more cost efficient in the short-run, because fewer operating expenses can support the same quantity of loans and other outputs. Under this hypothesis, we expect a negative coefficient of the loan loss provisions ratio, since if banks which spend more resources on loan screening would have less problem loans at the expense of higher operating costs (Mester 1996).

The ratio of cash and due from banks to total assets controls for the liquidity of a bank. While liquid assets reduce bank’s liquidity risk, they may be more costly to handle, as these assets may involve additional transportation, storage, protection and labour costs (Kwan, 2003). Thus, the cash ratio is expected to have a positive coefficient.

The ratio of equity capital to total assets further captures the quality of bank management and the bank’s risk preferences. According to Hughes, Lang, Mester, and Moon (1995, 1996) and Hughes and Moon (1995) the assumption of risk neutrality for banks is firmly rejected. Moreover, the ratio of equity to total assets also reflects the degree to which shareholders have their own capital at risk in the institution, and hence may reflect their incentives to monitor management and assure that the institution operates efficiently. Under the ‘moral hazard’ hypothesis, the higher the capital ratio, the more efficient the institution is likely to be (Eisenbeis et al. 1999). Therefore, to the extent that well-capitalized banks reflect both high quality management and aversion to risk taking, these banks are likely to be more cost efficient in producing banking outputs, and thus one would expect a negative coefficient for the equity ratio. However, apart

² Problem loans were reported for less than half of the sample banks. Therefore, we use loan loss provisions rather than problem loans to proxy for output quality.

from risk, a bank's capital level directly affects costs by providing an alternative to deposits as a funding source for loans. Since raising equity typically involves higher costs than raising deposits, the coefficient of the equity ratio is expected to be positive. Overall, the coefficient of equity ratio is ambiguous.

The ratios of loans to total assets, bank deposits to customer and short-term funding, and off-balance sheet items to total assets are included to control for output mix. As far as the ratio of loans to assets is concerned, since operating costs related to originating, maintaining and monitoring loans might be much greater than those of investment securities, banks with a greater proportion of loans in their balance sheet are expected to have higher costs, and thus we expect a positive coefficient. Moreover, since bank deposits are less costly to service than retail deposits, the coefficient of the ratio of bank deposits to customer and short-term funding is expected to be negative. The ratio of off-balance sheet items to total assets is also included in our model, since off-balance sheet items are often effective substitutes for directly issued loans, requiring similar information-gathering costs of origination and ongoing monitoring and control of the counterparties.

The Herfindahl index is used to capture the degree of competition in the market in which a bank operates, that may also have an impact on its operating costs. Particularly, under Hicks' (1935) 'quiet life' hypothesis, concentration is expected to be negatively related to cost efficiency, because when competition is not robust, banks might feel less pressure to keep costs down. Thus, the coefficient of the Herfindahl index is expected to be positively related to operating costs.

A bank's market share is also used to further capture the market power. If banks with higher market shares are able to share resources to produce more outputs (i.e., cross sell products at lower cost), we expect a negative coefficient, while under the 'quiet life' hypothesis its coefficient is expected to be positive.

After controlling for managerial quality, risk preference, liquidity, and output mix, the country specific dummy variables test whether there are systematic differences in operating costs across countries. Country specific factors, including the productivity of the labour force and the efficiency in resource utilization, will be summed up by the coefficient of the country dummies (Kwan, 2003). For identification purpose, the dummy variables for Ireland and Malta are excluded so that the estimated coefficients measure the production efficiency of the EU-15 and new EU countries relative to Ireland and to Malta respectively.

We also use a time trend in order to capture any systematic changes in production costs over time. Technological innovations, including the increasing adoption of more advanced risk

management systems, as well as the need for more efficient production due to the increasing competitive pressures are expected to have lowered production costs over time in the EU-15 countries, and therefore we expect a negative coefficient. A negative coefficient is also expected for the ten new EU countries, where in addition to the above-mentioned factors, the entry of foreign banks bringing financial know-how, sophisticated IT applications and investment resources, as well as the implementation of a common reform process, including the privatization of state-owned banks, and the adoption of new prudential regulation and tighter supervision, are expected to have cut down operating costs over time.

3.1 The effects of bank and market characteristics on operating costs.

Tables 4 and 5 present the regression results with total operating costs as the dependent variable for EU-15 and new EU countries respectively. The *t*-statistics are calculated using heteroscedasticity-consistent standard errors. Both models fit the data reasonably well, with R-square being about 0.46% and 0.52% for EU-15 and new EU countries respectively.

