Cross-Country Comparisons of Competition and Pricing Power in European Banking

Santiago Carbó[a], David Humphrey[b], Joaquín Maudos[c] and Philip Molyneux[d]

Abstract

Studies of banking competition and competitive behaviour both within and across countries typically utilise only one of the few measures that are available. In trying to assess the relative competitive position of banking markets in 14 European countries, existing indicators of competition are found to give conflicting predictions across countries, within countries, and over time. This is because indicators of competition tend to measure different things and are additionally influenced by cross-country differences in cost efficiency, fee income levels, real economic growth and inflation. We attempt to separate bank pricing power from these embodied influences and derive more consistent cross-country estimates of banking sector competition. The main result is that our measure of bank pricing power suggests that banking market competition in Europe may well be stronger than implied by traditional measures and analysis.

Key words: competition, banking, pricing power

[a] Universidad de Granada and Funcas; Departamento de Teoría e Historia Económica, Universidad de Granada, 18011- Granada, Spain. E-mail: scarbo@ugr.es

[b] Department of Finance, Florida State University, Tallahassee, FL 32306-1042, USA. E-mail: dhumphrey@cob.fsu.edu

[c] Universidad de Valencia and Ivie, Departamento de Análisis Económico, Avda. De los Naranjos, s/n; 46022 Valencia, Spain, E-mail: joaquin.maudos@uv.es [corresponding author]

[d] Bangor Business School, University of Wales, Bangor - Division of Financial Studies, Bangor Gwynedd LL57 2DG, Wales, United Kingdom. E-mail: abs005@bangor.ac.uk

1. Introduction

Almost all studies of bank competition deduce competitive behaviour within or across countries from basically just one of a small number of measures. These include measures that are estimated statistically as well as other indicators (usually ratios) obtained from bank financial statements. While some researchers may prefer one measure over another, there is no consensus regarding the "best" measure by which to gauge competition (Northcott, 2004). This, of course, may not matter if all the different measures provide similar inferences about competitive behavior. However, if they do not yield similar results then the choice of a particular indicator can influence interpretations of competitive behavior within a given country. Furthermore, if the different measures of competition do not provide similar results and are in addition influenced by country-specific factors, then this calls into question the reliability of studies examining banking market competition across countries.

These issues concerning the measurement of competition are of particular policy relevance since European banking markets have become more concentrated in recent years. The number of banks in the European Union-15 decreased from around 9,624 in 1997 to less than 7,500 in 2003, an 18% reduction (ECB, 2004). The asset market share of the five largest banks in 12 of the 15 European Union (EU) banking markets rose over 1997-2003. Overall, this five-firm concentration ratio (CR-5) expanded from 46% to 53% (ECB, 2004).[1] As banking systems become more concentrated –and given that the relationship between concentration and market power remains unclear– it is important that policy makers apply the appropriate metrics to be able to gauge accurately the overall state of banking market competition, the effects of deregulation, as well as judge the likely impacts of prospective mergers.

In order to examine whether different measures yield similar results the first empirical part of this paper compares structural and non-structural indicators of competition across 14 European banking markets over 1995 to 2001. In particular, we measure competition using indicators from the so-called New Empirical Industrial Organization (NEIO) literature. This literature suggests that measures of the mark-up of price (average revenue) over marginal costs (giving a Lerner index) and the degree to which input price changes are reflected in average revenues (the H-statistic) provide "realized" measures of the degree of banking market competition. These indicators are estimated using bank-level data for the European Union and are compared with a standard market structure measure of concentration (a Hirschman-Herfindahl index) and

[1] Similar results for European banking sector concentration are reported in ECB (2003) and Jansen and DeHaan (2003). The growth in asset concentration among the 10 largest banks in the U.S. was even more rapid, rising from 22% to 46% over 1980-2003 (Piloff, 2004).

other bank performance indicators (net interest margin and return on assets) that are often used to gauge the competitive features of the industry. Here we find that the various indicators yield different results about competitive behaviour within and across countries and over time.

Secondly, we identify a number of bank-specific and country-specific factors that explain differences in structural and non-structural measures of banking competition. An empirical approach is adopted similar to that of Demirgüç-Kunt, Laeven, and Levine (2004) and Claessens and Laeven (2004) to examine the influence these characteristics have on competition measures for Europe. Differences in competition measures are shown to be explained in part by variations in bank-specific cost efficiency and the proportion of fee income from non-traditional services along with country-specific rates of real output growth and inflation.

The final part of the paper uses a procedure developed in the frontier efficiency literature to identify a new indicator of bank pricing power. Here we 'strip out' the effects of the previously identified four factors that help to explain differences in measures of competition. Our new measure of bank pricing power provides a somewhat more consistent indicator of banking sector competition than traditional measures. We conclude that if differences in cost efficiency, fee income, real output growth and inflation are taken into account then European banks' pricing power appears weaker than suggested using traditional competition indicators.

This study is divided into seven sections. Some background information on banking competition measures and results for Europe is provided in Section 2 while Section 3 describes the structural and non-structural competition measures used in our empirical analysis and outlines the dataset. This is followed by Section 4 which examines whether indicators of competition are consistent with each other and provide the same results. Here we analyse the evolution of the different measures of banking competition over 1995-2001 both across and within 14 European countries. Section 5 outlines the reasons why various measures can yield conflicting results and an econometric analysis is used to examine the factors (cost efficiency, fee income, real output growth and inflation) that are identified as being important in explaining cross-country differences in the various competition measures. Procedures developed in the frontier efficiency literature are applied in Section 6 to 'strip out' the above named factors in order to isolate a likely more accurate indicator of bank pricing power from current measures of market competition. The study ends with a brief summary of our results in Section 7 along with a discussion of some implications of the analysis for competition policy in Europe.

2. Competition in Banking: A Brief Survey

Two types of competition measures have generally been used in the established literature to analyze the competitive features of the banking industry – these are referred to as structural and non-structural indicators. Traditional industrial organization theory focuses on the Structure-Conduct-Performance (SCP) paradigm where the competitive features of industry are inferred from structural characteristics that influence firm behavior and performance. Market structure can be indicated by various measures including market shares, concentration ratios for the largest sets of firms, or a Hirschman-Herfindahl index. The SCP approach aims to see if there is a relationship between the structural features of an industry and firm performance (measured using either some profit or price indicator). Typically, this approach was based on empirical studies during the 1940s and 1950's that originally focused on manufacturing industries with high fixed costs, few competitors, and limited new firm entry. Under these conditions increased market concentration was significantly statistically associated with higher prices and greater than normal profits (or return on invested capital). With smaller numbers of firms (oligopoly) and limited contestability, it is easier to collude--explicitly or implicitly--to control various market outcomes, resulting in uncompetitive behavior.

While the SCP approach argues that a concentrated market structure is associated with higher prices and profits, higher profits could alternatively be the result of greater efficiency in production and managerial organization (Smirlock, 1985; Evanoff and Fortier, 1988). Berger (1995) finds some evidence that the efficiency hypothesis holds in U.S. banking in that this hypothesis explains somewhat more of the variation in bank profitability than does the traditional SCP paradigm. However, the statistical relationships are weak and both hypotheses together explain less than 20% of the variation in profits across banks. While the earlier U.S. literature tends to find evidence that the traditional SCP paradigm holds, later studies that test both the SCP and efficiency hypotheses jointly tend to reject the SCP paradigm in favor of the efficiency hypothesis.[2] In contrast, European banking studies tend to find more evidence that the traditional SCP hypothesis holds (Goddard, Wilson, and Molyneux, 2001). For Europe, structural factors seem to be important in determining competitive behavior.

An alternative view is embodied in the literature examining the strategic reactions of competing oligopolies (from the earliest work of Cournot and Bertrand to more recent work by Stigler, 1964). The extensive theoretical literature on oligopoly behavior has long recognized that major firms in concentrated markets can compete aggressively with one another, and this usually involves firms having to guess the price and quantity reactions to strategic moves made by each other (so-called conjectural

[2] See Gilbert (1984) and Berger, Demsetz, and Strahan (1999) for reviews of the U.S literature.

variations). In these relationships, the competitive environment is determined by the strategic reactions of firms and not necessarily by the structure of the market.

In addition, the role of market contestability advanced initially by Baumol (1982) and Baumol, Panzar and Willig (1982) is an important qualification when assessing the likely predictive accuracy of the SCP paradigm. In contestable markets the competitive behavior of firms is determined by (actual or potential) entry and exit conditions (sunk costs). With low entry restrictions on new firms and easy exit conditions for firms that fail to earn reasonable profits, incumbent firms in an industry are pressured to behave competitively to deter entry even if the existing market is concentrated. Here structural features of a market are irrelevant in determining market competition since entry and exit conditions determine competitive behavior. As in the case of competing oligopolists, the competitive features of a contestable market cannot be inferred using structural indicators so separate indicators based on realized pricing behavior and/or market contestability need to be found.