(Insert Table 4 about here)

The coefficient of the loan loss provisions ratio is positive (consistent with the ‘bad management’ or the ‘bad luck’ hypothesis) and statistically significant for both EU-15 and new EU countries, indicating that an inefficient bank with a high loan loss provisions ratio could be associated with high operating costs. Our results are consistent with the vast majority of the literature, including Berger, Hancock, and Humphrey (1993), Kaparakis et.al. (1994), Kwan and Eisenbeis (1996), Berger and Mester (1997), Peristiani (1997), DeYoung and Hasan (1998), Eisenbeis et al., (1999), Altunbas et al. (2000), McKillop, Glass and Ferguson (2002), Mertens and Urga (2001), Akhigbe and McNulty (2003), who have found that more efficient banks have lower levels of non-performing loans.

(Insert Table 5 about here)

The liquidity ratio is also positive and statistically significant for both EU-15 and new EU countries, suggesting that although liquid assets reduce a bank’s liquidity risk, these assets involve additional operating costs as in Altunbas et al. (2000) and Kwan (2003), who also found that efficient banks appear to have lower liquidity ratios. On the other hand, the coefficient of equity to total assets is positive, but statistically significant only for EU-15 countries, which

indicates that raising equity typically involves higher costs than raising deposits. The positive relationship between operating costs and capitalization challenges the ‘moral hazard’ hypothesis, and contrasts with the findings of Mester (1996), Kwan and Eisenbeis (1996), Eisenbeis et al. (1999), Altunbas et al. (2000), and Limam (2001). As far as the new EU countries are concerned, the coefficient of the equity ratio is insignificant.

Of the three variables controlling for output mix, the ratio of loans to total assets is positive and statistically significant for both EU-15 and new EU countries, indicating that the costs associated with information-gathering of the origination and the ongoing monitoring of loans are quite substantial. This finding is in line with Altunbas et al. (2000), who have found that efficient banks appear to have lower loan-to-assets ratios. Moreover, Kwan (2003) also found a positive (though not statistically significant) relationship between total operating costs and the loan ratio. The coefficient of off-balance sheet items to total assets is negative for both EU-15 and new EU countries, but statistically significant only for the latter. This indicates that a higher proportion of off-balance sheet items to total assets is associated with lower operating costs in the new EU countries, as this type of activities require less resources than loans. However, contrary to what one would expect, the off-balance sheet ratio is not statistically significant for EU-15 countries. Moreover, the ratio of bank deposits to customer and short-term funding has the expected negative sign, since bank deposits are less costly to service than retail deposits, but is statistically significant only for EU-15 countries.

As far as the coefficient of the variable for each bank’s market share is concerned, this is positive for both EU-15 and new EU countries, but statistically significant only for the former. This positive and statistically significant coefficient indicates that banks that have larger shares in the EU-15 banking markets, and hence possess some degree of market power, have less pressure to operate at the minimum level of costs and thus are less efficient. This finding is further confirmed by the positive and statistically significant coefficient of the Herfindahl Index for EU-15 countries, which indicates that banks in more concentrated markets that face less competition feel less pressures to keep costs down, and usually opt for a ‘quiet life’, according to Hick’s (1935). Indeed, several studies, including Berger and Hannan (1996), Miller and Noulas (1996), Dietsch and Lozano-Vivas (2000) and Sathye (2001) have also verified the ‘quiet life’ hypothesis for various banking markets. However, a puzzling finding is that the coefficient of the Herfindahl Index variable is negative (and statistically significant) for the ten new EU countries. This suggests that, contrary to what one would expect, banks in more concentrated markets are more cost efficient. A possible explanation is that banks in the ten new EU countries do not fully exploit their market power, as in DeYoung, Hasan and Kirchoff (1998). Moreover, the dominant

presence of foreign banks in the region has enhanced competition and has probably forced banks to operate more efficiently, despite the high degree of concentration in these markets.

Finally, as far as the size variable is concerned, it has a negative sign and is statistically significant for both EU-15 and new EU countries, indicating that larger banks have lower costs and thus, are more cost efficient. This finding is in agreement with a substantial body of the literature (i.e., Aly et al. (1990), Berger, Hancock, and Humphrey (1993), Allen and Rai (1996), Miller and Noulas (1996), Kwan and Eisenbeis (1996), DeYoung and Hasan (1998), Eisenbeis et al. (1999), Limam (2001) and Hasan and Marton (2000). Moreover, we can observe that the square of total assets is positive and statistically significant for new EU countries, indicating that there is a non-linear relationship between bank size and operating costs for this region. On the other hand, the coefficient for EU-15 countries is not statistically significant.