Non-structural indicators of competition used to quantify realized firm pricing behavior are (mainly) based on measures of monopoly power developed by Lerner (1934). In particular, these include measures of competition between oligopolists such as Iwata (1974)[3] and those that test for competitive behavior in contestable markets by Bresnahan (1982), Lau (1982) and Panzar, and Rosse (1987). This empirical literature is referred to as the New Empirical Industrial Organization (NEIO) approach. These measures are developed from (static) theory of the firm models under equilibrium conditions and typically use some form of price mark-up over a competitive benchmark. In the Lerner index, it is the mark-up of price (average revenue) over marginal cost and the divergence of price from perceived marginal revenue for the Bresnahan measure. The higher the mark-up, the greater the realized market power. An alternative approach, developed by Panzar and Rosse (1987)--the H-statistic--focuses on the degree to which changes in the average cost of different inputs leads to subsequent changes in average revenues provided that the industry in a long-run equilibrium. The greater is the transmission of cost changes into price changes, in either direction, the more competitive the market is deemed to be since costs would then primarily determine price--not market concentration.[4]

The Iwata (1974) model provides a framework for estimating conjectural variation values--firms' reactions to changing market shares and pricing by rivals--for banks that supply homogenous products. As far as we are aware, the Iwata measure has only been applied once to banking by Shaffer and Di Salvo (1994). While they find

[3] Also see Berg and Kim (1998).

[4] Other approaches consist of those developed by Kessidis (1991) who proposes a model of contestability focusing on sunk costs and Corvosier and Gropp (2002) who look at the role of information technology, its influence on sunk costs, and competition in European deposit and loan markets.

evidence of imperfectly competitive behavior in a highly concentrated duopoly market, the market examined was very small and local in nature.[5]

Much wider use has been made of the measures suggested by Bresnahan (1982) and Lau (1982), and later on following the empirical framework outlined in Bresnahan (1989). This approach requires a structural model of banking competition where a parameter representing the apparent market power of banks is included. This parameter simply measures the extent to which the average firm's marginal revenue varies from average revenue indicating the slope of the demand curve and hence the implied market power of firms over price. This approach was first applied to the banking industry by Shaffer (1989, 1993) using aggregate data for the U.S. loan market and the Canadian banking industry, respectively. Applications of this approach to European banking are numerous and include studies on Finnish banking by Suominen (1994), on various European countries by Neven and Röller (1999) and Bikker and Haaf (2002), on Italian banking by Coccorese (1998) and Angelini and Cetorelli (2003), on Dutch consumer credit markets by Toolsema (2002), and on Portuguese banking by Canhoto (2004)[6]. Most of this literature finds little evidence of market power in European banking, the exception being Neven and Röller (1999) who find significant monopoly collusive behaviour when they consider the corporate and household loan market across six countries between 1981 and 1989.

There is also an extensive literature that uses the Panzar and Rosse (1987) H-statistic, which relates input cost changes to output price changes, to investigate competitive conditions in European banking and elsewhere. Molyneux, Lloyd-Williams, and Thornton (1994), Bikker and Groenveld (2000), De Bandt and Davis (2000), Weill (2003), Boutillier, Gaudin, and Grandperrin (2004), and Koutsomanoli-Fillipaki and Staikouras (2004) all find that monopolistic competition is prevalent across various European countries. Claessens and Laeven (2004) examine the determinants of the H-statistic for a sample of over 50 banking markets including Europe. In virtually every country evidence of monopolistic competition is found. They also find no relationship between competitive conditions and market structure as measured by concentration ratios and the Hirschman-Herfindahl index. Individual country studies by Vesala (1995) for Finland, Coccorese (1998) and Hondryiannis, Lolos, and Papapetrou (1999) for Greece, Hempell (2002) for Germany, Coccorese (2004) for Italy, and Maudos and Pérez (2003) and Carbó, Humphrey, and Rodríguez (2003) for Spain all come to similar conclusions – namely that monopolistic competition is prevalent in European banking

[5] The market investigated contained a sample of banks operating in south central Pennslyvania.
[6] See also Uchida and Tsutsui (2005) for a study of competition in Japanese banking using the Bresnahan approach.

systems. Evidence as to whether competition in these countries is improving or not has been mixed.

Finally, a number of recent studies have used the Lerner index to try to determine the trend in competitive behaviour over time. Generally, these studies suggest a worsening of competitive conditions in European banking during the 1990's (see Fernández de Guevara and Maudos, 2004; Fernández de Guevara, Maudos and Pérez, 2007; Carbó and Rodríguez, 2007; Maudos and Fernández de Guevara, 2007). This is usually inferred from a rising margin or a higher Lerner index. However, Maudos and Fernández de Guevara (2004) show that while these margins fell in 10 out of the 14 EU banking sectors studied over 1993-2002, this reduction can be compatible with a weakening of competitive conditions (an increase in market power) as explained below. A similar result is found when the analysis is applied on a regional basis within a country (Carbó, Humphrey, and Rodríguez, 2003; Maudos and Pérez, 2003). These results are at odds with the general perception that competition has increased in Europe (c.f., Padoa-Schioppa, 2001; European Central Bank, 2003). A likely explanation for the difference in these views is that competition can increase in traditional markets for banking services--where the Lerner index is often seen to fall over time--while banking firms have found new sources of (fee) income which expands their overall return on assets. That is, the Lerner index may fall for deposits and/or loans (see Carbó, Fernández, Humphrey and Maudos, 2005; and Maudos and Fernández de Guevara, 2007) while at the same time a more aggregate indicator of overall competition--the return on assets--may rise as income from off-balance-sheet activities expands. Another explanation focuses on the increased efficiency experienced by European banks due to cost savings from the shift to electronic payments and the substitution of ATMs for expensive branch offices (Carbó, Humphrey, and López del Paso, 2006; Humphrey, Willesson, Bergendahl, and Lindblom, 2006). Lower operating costs from these two sources of technological change can affect the Lerner index and return on assets but likely have a smaller effect on net interest margins. For example, technological advances may lower marginal costs faster than prices suggesting a higher return on assets (ROA) and mark-up over costs (Lerner index) and hence greater market power while at the same time reducing the need to cover lower deposit operating cost in the spread between loan and deposit rates that determine the net interest margin. Hence, different measures of competitive behaviour may imply varying results for competition, depending on which measure is being relied upon.

3. Competition Measures and Bank Sample

The following describes five indicators that are widely used to infer competitive behaviour in the European banking industry. These include:

- NIMTA: Net interest margin/total asset ratio. This reflects the loan-deposit interest spread or interest rate mark-up after controlling for different sized banks by deflating by total asset value.

- LERNER: Lerner index, defined as $(P_{TA} - MC_{TA})/P_{TA}$. Here P_{TA} is the price of total assets computed as the ratio of total (interest and non-interest) income to total assets. MC_{TA} is the marginal cost of total assets computed from a standard translog function with a single output (total assets) and three input prices (deposits, labour and physical capital) using panel data in a fixed effects model covering all 14 countries over 1995-2001. Our definition of price is broader than the usual net interest margin measure NIMTA since the numerator of the Lerner index includes both interest and non-interest income.[7]

- ROA: The ratio of bank net income to the value of total assets. This is a profitability measure that considers all sources of income, not just that from traditional loan and security asset holdings.

- H-STATISTIC: Based on a reduced-form revenue equation, the so-called H-statistic (Panzar and Rosse, 1987) measures the sum of elasticities of revenues with respect to input prices. The estimated value of the H-statistic ranges between $-\infty$ and 1. Under perfect competition, a decrease in input prices reduces marginal costs and revenues by the same amount as a cost reduction (H = 1). A value of the H-statistic between 0 and 1 indicates monopolistic competition. Values equal or less than 0 are consistent with monopoly behaviour (as a decrease in input prices decreases marginal costs but would not also reduce revenues). We use panel data for each of the 14 countries over 1995-2001 to estimate a double log linear equation in order to derive H-statistics. In general, the H-statistic is calculated as the sum of the ratios of the percentage change in total revenue (from all sources) to the percentage change in the three input prices (funding, labour and capital costs), holding constant total banking output (total assets), leverage, and two balance sheet composition variables (loans to assets and deposits to total liabilities). Following an approach similar to other papers (Molyneux, Lloyd-Williams, and Thornton, 1994; De Bandt and Davis, 2000; Claessens and Laeven, 2004 and 2005; among others), the H-statistics are

[7]The model most often used to obtain the Lerner index of market power in banking is the Monti-Klein imperfect banking competition model. This model examines the behaviour of a monopolistic bank faced with a downward sloping loan demand curve and an upward sloping deposit supply curve. More details on the estimation of the Lerner index can be found in Fernández de Guevara, Maudos, and Pérez (2005).

derived from a revenue function estimated separately for each country. However, we specify a more flexible (translog) revenue function which includes levels, interaction and squared terms for inputs prices, a trend dummy and control variables[8].