The country dummies for all EU-15 countries are positive and statistically significant, demonstrating that there are substantial differences in the cost structures of European banks. Particularly, we can observe that all fourteen countries have higher costs than Ireland, with France exhibiting the highest costs followed by UK, Italy and Germany. Among new EU countries, only the dummies for Estonia, Lithuania and Slovenia are statistically significant (and positive), with Estonia having the highest operating costs. Overall, our results indicate that there is greater homogeneity in the cost structure of the ten new EU countries compared with EU-15 countries. Finally, the coefficient of the time trend is negative and statistically significant for both EU-15 and new EU countries, which designates that operating costs have declined over time, verifying efforts to direct the banking sector towards a more efficient structure.

3.2 The effects of bank and market characteristics on personnel expenses and physical capital costs

As part of a sensitivity analysis and in order to delve deeper into the banking production costs, in this section we assert the role of personnel expenses and physical capital costs as the dependent variable, respectively.

Tables 6 and 7 present the regression results with personnel expenses as the dependent variable for EU-15 and new EU countries, respectively. The *t*-statistics are calculated using heteroscedasticity-consistent standard errors, and the model fits the data reasonably well, with R-squared being about 49% and 57% for EU-15 and new EU countries, respectively.

(Insert Table 6 about here)

In detail, Table 6 shows that the coefficient of the loan loss provisions ratio is positive and statistically significant only for EU-15 countries, indicating that dealing with a higher ratio of problem loans invokes additional labour costs for these banking systems. For the new EU countries, as Table 7 demonstrates, the loan loss provisions ratio, although positive, is statistically insignificant. The liquidity ratio is positive and statistically significant at the 1% level for both EU-15 and new EU countries, consistent with the fact that liquid assets require more labour costs in order to cover additional protection and transportation needs. The ratio of equity to total assets is also positive but statistically significant only for EU-15 countries, while the ratio of loans to total assets, consistent with the general notion that originating, maintaining and monitoring loans involves a substantial amount of human resources, has a significantly positive coefficient for both EU-15 and new EU countries. Of the other variables that control for the output mix, only the ratio of bank deposits to customer and short-term funding is statistically significant and has a negative sign, indicating that bank deposits require less human capital to service than retail deposits for both EU-15 and new EU countries. On the other hand, the off-balance sheet ratio is not statistically significant.

(Insert Table 7 about here)

As far as the variables for market share and the Herfindahl Index are concerned, neither of them is statistically significant for the new EU countries. However, for the EU-15 countries, as in the case of total operating costs as the dependent variable, both market share and the Herfindahl Index have a significantly positive coefficient. The size effect is not evident in the case of the ten new EU countries, though this is not the case for the old EU countries, where the size variable has a significantly negative coefficient and we can also observe non-linearities in the relationship between size and personnel expenses. Finally, the time trend remains negative and statistically significant for both EU-15 and new EU countries, verifying the common trend towards cost reduction.

As far as the country dummies are concerned, for the EU-15 region we observe that all fourteen countries have higher costs than Ireland, with France having the highest positive coefficient, followed by Italy, Germany, and the UK. This finding further confirms our previous results that EU-15 countries have heterogeneous cost structures. On the other hand, the ten new EU countries exhibit smaller differences, with only three country dummies having a statistically significant coefficient (and particularly, Czech Republic has a significantly negative coefficient, while Estonia and Lithuania have positive ones).

Tables 8 and 9 present the results with physical capital cost as the dependent variable for EU-15 and new EU countries respectively. The loan loss provisions ratio is significantly positive, for both EU-15 and new EU countries and this is also the case for the liquidity ratio, indicating that liquid assets require additional transportation, storage and protection costs. The equity ratio, the loan ratio, the bank deposits ratio, the market share variable and the Herfindahl Index variable are all statistically significant for EU-15 countries and have the expected signs. However, for the ten new EU countries, of the above mentioned variables only the coefficient of the Herfindahl Index variable is statistically significant, and negative as in the case of total operating costs. Moreover, the off-balance sheet ratio is statistically significant for both EU-15 and new EU countries, though it is negative for the former and positive for the latter (WHY??).