- HHI: A Hirschman-Herfindahl index of banking market concentration defined as the sum of the squares of the market shares of all banks (commercial banks, savings banks, co-operative banks, etc) existing in a country. More formally, $HHI = \sum_{i=1}^{n} (MSi)^2$ with MSi being the market share of every bank in the market, and n being the number of banks. The HHI measure is more informative than an n-firm concentration ratio since it will reflect the similarity or difference in market shares among firms in a market even when the n-firm concentration ratio between two countries (or time periods) are the same.

In order to compare measures of competitive behaviour in European banking we obtain financial information on a large sample of banks from the BankScope database, provided by Fitch-IBCA, over 1995-2001. All types of depository institutions (commercial banks, savings banks, and co-operative banks) are included in our sample so as to provide a broad representation of banking sectors in each country. Our indicators of EU banking competition are based on a balanced panel of 1,912 banks over 7 years giving 13,384 observations. The composition of the sampled banks is shown in Appendix Table A1.

4. Do Indicators of Banking Sector Competition Provide the Same Results?

4.1 Cross-Country Comparisons of Market Competition Measures

Table 1 shows the means of the five indicators of banking market competition across our 14 European countries over 1995-2001 as well as for the whole EU[9]. There are significant cross-country differences in these competition measures. For the net interest margin, Denmark and Italy have the highest margins (at 4.7% and 3.5%, respectively) while Luxembourg and Ireland have the lowest (at .8 and 1.2%). The EU average is toward the upper range of these two extremes (2.3%). As seen, the difference in average net interest margins is quite large.

The Lerner index (LERNER) – the mark-up of price over marginal cost - is often used as an indicator of banking competition and also varies considerably across countries. Denmark and Spain have the highest values (at 22% and 20%, respectively)

[8] This allows us to estimate H-statistics at the individual bank-level.
[9] We exclude Finland as only a limited number of observations per year are available.

while Luxembourg (11%) and the U.K. (11%) have the lowest. The Lerner index for the EU is 16%. A broad measure of banking profitability is the return on assets (ROA) which for the EU averages 69 basis points. The ROA ranges from 27 basis points in Germany and 47 basis points in Luxembourg to 139 in Greece and 129 in Denmark.

Turning to the H-statistic, a value close to 1.00 implies that changes in costs are basically fully reflected in changes in output prices, implying a competitive market, while a value close to 0.0 implies essentially no competitive pressure so banks adjust prices with very little regard to changes in costs. The intermediate values seen in Table 1 range from .50 to .97[10] and suggest that almost all countries are only partly sensitive to cost changes in setting prices. This indicates an intermediate degree of market power over price (monopolistic competition) which does not differ much among countries. With somewhat higher H-statistics, Luxembourg (.97) and Portugal (.91) appear to have more competitive markets than do Sweden (.50) and Greece (.57)[11].

The Hirschman-Herfindahl measure is an indicator of market structure (HHI) where higher values reflect more concentrated banking markets and (potentially) less competition. The highest level of banking market concentration within the EU is found in Greece (1,530) and the Netherlands (1,285) while the lowest is indicated for Germany (188) and Luxembourg (305). Market concentration in the EU averages 748, a value which would indicate a competitive market using the U.S. criteria for approving a banking merger.

Casual inspection of our five competition measures across European countries in Table 1 suggests that neither the net interest margin nor the Lerner index is well correlated with the HHI structural measure. This was also pointed out in Bikker and Haaf (2002), Fernández de Guevera and Maudos (2004), and Claessens and Laeven (2004) who observe little relationship between structural and non-structural measures of bank competition. However, in terms of rankings it can be seen that the five measures appear relatively consistent in identifying the most and least competitive banking markets. The most competitive seems to be Luxembourg which is ranked number one for four of the five measures (and second in terms of ROA). This probably reflects the role of Luxembourg as an offshore financial centre and the specific role played by foreign banks. The rankings suggest that the least competitive banking systems are those of Denmark and Greece. Also, Table 1 suggests a degree of consistency in ranking the U.K. (and possibly Ireland) as a relatively competitive market whereas there are substantial differences for other countries.

[10] These two values are significantly different at the 95% level of confidence using a t-test for the equality of means (t-values are 21.97 assuming equal variance and 8.33 where variance equality is not assumed).
[11] The usual long-run equilibrium tests have been performed confirming that the H-values can be interpreted as equilibrium competitive measures.

While the five measures may yield consistent rankings of competition at the extremes, there is little evidence of consistency when cross-country correlations are examined among the five measures in Table 1. These correlation coefficients (r values) are shown in Table 2 and indicate the direction of the relationship between any two competition measures while the R^2s in parenthesis show the extent to which the paired measures contain the same information. All correlation coefficients are positive so that when one measure is relatively high (low) the others are also relatively high (low). Since a higher H-statistic implies greater competition while for the other four measures higher values imply less competition, the H-statistic results have been multiplied by -1.0 in Table 2 (and in all subsequent analysis). Now in all cases a higher value of all competition measures implies less competition. Thus the positive relationship between the H-statistic and the other measures indicates that when the other four competition measures suggest greater competition, the H-statistic also suggests more competition.

The R^2 values in parenthesis in Table 2 directly indicate the degree of consistency among our five banking competition measures. If any of these pair-wise values were equal to 1.0, then either of the paired indicators would be a perfect substitute for the other - each would contain the same information and be perfectly consistent with each other. If this pair-wise value were equal to .50, however, then variation in one competition indicator can only be explained by 50% variation in the other suggesting substantial measurement error and a lack of consistency between the two indicators. While there would be a degree of consistency between the paired competition measures if $R^2 = .50$, it would not be strong since some of the time one indicator could yield opposite results concerning the level of banking competition. Finally, if the pair-wise value is at or close to 0.0, then the paired competition measures contain no similar information, are basically uncorrelated, and would only randomly yield similar information regarding the level of competition.

The relationships between the five competition measures in Table 2 are weak since at most only 37% of the information in one competition measure - the mark-up of price over marginal cost (the Lerner index) - is also contained in another - ROA. And at most 24% of the information in ROA is contained in the market structure measure HHI. All the other R^2s are usually considerably less than these values. In general, the net interest margin, the Lerner index, and the return on asset measures are only weakly positively related to one another, showing a low degree of cross-country consistency over time. The market structure measure HHI is only weakly correlated with the return on assets while variation in the H-statistic explains no more than 19% variation in the other measures[12].

[12] The findings are similar when we examine cross-country correlations using mean values of the competition measures (i.e., ignoring the 7-year time dimension so n = 14, not 98). Here we find that at most only 46% of the information in the net interest margin (NIMTA) is also contained in the Lerner

4.2 Within-Country Comparisons of Market Competition Measures

Repeating the correlation analysis of Table 2 for banks within each of the 14 European countries separately, we obtain Tables 3A and 3B. The weak conclusions regarding consistency among competition measures across countries derived above are seen to be even weaker when individual countries are being compared since the strength of the relationships differ both in size and sign across countries (see last row in table). For example, when the net interest margin is paired with the Lerner index or the return on assets (the first two columns in Table 3A), the relationship between these two pairs is negative for under half of the countries and positive for the remainder. Indeed, out of the 84 correlations shown in Table 3A, 63% (53) are positive while 37% are negative. Only Germany, Ireland and Sweden have positive correlations across all competition measures and half of the 14 countries (Belgium, Denmark, Germany, Ireland, Netherlands, Sweden, and the U.K.) have all positive correlations among the NIMTA, Lerner, and ROA measures while the other seven countries do not.

Within individual countries, only one of the ten pair-wise comparisons in Tables 3A and 3B show a strong degree of similarity. This is where there is a consistently positive relationship between the Lerner index and the return on assets in Table 3A (Column 4 with 13 positive r's out of 14). In the other pair-wise comparisons there is at least some positive relationship between ROA and three other measures - H-statistic, HHI and ROA (9 positive r's out of 14) and a negative relationship between net interest margins and the H-statistic and HHI (9 negative r's out of 14). Even so, this is a long way from using these different measures more or less interchangeably as is the maintained hypothesis in the literature when only one competition measure is typically used to draw inferences from. The conclusion so far has to be that it is apparently not possible to select one or two measures of banking competition that seem to be informative in one country and necessarily expect the same two measures to be equally informative when applied to another country (apart perhaps when one compares the rankings for the most and least competitive systems). Overall, the cross-country results are just too inconsistent.

What about over time? Did the competition measures generally fall indicating an improvement in competition over time? The correlation of competition measures with time over our seven annual periods is shown in Table 4. A negative (positive) value indicates that competition improved (worsened) over time. The net interest margin, with only one positive correlation (Netherlands) with time out of 14 countries, indicates an improvement in competition while for the majority of countries the other four measures rose suggesting reduced competition. Thirteen of the 14 countries experienced a reduction in net interest margins while 6 to 8 countries experienced a rise in their Lerner

---

index and 44% of the information in the Lerner index is also contained in the ROA. All other R^2s are

index, their ROA, their H-statistic, and their HHI market concentration measure. This suggests again that all five indicators do not provide the same inferences regarding competition.[13]

4.3 Is One Competition Measure Strongly Explained by the Other Four?

If the differences in the way in which the aforementioned measures are not very important to predicting competition, then in principle some sort of weighted average or factor analysis composite of these separate measures may be a way to reflect better market competition rather than relying on only one indicator for this assessment. Such an arrangement would likely be more successful if the R^2 from regressing any one of our competition measures (CM_i) on the four remaining measures (CM_j , $i \neq j$, $j = 1,...,4$) was reasonably large.

As shown in Table 5, this does not seem to be the case. This holds whether the specified relationship is performed using all 14 EU countries, only just four of the largest countries (Germany, France, Italy, and Spain), or just one country (for example, Spain). The greatest similarity among the five competition measures across the 14 countries seems to be the net interest margin (NIMTA) and the ROA with the other four indicators where 34% of their variation is "explained" by the other measures. The same is true when the analysis focuses on only four large countries (Germany, France, Italy, and Spain). When only one country is examined (for example, Spain), however, the similarity among competition measures is higher although less than 50% in three out of the 5 competition measures. These results confirm, from a different perspective, the lack of consistency among competition measures both within and across countries in Europe.

5. What Explains the Differences in Competition Measures?

Given the evidence provided so far it seems likely that the way in which the various measures of competition are derived 'does matter'. In order to choose a measure of competition and interpret the results accurately one clearly needs to understand what the indicators measure and how they differ. As noted above, the four non-structural measures of competitive behavior are often used interchangeably since it is believed that they tend to effectively measure the same thing - control over price and profitability - but go about it differently. The following shows more clearly how the various measures are actually related. The base case to which each measure is compared is simply profits before losses or taxes per euro of asset value or (TR - TC)/TA where TR is total revenue, TC is total cost, and TA is total assets. The purpose is to illustrate what has to be done to (TR - TC)/TA in order to obtain the net interest margin (NIMTA), Lerner

---

considerably lower.

[13] With only seven annual observations per country, the results in Table 4 should be treated with caution and the focus should be more on the sign of the correlation than on the size.

index, return on assets (ROA), and H-statistic measures that are commonly used to gauge market competition in banking. These manipulations are shown below:

NIMTA = (interest income - interest expense)/TA

= [(TR - non-interest revenue) - (TC - operating cost)]/TA

= (TR - TC)/TA - (non-interest revenue - operating cost)/TA

LERNER = (P - MC)/P

= (TR/TA - ∂ TC/∂ TA)/(TR/TA), holding input prices constant.

Under constant returns to scale ∂ TC/∂ TA = TC/TA, the Lerner index

= (TR - TC)/TA divided by TR/TA.

The Lerner index is not a mark-up over all costs, only over marginal costs. These mark-ups necessarily include the need to recover unit fixed expenses as well as a "normal" return on invested financial capital. The Lerner index is a "level" measure of the percent that price (P) exceeds marginal cost (MC). One can view the Lerner index as a price-cost spread in average terms.

ROA = (net income)/TA

Where net income = TR - losses - taxes - TC, we have

= (TR - losses - taxes - TC)/TA

= (TR - TC)/TA - (losses + taxes)/TA.

H-STATISTIC = $\sum \partial TR / \partial(input\ prices)$, holding output level and mix constant.

As (average input prices) = (average cost), we have

H-statistic = ∂(TR/TA)/∂ (TC/TA) holding TA constant.

When the H-statistic is stable, the margin equals the average, so

(stable H-statistic) = (TR/TA)/(TC/TA) = TR/TC.

Subtracting 1 from both sides gives

(stable H-statistic) - 1 = TR/TC - 1 = (TR - TC)/TC.

Multiplying both sides by TC/TA, we get

[(stable H-statistic) -1](TC/TA) = (TR - TC)/TA

The H-statistic is a "change" measure (unlike the Lerner index which is a “level” measure) that indicates the extent to which percent changes in input costs are reflected in price changes. Thus one can think of H-statistic as reflecting the price-cost spread in marginal terms.

This way of expressing our four non-structural competition measures suggests that the benchmark unadjusted return on assets (TR - TC)/TA can be defined as:

= NIMTA + (non-interest revenue - operating cost)/TA
= Lerner index times (TR/TA) assuming constant returns to scale
= ROA + (losses + taxes)/TA
= a (stable H-statistic - 1) times (TC/TA)

Thus while the competition literature often uses these four measures interchangeably, they can differ in their cross-country competition predictions when:

(a) there are important differences in the share of fee and off balance sheet revenues in TR across countries (reflecting expanded revenues from non-traditional banking deposit and loan services);

(b) operating cost is falling at different rates across countries (due most likely to differences in the shift to lower cost electronic payments and ATMs);

(c) scale economies differ due to markedly different average sizes of banks among smaller and larger European countries; and

(d) there are marked differences in loan losses and taxes across countries.

One can illustrate how some of these differences 'matter' by referring to the time trends reported in Table 4. Here we found that the Lerner index generally increased between 1995 and 2001 while the ROA was split between rising and falling over the period. However, the inference that competition may have worsened in Europe is not borne out by the behavior of net interest margins (NIMTA) which fell in all but one country. Since the net interest margin looks only at the net interest return while the Lerner index and ROA are more comprehensive and include non-interest (off-balance-sheet and fee) returns and non-interest (operating) cost, it may well be that competition in the traditional deposit and loan markets rose (reducing the net interest margin) while bank expansion into newer areas of business and the effect of technical change in reducing operating cost would be consistent with the rise in the Lerner index and the return on assets.

If this explanation is accepted, then one could argue that the net interest margin is the preferred measure for analyzing competition in traditional banking loan and deposit services in Europe. In contrast, the Lerner index and ROA would reflect better competition in broader banking activity. The trends reported in Table 4 for these

measures reflect less competition in non-traditional banking services and more pricing power in this area. After all, non-traditional sources of revenue from off-balance-sheet activities will raise revenues much faster than costs and leave traditional banking output (total assets) almost unchanged. This would also be consistent with an apparent rise in pricing power derived from the H-statistic. The concurrent rise in the concentration measure HHI is then likely to be reflective of the wave of banking mergers associated with these new activities rather than indicating a reduction in competition in traditional banking services.

Competition measures can also be affected by country-specific influences that may distort cross-country comparisons. The following provides a regression analysis that examines these factors. An influence related to profitability and rates of return concerns differences in cost efficiency among countries. Countries with greater cost efficiency have a lower ratio of operating cost to asset value (OCTA) which, if not controlled for, may otherwise suggest less competition in a market for banking services. Importantly, bank unit operating costs have been falling over time due to the shift to electronic payments and expanded use of ATMs as opposed to more expensive branch offices. As well, banking profits tend to rise when a country is in the upswing of a business cycle (measured by the annual rate of growth of real GDP - GDPGR) due to expanding loan demand and/or when inflation is high (measured by a cost of living index - COL[14]). However, these two effects are usually temporary and reversed when GDP growth is slow and inflation is low[15].

As outlined above, banks provide both traditional loan and deposit services as well as newer non-traditional services such as off-balance sheet activities including derivatives trading, fund management, underwriting, insurance and a host of other fee or commission-based services. From a public cost and benefit standpoint, traditional loan and deposit services are more important than the newer specialized services since traditional activities affect more people and these users are less sophisticated and less likely to have the opportunity to shop around for a better price. This influence can be partially controlled for by the ratio of fee income to asset value (FEEINC) since fee revenue is mostly associated with supplying non-traditional services. Lastly, a dummy variable for the type of bank (commercial, savings, or cooperative) was also specified (TYPEBANK).

The full linear specification for explaining non-core differences in competition measures CM_i (i = NIMTA, Lerner index, ROA, H-statistic) across 14 countries is:

[14] GDPGR and COL variables come from the World Development Indicators of the World Bank. The cost of living is measured by the rate of change of the consumer price index.