(Insert Table 8 about here)

Finally, the size variable is significantly negative for both EU-15 and new EU countries, indicating that larger banks are able to manage their physical capital costs more efficiently than their smaller counterparts. Moreover, we find some evidence that there is a non-linear relationship between size and physical capital costs for the ten new EU countries. The coefficient of the time trend is negative but significant only for EU-15 countries. As far as the country dummies are concerned, we observe significant differences not only for EU-15 countries, but also for the ten new EU countries, suggesting that the cost of physical capital differs widely among countries.

(Insert Table 9 about here)

4. Conclusion

The substantial changes occurred in the European financial landscape, with the most important being the recent EU enlargement, have intensified competition in the European banking markets and have brought the issue of operating efficiency in the centre of attention. This paper seeks to contribute to the literature by analysing operating efficiency of the 25 European Union countries over the period 1998-2003, by constructing measures of operating costs with the use of accounting data, and by investigating the relationship between operating costs and various bank

and market characteristics. Our findings show that there are substantial differences in the operating costs of the EU-15 countries, while, on the other hand, the ten new EU countries have a more homogeneous cost structure. Another interesting finding is that banks' operating costs have declined over time for both EU-15 and new EU countries. Our results further reveal a negative relationship between operating efficiency and the ratio of loan loss provisions to loans, the liquidity ratio, and the loans to assets ratio while, on the other hand, operating efficiency is positively related to the banks' size. Similar outcomes are obtained in the case that operating cost is replaced by personnel expenses and physical capital to total assets.

Overall, the results strongly suggest that substantial differences in the cost structure of the European Union banking systems still exist (despite the efforts towards greater financial integration), and that these changes are more apparent in the case of the old EU countries. On the other hand, the new EU countries' banking systems have a more homogeneous cost structure. The decreasing trend of operating costs shows that the regulatory reforms in these countries and the restructuring of the banking market have resulted in a more cost efficient banking, though significant challenges still lie ahead.

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Table 1: Number of banks in the sample

Country	Year					
	1998	1999	2000	2001	2002	2003
Austria	93	101	116	121	122	96
Belgium	18	20	22	25	25	20
Denmark	60	59	61	62	65	60
Finland	4	5	4	6	6	5
France	137	169	176	176	164	160
Germany	1135	1024	1228	1282	1313	648
Greece	7	8	9	8	10	10
Ireland	9	11	11	10	15	13
Italy	330	359	391	416	422	133
Luxembourg	40	44	46	51	34	24
Netherlands	20	17	13	16	13	15
Portugal	12	12	13	15	16	8
Spain	68	69	84	91	94	86
Sweden	5	9	10	73	76	30
UK	33	38	39	40	45	36
EU-15	1971	1945	2223	2392	2420	1344
Cyprus	4	5	5	8	7	4
Czech Republic	9	12	12	14	13	9
Estonia	4	4	4	4	5	5
Hungary	10	12	12	10	10	8
Latvia	9	11	12	13	13	15
Lithuania	6	7	8	9	9	8
Malta	4	4	4	6	7	6
Poland	17	19	21	21	23	14
Slovakia	6	9	7	8	11	8
Slovenia	8	8	9	11	13	12
New EU	77	91	94	104	111	89