[15] For example, Huybens and Smith (1999) show that inflation artificially increases banking margins. Also Demirgüç-Kunt, Laeven and Levine (2004) note that both inflation and economic growth can influence interest margins. They find that inflation has a positive influence on margins, whereas economic growth has a small negative impact.

$$(1)\ CM_i = a_{Oi} + a_{1i}\,OCTA + a_{2i}\,GDPGR + a_{3i}\,COL + a_{4i}\,FEEINC + a_{5i}\,TYPEBANK + e_i + u_i$$

where all the variables have just been defined. The OCTA and FEEINC variables differ by bank, by year, and by country while the COL and GDPGR variables differ by year and by country. The last term in (1), $e_i + u_i$, is a composite error term and is discussed further below. The results of the four OLSQ regressions are shown in Table 6 pooled over 14 countries (n = 13,384)[16].

Consistent with the so-called "efficient structure" hypothesis that higher bank profits may (at least in part) be the result of efforts to reduce costs as well as the exercise of market power, the change in unit operating cost over 1995-2001 was negatively associated with the Lerner index and the return on assets. As this approximate cost efficiency measure fell by almost 6% between 1995-2001, the implication is that this cost reduction is associated with higher measured levels of these two market competition indicators and, if not adjusted for, these indicators would suggest that banking markets are less competitive than they actually may be.

Improved cost efficiency, however, is positively associated with the net interest margin and the H-statistic so these competition indicators have fallen with the reduction in operating expenses. If not adjusted for, this would suggest that competition has improved when in fact only costs have fallen[17]. As some of the net interest margin will reflect the recovery of unpriced deposit operating expenses, loan interest income can fall relative to deposit interest paid (lowering NIMTA) when these operating expenses fall. The same explanation can apply to the H-statistic since a reduction in operating expenses over time can show up as a corresponding reduction in revenues needed to cover financing and operating costs. In either case, the apparent improvement in competition implied from these two measures would be due to cost changes, not changes in market competition.

In sum, if the operating cost reduction that induces a rise in the Lerner index and ROA but induces a reduction in the net interest margin (NIMTA) and the H-statistic can be "subtracted" from these four measures, the result would likely be a better indicator of "pure" market competition as well as some possible improvement in consistency among competition measures (since changes in operating cost may raise the first two measures but reduce the latter two, contributing to a negative or lower positive correlation among them).

[16] A fixed or random effects model is not appropriate here as we wish to determine the influence of the specified variables alone without also incorporating dummy variables to reflect unknown country or bank-specific influences.

[17] Recall that we multiply the usual H-statistic by -1.0 so that higher values of all competition indicators would reflect less competition. Hence the positive correlation between operating cost reductions and our modified H-statistic would suggest greater competition.

With respect to the other influences in Table 6, both the growth in real GDP and the cost of living index fell over 1995-2001 (by 31% and 29%, respectively) and both are associated with a reduction in the return on assets, a rise in the H-statistic, but have opposite and potentially offsetting effects on the net interest margin and Lerner index. In addition, the 10% rise in fee income over 1995-2001 appears to have contributed to higher measured levels for the Lerner index and the return on assets since these two measures are broad-based profitability indicators that reflect both traditional and non-traditional sources of profits. The effect of higher fee income on the net interest margin and the H-statistic, which are more narrow indicators of profitability, is negative. Overall, for the 14 countries 11% to 57% of the variation in the four competition measures was "explained" by equation (1), with net interest margins (having the highest R^2) being the most affected by country-specific influences.

Results from re-estimating equation (1) using only bank observations for Germany, Italy, France, and Spain are shown in Table 7 (n = 11,375). Excluding the dummy variable for the type of bank, there was only one sign change among the four explanatory variables in Tables 6 (14 countries) and 7 (4 large countries). Thus little is changed by focusing only on the largest countries.

When making cross-country competition comparisons we conclude that differences in cost efficiency and fee income from non-traditional services can have a significant influence on the non-structural measures of competition, as do differences in real output growth and inflation. As these influences have little to do with longer-term bank pricing power, they need to be considered and adjusted for when assessing the level of banking market competition across countries. Overall, we tentatively conclude that the 'best' within country measure of competition for traditional banking services is net interest margins. The Lerner index and ROA are preferred for measuring within country competition in broader banking activity. However, net interest margins are probably the weakest cross-country measure of competition as they are most affected by country-specific factors.

6. Accounting for Differences in Competition Measures – A New Indicator of Bank Pricing Power

Having seen that measures of competition can be influenced by country-specific factors, we now try to take account of these differences by deriving a new, adjusted measure of bank pricing power. It is one thing to point out that banking market-specific differences in cost efficiency, non-traditional activities, real output growth and inflation should be considered when assessing the predictions of bank pricing power and quite another to actually adjust competition measures for these influences. Not having detailed cost accounting data, our approach to making such an adjustment relies on developments in the frontier efficiency literature. In this regard, the expression $e_i + u_i$ in

(1) is a composite error term with e_i representing random error while u_i reflects the unexplained portion of each competition measure (CM_i) which we suggest reflects a measure of bank pricing power after it has been adjusted for the statistically associated effects of (1) cost efficiency, (2) non-traditional banking activities, and (3) temporary changes in bank pricing power due to the business cycle and inflation. In effect, we "subtract" the influences associated with the independent variables in equation (1), and shown in Table 6, from each of the competition measure dependent variables.

Averaging $e_i + u_i$ over time for all sampled banks in each of 14 countries separately is expected to generate an average e_i that approaches zero while the average u_i is expected to yield a truer indicator of the level of average bank cross-country control over market price.[18] As our goal is to adjust the measured level of our four competition measures, rather than only make relative comparisons as is done in the efficiency literature, the intercept of each estimated equation is added to the averaged residual for each equation so that only the effect of the independent variables is "subtracted". Denoting the estimated intercept plus the averaged composite error term $e_i + u_i$ as PPM_i (a pricing power measure), the correlations among these adjusted competition measures are shown in Table 8 (the second part of each column). The correlations among these competition measures before they are adjusted (the first part of each column) are reported to see if our adjusted measures (PPM) may be more consistent than before.[19] Greater consistency occurs when the correlation coefficient (r value) in the second part of column is a higher positive value than the value shown in the first part of the column. Out of 10 possibilities, 4 show an improvement in consistency, 3 of which are restricted to the relationship among the net interest margin, Lerner index, and ROA. The relationship between these 3 measures and the H-statistic or the HHI is uniformly worse. Thus our adjustment moves the competition indicators that focus on profitability - NIMTA, Lerner index, and ROA - closer together but at the cost of making them less consistent with the H-statistic and HHI measure of market concentration.

The reason why there is now greater similarity among the net interest margin, the Lerner index, and the return on assets is that these three measures are all affected by changes in the value of operating cost and fee income, whether transmitted through the

[18] This approach is taken from the so-called 'distribution-free' application that is used in the efficiency frontier literature, where the u_i term is presumed to reflect the average unspecified cost or profit inefficiency "left over" and unexplained in a cost or profit function estimation. This is sometimes referred to as 'core inefficiency'. Berger (1993) provides a good discussion of this procedure, as do many other researchers in this area. Borrowing from this approach we assume a composite error term composed of random error e_i and another term u_i that reflects the unexplained portion of each competition measure not explained by the independent variables in the regression. To decompose the composite residual into its two components we assume that random errors average out to zero. Simply put, the average random error "disappears" leaving an average u_i which may reflect better underlying market competition. Following the standard DFA procedure, equation (1) is estimated separately for each year, although results using the pooled regression are very similar.

weighted average price or the quantity component of the change in the value of the competition measure. In contrast, the H-statistic effectively holds operating input quantities constant (by holding banking output level and composition constant) and relies only on the association of changes in input prices with changes in average unit revenues. If only the prices of inputs, average unit total revenues, and average unit fee revenues were changing over 1995-2001, then all four of the non-structural market competition measures should become more consistent. Apparently, the quantity component of the value of operating inputs and the value of fee income have changed more than the average price or average revenue component. Hence the divergence seen in Table 8 between the H-statistic and the other measures is likely due to the fact that the H-statistic is affected only by changes in prices while the NIMTA, Lerner index, and ROA are affected by changes in value derived from changes in price or quantity or both.[20]

The effect of the adjustment made to the four market competition measures is seen better when the unadjusted values of each CM_i are plotted across 14 countries in Figure 1 (the lines with boxes) and compared to the adjusted PPM_i values (the solid lines). The pricing power portions of the net interest margin (NIMTA), the Lerner index, the return on assets (ROA) are all either somewhat or markedly lower and, seen in Table 8 for these three measures only, more similar in their cross-country variation than are the standard unadjusted measures. The pricing power results for the H-statistic, however, are higher (smaller negative value).[21]

Since in all cases a higher value of any of the four competition measures would indicate less competition, the pricing power values for the net interest margin, the mark-up of price over marginal cost, and the return on assets all suggest that actual price competition in our 14 country banking markets may be stronger than what would be otherwise inferred with the unadjusted - and typically applied - competition measures. The divergent results for the H-statistic is, as noted above, apparently due to the fact that input and output quantities are effectively held constant in this measure so only price changes - not changes in values - will be reflected here. Consequently, our tentative conclusion is that the H-statistic is not a good candidate for the adjustment procedure we propose. We conclude that the net interest margin, the Lerner index, and

[19] These are cross-country correlations using mean values. See footnote 12.

[20] It is clear that the value of operating cost or the value of fee income can directly affect the net interest margin and ROA. Since the Lerner index is determined from the average "price" (unit revenue) of banking assets while changes in marginal cost can arise from changes in input prices or quantities, changes in the value of operating cost or fee income will also directly affect this measure as well.

[21] Recall that we multiply our unadjusted H-statistic by -1.0 so that higher values of all competition measures indicate less competition. This means that perfect competition for us is -1.00 while monopoly is 0.0 or a positive value.

the return on asset measures will likely reflect more accurately changes in competition over time.

Using the unadjusted competition measures to approximately rank the 14 countries in terms of their apparent degree of competition across all four of the non-structural measures shown in Figure 1, the banking markets of Luxemburg, Ireland, the U.K., and Germany (with the lowest unadjusted values) seemingly represent the most competitive markets while Denmark, Italy, Spain, and Greece (with the highest values) seem to be the least competitive. Using the adjusted competition or pricing power measures (PPM), Luxembourg (again) and Greece would be the most competitive while Denmark and Spain (both again) would be the least competitive. At the extreme ends, the country competition rankings are not changed much by our adjustment apart from Greece where country effects appear to have a substantial influence.

As seen in Figure 1, the main effect of our adjustment has been to reduce both the measured differences in the competition indicators across countries as well as lower them overall, suggesting greater competition. Indeed, the mean value of the net interest margin falls from an unadjusted 230 basis points down to a bank pricing power value of 57 BP while the unadjusted ROA is reduced from 69 BP down to 8 BP after adjustment. Our adjustment also leads to a 2 percentage point reduction in the Lerner index (down to an average mark-up of 14%) but the H-statistic experiences a rise of 5 percentage points.[22] The cross-country variation in our adjusted competition measures (using the coefficient of variation) is also reduced for all competition indicators, with the greatest reduction experienced by the net interest margin and ROA.

Overall, banking markets are apparently not as uncompetitive nor as different in their level of competition as previously thought or as much as standard measures would indicate. This is understandable since we "subtracted" the apparent effects of cross-country differences in cost efficiency, business cycle, inflation and non-traditional banking services from the non-structural measures of competition. This suggests that cross-country comparisons of banking sector competition are likely more accurate and consistent when country-specific factors are taken into account. These adjustments are best suited to the ROA, net interest margins and the Lerner index and are our 'preferred' indicators for cross-country comparisons of banking market competition.

7. Conclusions and Policy Implications

Many studies have attempted to determine the degree of competition in banking markets. The vast majority have made this assessment relying upon only one of the various measures developed for this purpose. As we demonstrate here for a cross-section of 14 European countries over 1995-2001, our comparison of five well-known

[22] Translating this into the standard H-statistic, it falls from .70 to .65 and suggests less competition.

indicators of banking market competition often give conflicting predictions of competitive behaviour across countries, within countries, and over time. These five measures - net interest margin, Lerner index, returns on assets, H-statistic, and HHI market concentration - are only weakly positively related to one another. The measures were computed for 14 countries using a balanced panel of 1,912 banks over seven years (giving 13,384 observations).

The essence of our results can be simply illustrated. Using average values across countries and time, the coefficient of determination (R^2) between return on assets (ROA) and the Lerner Index, ROA and HHI, and net interest margins and the Lerner index are only .37, .24, and .22, respectively.[23] Other relationships are weaker still. If these pair-wise relationships were .50, then effectively only 50% of the time would these measures contain the same information for assessing market competition. These and other results detailed in the text suggest that cross-country comparisons of banking competition in Europe lack consistency and may be unreliable as presently constructed.

Our set of competition measures are treated in the literature as being more or less substitutable but we find that the determination of competition may differ depending on the measure chosen to assess it. This is because the competition indicators measure different things. Net interest margins, for example, look only at the net interest return while the Lerner index and ROA are more comprehensive and include non-interest (off-balance-sheet and fee) returns and non-interest (operating) cost. As such, it may well be the case that competition in traditional deposit and loan markets (reflected in declining net interest margins) can be observed at the same time when the Lerner index or ROA are increasing (caused by bank expansion into fee-based areas of business and the effect of technical change in reducing operating costs). Overall, for analyzing competition within a single country we (tentatively) conclude that net interest margins is the preferred measure when the focus is on traditional banking loan and deposit services. The Lerner index and ROA better reflects competition in broader banking activity. In attempting to identify some of the reasons why competition measures differ across country, we found that in addition to cost efficiency and fee income, business cycle effects and inflation also appear to be important. Net interest margins are much more affected by these effects than other non-structural measures and therefore appear to be the weakest competition indicator for cross-country comparisons when unadjusted for cross-country differences.

Given the influence of country-specific factors on competition measures the final part of the paper derives a new, adjusted measure of bank pricing power. Here we use an approach from the frontier efficiency literature to subtract the influence of country-specific effects from four non-structural competition measures. Once country-

[23] From Table 2 in the text.

specific factors are removed the measured differences in the competition indicators are substantially reduced, suggesting that these banking markets are not as different in their level of competition as previously thought. Nevertheless, country competition rankings can change when country-specific factors are taken into account. We suggest that cross-country comparisons of banking sector competition are likely to be more accurate and consistent when country-specific factors are taken into account. These adjustments are best suited for competition comparisons using net interest margins, as well as ROA and the Lerner index.

From a policy perspective our findings suggest that it is important to not only consider a range of different measures but also to take into account country-specific factors when gauging the overall state of banking market competition in Europe. Similar considerations also need to be borne in mind when assessing the effects of deregulation as some studies have attempted, or for policy makers to judge the likely effects of prospective mergers.

Acknowledgements:

The authors gratefully acknowledge the detailed and constructive comments from an anonymous referee. All errors and omissions, of course, rest with the authors. Thanks also to the financial support provided by the BBVA Foundation. Joaquin Maudos thanks the *Ministerio de Ciencia y Tecnologia–FEDER* (projects SEJ2004-00110 and SEJ2005-02776) – for financial assistance. Santiago Carbó also thanks the *Ministerio de Ciencia y Tecnologia–FEDER* (SEC2002-00348 and SEJ2005-04927) for financial support.

References

Angelini, P., Cetorelli, N., 2003. The effects of regulatory reform on competition in the banking industry. Journal of Money, Credit and Banking 35, 663-684.

Baumol, W., 1982. Contestable markets: An uprising in the theory of industry structure. American Economic Review 72, 1-15.

Baumol, W., Panzar, J., Willig, R., 1982. Contestable markets and the theory of industry structure. Harcourt Brace Jovanovich, San Diego.

Berg, S., Kim, M., 1998. Banks as multiproduct oligopolies: an empirical evaluation of the retail and corporate banking markets. Journal of Money, Credit and Banking 30, 135-153.

Berger, A., 1993. 'Distribution free' estimates of efficiency in the US banking industry and tests of the standard distributional assumptions. Journal of Productivity Analysis 4, 261-292.

Berger, A., 1995. The profit-structure relationship in banking – tests of market-power and efficient-structure hypotheses. Journal of Money, Credit, and Banking 27, 404-415.

Berger, A., Demsetz, R., Strahan, P., 1999. The consolidation of the financial services industry: Causes, consequences, and implications for the future. Journal of Banking and Finance, 23(2-4), 135-194.

Bikker, J., Groeneveld, J., 2000. Competition and concentration in the EU banking industry. Kredit and Kapital 33, 62-98.

Bikker, J., Haaf, K., 2002. Competition, concentration and their relationship: An empirical analysis of the banking industry. Journal of Banking and Finance 26, 2191-214.

Boutillier, M, J., Gaudin, J., Grandperrin, S., 2004. La situation concurrentielle des principaux secteurs bancaires Europeens entre 1993 et 2000: Quels enseignements pour la future structure des marches financiers issue de l'uem. Fondation Banque de France Working Papers, February 22.

Bresnahan, T., 1982. The oligopoly solution concept is identified. Economic Letters 10, 87- 92.

Bresnahan, T., 1989. Empirical studies in industries with market power, in Handbook of Industrial Organisation, Vol. II (edited by R. Schmelensee and R. Willig), 1011-1058.

Canhoto, A., 2004. Portuguese banking: A structural model of competition in the deposits market. Review of Financial Economics 13, 41-63.

Carbó, S., Humphrey, D., Rodríguez, F., 2003. Deregulation, bank competition and regional growth. Regional Studies 37, 227-237.