Source: Fitch-IBCA database and own estimations

Table 2: Banking Indicators for EU-15 countries

Country	TA	LLP/L	L/A	E/A	PE/A	PCC/A	TOE/A
Austria	4115149 (17200000)	1.08 (0.86)	58.07 (14.35)	6.64 (3.34)	1.42 (0.55)	1.03 (0.88)	2.46 (1.29)
Belgium	40100000 (87700000)	0.79 (1.04)	42.46 (21.20)	6.60 (5.52)	0.98 (0.56)	1.05 (0.95)	2.03 (1.40)
Denmark	5018835 (25300000)	1.16 (0.83)	57.95 (13.36)	12.70 (4.71)	2.07 (0.78)	1.56 (0.58)	3.63 (1.23)
Finland	39700000 (60100000)	0.12 (0.17)	62.92 (10.73)	5.85 (1.83)	0.84 (0.30)	1.01 (0.37)	1.85 (0.64)
France	30800000 (98100000)	0.63 (0.79)	57.76 (22.40)	6.49 (3.65)	1.47 (0.73)	1.14 (0.78)	2.61 (1.32)
Germany	3420604 (33900000)	0.96 (0.74)	61.45 (12.64)	5.09 (1.70)	1.41 (0.44)	1.06 (0.57)	2.47 (0.88)
Greece	15800000 (15100000)	1.14 (1.23)	48.66 (13.44)	10.27 (6.44)	1.71 (0.66)	1.53 (0.92)	3.24 (1.43)
Ireland	25200000 (35800000)	0.56 (0.95)	52.35 (22.42)	5.85 (2.39)	0.48 (0.51)	0.70 (1.37)	1.18 (1.61)
Italy	5065612 (24400000)	0.66 (0.55)	57.95 (12.73)	11.42 (3.95)	1.67 (0.42)	1.42 (0.51)	3.09 (0.80)
Luxembourg	10300000 (12800000)	0.79 (0.97)	22.65 (14.86)	4.41 (2.82)	0.55 (0.49)	0.56 (0.51)	1.11 (0.94)
Netherlands	91500000 (171000000)	0.66 (1.02)	60.36 (16.70)	6.72 (3.69)	1.08 (0.81)	0.78 (0.51)	1.86 (1.27)
Portugal	16000000 (21500000)	1.04 (1.17)	64.42 (15.59)	9.85 (8.07)	1.27 (0.60)	1.50 (1.48)	2.77 (2.04)
Spain	14900000 (45900000)	0.61 (0.58)	62.33 (19.31)	8.38 (4.50)	1.46 (0.92)	1.09 (0.84)	2.54 (1.70)
Sweden	9888679 (31200000)	0.59 (0.70)	74.55 (12.28)	12.58 (4.56)	1.47 (0.46)	1.44 (0.52)	2.91 (0.92)
UK	64900000 (124000000)	0.88 (0.86)	53.94 (23.25)	9.36 (6.43)	1.12 (0.68)	1.51 (1.43)	2.63 (1.92)
EU-15	9225627 (49200000)	0.86 (0.76)	59.35 (15.85)	6.97 (4.09)	1.45 (0.57)	1.15 (0.69)	2.59 (1.11)

Note: TA: Total Assets; LLP/L: Loan Loss Provisions/Loans; E/A: Equity/Total Assets; L/A: Loans/Total Assets; TOE/A: Total Operating Expenses/Total Assets; PE/A: Personnel Expenses/Total Assets; PCC/A: Physical Capital Costs/ Total Assets. Figures are means in thousands of € for TA and percentages for all other variables) for EU-15 countries over the period 1998-2003. Standard deviations are presented in parentheses.

Table 3: Banking Indicators for new EU countries

Country	TA	LLP/L	L/A	E/A	PE/A	PCC/A	TOC/A
Cyprus	4262016 (4450071)	1.51 (2.90)	58.58 (11.08)	6.81 (2.42)	1.50 (0.55)	1.22 (1.68)	2.72 (2.00)
Czech Republic	4111939 (5626503)	2.75 (3.11)	41.52 (21.97)	7.59 (5.35)	0.84 (0.35)	1.77 (0.98)	2.61 (1.22)
Estonia	1255393 (1728621)	2.43 (2.35)	54.94 (13.88)	10.58 (2.95)	2.11 (1.05)	2.85 (1.49)	4.96 (2.33)
Hungary	2505985 (2746961)	0.83 (0.64)	51.30 (15.51)	9.16 (3.48)	1.48 (0.68)	2.59 (1.54)	4.07 (2.08)
Latvia	340933 (391743)	2.93 (3.57)	37.54 (20.30)	9.13 (4.73)	1.90 (1.27)	2.94 (1.83)	4.85 (2.80)
Lithuania	470432 (593425)	2.29 (2.61)	48.23 (14.18)	14.23 (8.20)	2.86 (1.12)	2.97 (0.96)	5.83 (1.92)
Malta	1631778 (1701529)	0.68 (0.45)	44.50 (15.49)	12.94 (11.35)	0.93 (0.44)	0.95 (0.70)	1.88 (1.07)
Poland	4187502 (5276555)	2.13 (1.53)	50.53 (14.62)	11.17 (6.14)	1.79 (0.57)	2.05 (0.82)	3.83 (1.13)
Slovakia	1552342 (1609585)	4.18 (4.24)	40.88 (14.38)	7.76 (3.67)	1.07 (0.34)	2.64 (1.73)	3.71 (1.80)
Slovenia	1453038 (1932183)	1.88 (1.67)	53.19 (8.45)	10.31 (3.77)	1.55 (0.26)	1.72 (0.45)	3.26 (0.65)
New EU	2396162 (3825714)	2.18 (2.60)	47.44 (16.96)	9.93 (5.92)	1.61 (0.90)	2.21 (1.39)	3.81 (2.02)

Note: TA: Total Assets; LLP/L: Loan Loss Provisions/Loans; E/A: Equity/Total Assets; L/A: Loans/Total Assets; TOE/A: Total Operating Expenses/Total Assets; PE/A: Personnel Expenses/Total Assets; PCC/A: Physical Capital Costs/ Total Assets. Figures are means in thousands of € for TA and percentages for all other variables) for new EU countries over the period 1998-2003. Standard deviations are presented in parentheses.

Table 4: Impact of market characteristics on Total Operating Costs on EU-15 countries

In (Total Operating Expenses/Total Assets)	Coef.	Std. Err.	t	P>t
ln (loan loss provisions/loans)	0.07760***	0.00547	14.18	0.000
ln(cash and due from banks/total assets)	0.15855***	0.00841	18.85	0.000
ln(equity/total assets)	0.19007***	0.01712	11.10	0.000
ln(loans/total assets)	0.18926***	0.02104	9.00	0.000
ln(off balance sheet items/total assets)	-0.00932	0.00727	-1.28	0.200
ln(bank deposits/customer & short-term funding)	-0.02119***	0.00509	-4.16	0.000
ln(market share)	0.12845***	0.02754	4.66	0.000
ln(HHI)	0.12055***	0.01956	6.16	0.000
ln(total assets)	-0.17520***	0.02785	-6.29	0.000
(total assets) ²	0.00000	0.00000	1.36	0.175
Time trend	-0.01194***	0.00356	-3.36	0.001
Austria	0.88655***	0.21301	4.16	0.000
Belgium	1.04502***	0.22150	4.72	0.000
Denmark	0.90040***	0.21149	4.26	0.000
Finland	0.59555***	0.23197	2.57	0.010
France	1.56001***	0.23496	6.64	0.000
Germany	1.28558***	0.23435	5.49	0.000
Greece	0.90237***	0.22191	4.07	0.000
Italy	1.41972***	0.22608	6.28	0.000
Luxembourg	0.56244**	0.22523	2.50	0.013
Netherlands	0.68547***	0.22832	3.00	0.003
Portugal	0.78377***	0.21452	3.65	0.000
Spain	0.99197***	0.22023	4.50	0.000
Sweden	0.89614***	0.21295	4.21	0.000
UK	1.49554***	0.23639	6.33	0.000
constant	0.65197	0.43560	1.50	0.134

R-squared

0.46150

F(25, 11941) = 194.90 (0.0000)

White's test for Ho: homoskedasticity

chi2(245) = 5089.29 (0.0000)

t-statistics are computed using heteroscedasticity-consistent standard errors. ***, **, * indicate significance at the 1%, 5% and 10% levels, respectively. The estimation method is OLS within panel.

Table 5: Impact of market characteristics on Total Operating Costs on new EU countries

In (Total Operating Expenses/Total Assets)	Coef.	Std. Err.	t	P>t
ln(loan loss provisions/loans)	0.04223*	0.02179	1.94	0.053
ln(cash and due from banks/total assets)	0.08006***	0.02132	3.75	0.000
ln(equity/total assets)	0.01098	0.03941	0.28	0.781
ln(loans/total assets)	0.18443**	0.08042	2.29	0.022
ln(off balance sheet items/total assets)	0.03592*	0.01895	1.90	0.059
ln(bank deposits/customer & short-term funding)	-0.03004	0.02064	-1.46	0.146
ln(market share)	0.03947	0.05593	0.71	0.481
ln(HHI)	-0.34101*	0.19761	-1.73	0.085
ln(total assets)	-0.27463***	0.07228	-3.80	0.000
(total assets) ²	0.00034***	0.00006	5.69	0.000
Time trend	-0.03261**	0.01484	-2.20	0.029
Cyprus	0.25603	0.16032	1.60	0.111
Czech Republic	0.14104	0.19644	0.72	0.473
Estonia	0.83937***	0.14136	5.94	0.000
Hungary	0.28625	0.22035	1.30	0.195
Latvia	0.16771	0.23565	0.71	0.477
Lithuania	0.64270***	0.12789	5.03	0.000
Poland	0.14992	0.25595	0.59	0.558
Slovakia	0.17062	0.17684	0.96	0.335
Slovenia	0.28392**	0.13593	2.09	0.037
constant	6.14287***	1.82417	3.37	0.001
R-squared	0.5196			
	F(20, 360) = 28.44 (0.0000)			
White's test for Ho: homoskedasticity	chi2(185) = 285.71 (0.0000)			

t-statistics are computed using heteroscedasticity-consistent standard errors. ***, **, * indicate significance at the 1%, 5% and 10% levels, respectively. The estimation method is OLS within panel.