Carbó, S., Humphrey, D., López del Paso, R., 2006. Electronic payments and ATMs: changing technology and cost efficiency in banking. In Balling, M., Lierman, F. and A. Mullineaux (eds.), Competition and Profitability in European Financial Services. Strategic, systemic and policy issues, Routledge, Abingdon (UK), 96-113.

Carbó, S., Fernández, J., Humphrey, D., Maudos, J., 2005. Estimating the intensity of price and non-price in banking: an application to the Spanish case. DT 02-05, Fundación BBVA.

Carbó, S., Rodríguez, F., 2007. The determinants of bank margins in European banking. Journal of Banking and Finance, forthcoming.

Claessens, S., Laeven, L., 2004. What drives bank competition? Some international evidence. Journal of Money, Credit and Banking 36(2), 563-583.

Claessens, S., Laeven, L., 2005. Financial dependence, banking sector competition and economic growth. Journal of the European Economic Association 3, 179-207.

Coccorese, P., 1998. Competition among dominant firms in concentrated markets: Evidence from the Italian banking industry. Centro Studi in Economia e Finanza, Working Paper 89.

Coccorese, P., 2004. Banking competition and macroeconomic conditions: A disaggregate analysis. Journal of Financial Markets, Institutions and Money 14, 203-219.

Corvosier, S., Gropp, R., 2002. Bank concentration and retail interest rates. Journal of Banking and Finance 26, 2155-2189

De Bandt, O., Davis, P., 2000. Competition, contestability and market structure in European banking sectors on the eve of EMU. Journal of Banking and Finance 24, 1045-1066.

Dermirgüç-Kunt, A., Laeven, L., Levine, R., 2004. Regulation, market structure, institutions and the cost of financial intermediation. Journal of Money, Credit and Banking 36, 592-622.

European Central Bank, 2003. Structural analysis of the EU banking. ECB, November.

European Central Bank, 2004. Report on EU banking structure. ECB, November.

Evanoff, D., Fortier, D. 1988. Re-evaluation of the structure-conduct-performance paradigm in banking. Journal of Financial Services Research 1, 277-94.

Fernández de Guevara, J., Maudos, J., 2004. Measuring welfare loss of market power: an application to European banks. Applied Economics Letters 11, 833-836.

Fernández de Guevara, J., Maudos, J., Pérez, F., 2005. Market power in European banks. Journal of Financial Services Research 27, 109-1338.

Fernández de Guevara, J., Maudos, J., Pérez, F., 2007. Integration and competition in the European financial markets. Journal of International Money and Finance 26, 26-45.

Gilbert, R., 1984. Bank market structure and competition – A survey. Journal of Money, Credit and Banking 16, 617-645.

Goddard, J., Wilson, J., Molyneux, P., 2001. European Banking: Efficiency, Technology and Growth. John Wiley: London.

Hempell, H., 2002. Testing for competition among German banks. Economic Research Centre, Deutsche Bundesbank, Discussion Paper 04/02.

Hondroyiannis, G., Lolos, S., Papapetrou, E., 1999. Assessing competitive conditions in the Greek banking system. Journal of International Financial Markets, Institutions and Money 9, 377-391.

Humphrey, D., Willesson, M., Bergendahl, G., Lindblom, T., 2006. Benefits from a changing payment technology in European banking. Journal of Banking and Finance 30, 1631-1652.

Huybens, E., Smith, B., 1999. Inflation, Financial Markets, and Long-run Real Activity. Journal of Monetary Economics 43, 283-315.

Iwata, G., 1974. Measurement of conjectural variations in oligopoly. Econometrica 42, 947-966.

Jansen, D., DeHaan, J., 2003. Increasing concentration in European banking: A macro-level analysis. De Nederlandsche Bank, Research Memorandum WO, No. 743, September.

Kessidis, I., 1991. Entry and market contestability: The evidence from the United States. In Entry and Market Contestability: An International Comparison, P. Geroski and J. Schwallbach (Eds). Blackwell, Oxford.

Koutsomanoli-Fillipaki, N., Staikouras, C., 2004. Competition in the new European banking landscape. Paper presented at the Money, Macro and Finance 36th Annual Conference, Casss Business School, London, September 6-8.

Lau, L., 1982. On identifying the degree of competitiveness from industry price and output data. Economics Letters 10, 93-99.

Lerner, A., 1934. The Concept of Monopoly and the Measurement of Monopoly Power. Review of Economic Studies 1, 157-175.

Maudos, J., Pérez, F., 2003. Competencia vs. poder de mercado en la banca española. Moneda y Crédito 217, 139-166.

Maudos, J., Fernández de Guevara, J., 2004. Factors explaining the interest margin in the banking sectors of the European Union. Journal of Banking and Finance 28, 2259-2281.

Maudos, J., Fernández de Guevara, J. 2007. The cost of market power in banking: social welfare loss vs. inefficiency cost. Journal of Banking and Finance, forthcoming.

Molyneux, P., Lloyd-Williams, D., Thornton, J., 1994. Competitive conditions in European banking. Journal of Banking and Finance 18, 445-459.

Neven, D., Röller, L., 1999. An aggregate structural model of competition in the European banking industry. International Journal of Industrial Organisation 17, 1059-1074.

Northcott, C., 2004. Competition in banking: A review of the literature. Bank of Canada, Working Paper 2004-24.

Padoa-Schioppa, T., 2001. Bank competition: A changing paradigm. European Finance Review 5, 13-20.

Panzar, J., Rosse, J., 1987. Testing for 'monopoly' equilibrium. The Journal of Industrial Economics 35, 443-456.

Piloff, S., 2004. Bank Merger Activity in the United States 1994-2003. Board of Governors of the Federal Reserve System, Staff Study 176, May.

Shaffer, S., 1989. Competition in the US banking industry. Economics Letters 29, 321-323

Shaffer, S., 1993. A test of competition in Canadian banking. Journal of Money, Credit and Banking 25, 49-61

Shaffer, S., DiSalvo, J., 1994. Conduct in a banking duopoly. Journal of Banking and Finance 18, 1063-82.

Smirlock, M., 1985. Evidence of the (non) relationship between concentration and profitability in banking. Journal of Money Credit and Banking 17, 69-83.

Stigler, G., 1964. A theory of oligopoly. Journal of Political Economy 72, 55-59.

Suominen, M., 1994. Measuring competition in banking: A two-product model. Scandinavian Journal of Economics 96, 95-110.

Toolsema, L., 2002. Competition in the Dutch consumer credit market. Journal of Banking and Finance 26, 2215-2229.

Uchida, H., Tsutsui, Y., 2005. Has competition in the Japanese banking sector improved?. Journal of Banking and Finance 29(2), 419-439

Vesala, J., 1995. Testing for competition in banking: Behavioural evidence from Finland. Bank of Finland Studies, E1.

Weill, L., 2003. On the relationship between competition and efficiency in the EU banking sectors. Mimeo, LARGE Universite Robert Schumann, Strasbourg, France.

APPENDIX

TABLE A1: NUMBER OF BANKS BY COUNTRY AND YEAR (1995-2001)

Country	Each Year	Total
Austria	41	287
Belgium	28	196
Denmark	62	434
France	184	1,288
Germany	1,155	8,085
Greece	8	56
Ireland	6	42
Italy	198	1.386
Luxembourg	61	427
Netherlands	10	70
Portugal	6	42
Spain	88	616
Sweden	7	49
United Kingdom	58	406
EU	1,912	13,384

Note: Given that only one Finnish bank observation was available across all the years we excluded Finland from our analysis.

FIGURE 1: AVERAGE UNADJUSTED (CM_i) AND ADJUSTED (PPM_i) COMPETITION MEASURES FOR EUROPE

(i = NIMTA, LERNER, ROA, H-Statistic; n = 14 countries
Unadjusted =lines with boxes; Adjusted = solid lines)