Table 6: Impact of market characteristics on Personnel Expenses for EU-15 countries

In (Personnel Expenses/Total Assets)	Coef.	Std. Err.	t	P>t
ln(loan loss provisions/loans)	0.07385***	0.00558	13.23	0.000
ln(cash and due from banks/total assets)	0.17310***	0.00843	20.52	0.000
ln(equity/total assets)	0.20360***	0.01724	11.81	0.000
ln(loans/total assets)	0.23062***	0.01948	11.84	0.000
ln(off balance sheet items/total assets)	0.00593	0.00628	0.94	0.345
ln(bank deposits/customer & short-term funding)	-0.01919***	0.00560	-3.43	0.001
ln(market share)	0.19423***	0.02943	6.60	0.000
ln(HHI)	0.12446***	0.02088	5.96	0.000
ln(total assets)	-0.24696***	0.02956	-8.35	0.000
(total assets) ²	0.00001**	0.00000	2.44	0.015
Time trend	-0.00613*	0.00364	-1.69	0.092
Austria	1.24711***	0.21842	5.71	0.000
Belgium	1.27944***	0.22358	5.72	0.000
Denmark	1.13343***	0.21886	5.18	0.000
Finland	0.64013***	0.23689	2.70	0.007
France	2.01977***	0.23611	8.55	0.000
Germany	1.75848***	0.23696	7.42	0.000
Greece	0.99379***	0.23433	4.24	0.000
Italy	1.79090***	0.22852	7.84	0.000
Luxembourg	0.79068***	0.22966	3.44	0.001
Netherlands	1.09485***	0.23044	4.75	0.000
Portugal	0.93296***	0.22063	4.23	0.000
Spain	1.39755***	0.22394	6.24	0.000
Sweden	1.05779***	0.21820	4.85	0.000
UK	1.74434***	0.23873	7.31	0.000
constant	0.56572	0.46818	1.21	0.227
R-squared	0.49200			
	F(25, 11941)= 170.51 (0.0000)			
White's test for Ho: homoskedasticity	chi2(245) = 3986.05 (0.0000)			

t-statistics are computed using heteroscedasticity-consistent standard errors. ***, **, * indicate significance at the 1%, 5% and 10% levels, respectively. The estimation method is OLS within panel.

Table 7: Impact of market characteristics on Personnel Expenses for new EU countries

In (Personnel Expenses/Total Assets)	Coef.	Std. Err.	t	P>t
ln(loan loss provisions/loans)	0.01765	0.01630	1.08	0.280
ln(cash and due from banks/total assets)	0.07240***	0.01676	4.32	0.000
ln(equity/total assets)	0.01036	0.04394	0.24	0.814
ln(loans/total assets)	0.32675***	0.09118	3.58	0.000
ln(off balance sheet items/total assets)	0.00315	0.02246	0.14	0.889
ln(bank deposits/customer & short-term funding)	-0.03527*	0.01952	-1.81	0.072
ln(market share)	-0.09159	0.05926	-1.55	0.123
ln(HHI)	-0.28250	0.21958	-1.29	0.199
ln(total assets)	-0.11342	0.07912	-1.43	0.153
(total assets) ²	0.00032***	0.00006	5.28	0.000
Time trend	-0.04417***	0.01459	-3.03	0.003
Cyprus	0.13536	0.14201	0.95	0.341
Czech Republic	-0.57264***	0.20711	-2.76	0.006
Estonia	0.65430***	0.14783	4.43	0.000
Hungary	-0.14605	0.22915	-0.64	0.524
Latvia	0.00235	0.26230	0.01	0.993
Lithuania	0.73449***	0.11700	6.28	0.000
Poland	-0.18285	0.27351	-0.67	0.504
Slovakia	-0.30783	0.19632	-1.57	0.118
Slovenia	0.14568	0.13232	1.10	0.272
constant	2.73786	2.08988	1.31	0.191
R-squared	0.5724			
	F(20, 360) = 32.48 (0.0000)			
White's test for Ho: homoskedasticity	chi2(185) = 257.20 (0.0000)			

t-statistics are computed using heteroscedasticity-consistent standard errors. ***, **, * indicate significance at the 1%, 5% and 10% levels, respectively. The estimation method is OLS within panel.

Table 8: Impact of market characteristics on Physical Capital Costs for EU-15 countries

In (Physical Capital Costs/Total Assets)	Coef.	Std. Err.	t	P>t
ln(loan loss provisions/loans)	0.08389***	0.00631	13.30	0.000
ln(cash and due from banks/total assets)	0.14937***	0.01013	14.75	0.000
ln(equity/total assets)	0.17511***	0.02060	8.50	0.000
ln(loans/total assets)	0.15101***	0.02432	6.21	0.000
ln(off balance sheet items/total assets)	-0.01644*	0.00895	-1.84	0.066
ln(bank deposits/customer & short-term funding)	-0.02259***	0.00570	-3.96	0.000
ln(market share)	0.05759**	0.02931	1.96	0.049
ln(HHI)	0.12770***	0.02304	5.54	0.000
ln(total assets)	-0.10170***	0.02977	-3.42	0.001
(total assets) ²	0.00000	0.00000	1.57	0.117
Time trend	-0.02176***	0.00408	-5.34	0.000
Austria	0.61314***	0.21827	2.81	0.005
Belgium	0.78565***	0.23861	3.29	0.001
Denmark	0.72982***	0.21706	3.36	0.001
Finland	0.66284***	0.24079	2.75	0.006
France	1.15230***	0.24460	4.71	0.000
Germany	0.91541***	0.24292	3.77	0.000
Greece	0.91662***	0.22444	4.08	0.000
Italy	1.16185***	0.23359	4.97	0.000
Luxembourg	0.45802**	0.23172	1.98	0.048
Netherlands	0.34188	0.23669	1.44	0.149
Portugal	0.75395***	0.22013	3.43	0.001
Spain	0.68486***	0.22632	3.03	0.002
Sweden	0.86043***	0.21855	3.94	0.000
UK	1.31263***	0.24547	5.35	0.000
constant	-0.92051**	0.46829	-1.97	0.049
R-squared	0.3461			
	F(25, 11939) = 166.99 (0.0000)			
White's test for Ho: homoskedasticity	chi2(245) = 3923.74 (0.0000)			

t-statistics are computed using heteroscedasticity-consistent standard errors. ***, **, * indicate significance at the 1%, 5% and 10% levels, respectively. The estimation method is OLS within panel.

Table 9: Impact of market characteristics on Physical Capital Costs for new EU countries

In (Physical Capital Costs/Total Assets)	Coef.	Std. Err.	t	P>t
ln(loan loss provisions/loans)	0.06599**	0.03176	2.08	0.038
ln(cash and due from banks/total assets)	0.09124***	0.02977	3.06	0.002
ln(equity/total assets)	0.00848	0.04348	0.19	0.846
ln(loans/total assets)	0.06159	0.08874	0.69	0.488
ln(off balance sheet items/total assets)	0.07803***	0.02230	3.50	0.001
ln(bank deposits/customer & short-term funding)	-0.02303	0.02588	-0.89	0.374
ln(market share)	0.10329	0.06747	1.53	0.127
ln(HHI)	-0.42290*	0.23590	-1.79	0.074
ln(total assets)	-0.34692***	0.08817	-3.93	0.000
(total assets)2	0.00035***	0.00007	4.70	0.000
Time trend	-0.02504	0.01986	-1.26	0.208
Cyprus	0.15449	0.22646	0.68	0.496
Czech Republic	0.57189**	0.24197	2.36	0.019
Estonia	1.06632***	0.17629	6.05	0.000
Hungary	0.53078*	0.27177	1.95	0.052
Latvia	0.28400	0.28151	1.01	0.314
Lithuania	0.64829***	0.16867	3.84	0.000
Poland	0.26443	0.32707	0.81	0.419
Slovakia	0.48287**	0.21406	2.26	0.025
Slovenia	0.38237**	0.17299	2.21	0.028
constant	7.19251***	2.16165	3.33	0.001
R-squared	0.45490			
	F(20, 360) = 17.73 (0.0000)			
White's test for Ho: homoskedasticity	chi2(185) = 278.68 (0.0000)			

t-statistics are computed using heteroscedasticity-consistent standard errors. ***, **, * indicate significance at the 1%, 5% and 10% levels, respectively. The estimation method is OLS within panel.