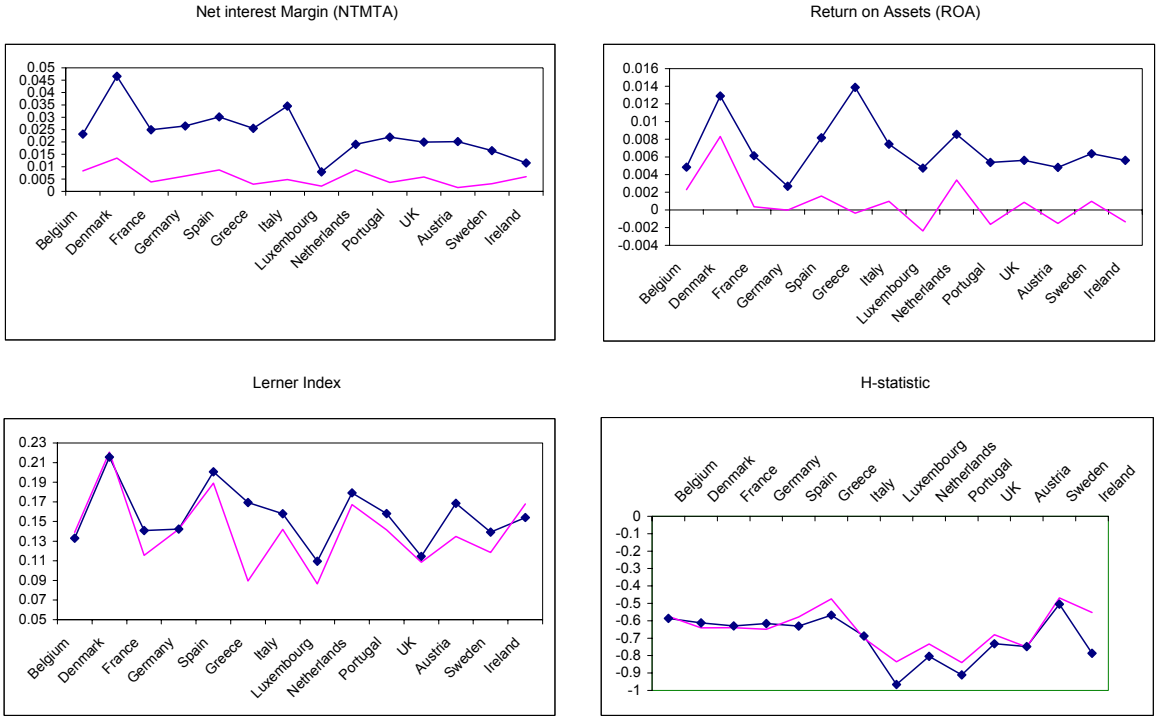

TABLE 1: MEAN VALUES AND RANKS OF COMPETITION MEASURES FOR EUROPE OVER 1995-2001*

	NIMTA	Rank	LERNER	Rank	ROA	Rank	H-STATISTIC	Rank	HHI	Rank
Austria	2.0%	6	17%	10	.48%	3	.75	5	677	7
Belgium	2.3	8	13	3	.48	3	.59	11	1,201	12
Denmark	4.7	14	22	14	1.29	11	.61	10	1,028	11
France	2.5	9	14	5	.61	6	.63	8	426	5
Germany	2.6	11	14	6	.27	1	.62	9	188	1
Greece	2.6	10	17	11	1.39	12	.57	12	1,530	14
Ireland	1.2	2	15	7	.56	5	.79	4	805	8
Italy	3.5	13	16	8	.74	8	.69	7	328	3
Luxembourg	0.8	1	11	1	.47	2	.97	1	305	2
Netherlands	1.9	4	18	12	.86	10	.80	3	1,285	13
Portugal	2.2	7	16	9	.54	4	.91	2	844	9
Spain	3.0	12	20	13	.82	9	.63	8	526	6
Sweden	1.7	3	14	4	.64	7	.50	13	969	10
U.K.	2.0	5	11	2	.56	5	.73	6	360	4
EU	2.3		16		.69		.70		748	

* Mean values of NIMTA, the Lerner index, and ROA are percentages. The H-statistic usually varies between zero and 1.0 while the HHI measure has no simple percent or basis point interpretation. The values of the H-statistic for each national banking system are derived from the estimated coefficients of a fixed effects model which is estimated separately for each country. To obtain yearly H-statistic values for each bank, we evaluated our estimated equations using each year's bank-specific input prices and other information, giving an H-statistic that varied by country, by year, and by bank. The NIMTA, Lerner index, and ROA measures also vary by country, by year, and by bank. For sample size see Appendix A1.

TABLE 2: CROSS-COUNTRY CORRELATIONS AMONG TIME-SERIES VALUES OF COMPETITION MEASURES FOR EUROPE

(Annual data, 1995-2001; n = 7 years x 14 countries = 98)

	NIMTA	LERNER	ROA	H-STATISTIC	HHI
NIMTA	1.00				
LERNER	.47 (.22)	1.00			
ROA	.46 (.21)	.61 (.37)	1.00		
H-STATISTIC	.44 (.19)	.25 (.06)	.30 (.09)	1.00	
HHI	.06 (.00)	.29 (.09)	.49 (.24)	.23 (.05)	1.00

Mean values for the five competition measures are observed for each of the seven years so n=98. Values not in parenthesis are correlation coefficients (r) while next to them are their squared values (R^2). The H-statistic was multiplied by -1.0 so now a higher value of all competition measures implies less competition.

TABLE 3A: PAIR-WISE CORRELATIONS: NON-STRUCTURAL COMPETITION MEASURES*

(Annual Data 1995-2001; n = 7)

Non-Structural vs. Non-Structural Measures						
	NIMTA LERNER	NIMTA ROA	NIMTA H-STATISTIC	LERNER ROA	LERNER H-STATISTIC	ROA H-STATISTIC
Austria	-0.55	0.32	-0.83	0.31	0.77	-0.30
Belgium	0.30	0.34	0.69	0.52	-0.44	-0.16
Denmark	0.60	0.96	-0.86	0.63	-0.25	-0.84
France	-0.82	-0.97	0.85	0.82	-0.83	-0.81
Germany	0.85	0.97	0.86	0.90	0.48	0.79
Greece	-0.85	-0.47	-0.94	0.59	0.90	0.32
Ireland	0.57	0.68	0.72	0.90	0.56	0.41
Italy	-0.67	0.70	0.41	-0.15	-0.39	0.20
Luxemburg	-0.67	-0.57	0.50	0.84	-0.47	0.03
Netherlands	0.50	0.28	-0.76	0.72	-0.44	-0.24
Portugal	-0.65	-0.43	-0.78	0.62	0.94	0.66
Spain	-0.88	-0.51	-0.88	0.71	0.98	0.68
Sweden	0.71	0.54	0.61	0.76	0.59	0.90
U.K.	0.83	0.50	-0.33	0.86	0.22	0.52
(+ r value)/14	7/14	9/14	7/14	13/14	8/14	9/14

* Only correlation coefficients (r's) are shown here. The H-statistic was multiplied by -1.0 so now a higher value of all competition measures implies less competition.

TABLE 3B: PAIR-WISE CORRELATIONS: NON-STRUCTURAL VS. STRUCTURAL COMPETITION MEASURES*

(Annual Data 1995-2001; n = 7)

	Non-Structural vs. Structural Measure:			
	NIMTA HHI	LERNER HHI	ROA HHI	H-STATISTIC HHI
Austria	-0.18	0.13	-0.53	0.50
Belgium	-0.91	-0.07	-0.34	-0.77
Denmark	0.17	0.14	0.09	-0.22
France	-0.77	0.84	0.81	-0.51
Germany	-0.73	-0.39	-0.58	-0.80
Greece	0.91	-0.77	-0.48	-0.79
Ireland	0.94	0.73	0.84	0.69
Italy	0.55	-0.22	0.56	-0.18
Luxembourg	-0.41	0.66	0.58	-0.15
Netherlands	-0.33	0.43	0.63	-0.02
Portugal	-0.61	-0.02	0.08	0.05
Spain	-0.88	0.61	0.15	0.67
Sweden	-0.28	-0.55	-0.10	0.17
U.K.	0.39	0.39	0.45	-0.05
(+ r value)/14	5/14	8/14	9/14	5/14

* Only correlation coefficients (r's) are shown here. The H-statistic was multiplied by -1.0 so now a higher value of all competition measures implies less competition.

TABLE 4: CORRELATIONS OF COMPETITION MEASURES WITH TIME*

(Annual Data 1995-2001; n = 7)

	Four Non-Structural Measures:				One Structural Measure:
	NIMTA	LERNER	ROA	H-STATISTIC	HHI
Austria	-0.91	0.64	0.01	0.70	-0.16
Belgium	-0.95	-0.05	-0.36	-0.80	0.94
Denmark	-0.86	-0.51	-0.77	0.72	-0.05
France	-0.95	0.88	0.94	-0.74	0.91
Germany	-0.97	-0.89	-0.99	-0.80	0.60
Greece	-0.86	0.84	0.18	0.98	-0.68
Ireland	-0.92	-0.36	-0.45	-0.83	-0.83
Italy	-0.93	0.75	-0.52	-0.64	-0.24
Luxembourg	-0.76	0.87	0.80	-0.32	0.88
Netherlands	0.19	0.78	0.58	-0.56	0.61
Portugal	-0.93	0.63	0.44	0.68	0.75
Spain	-0.97	0.81	0.38	0.79	0.87
Sweden	-0.98	-0.68	-0.42	-0.49	0.38
U.K.	-0.98	-0.88	-0.58	0.18	-0.36
(+ r value)/14	1/14	8/14	7/14	6/14	8/14

* Only correlation coefficients (r's) are shown here. The H-statistic was multiplied by -1.0 so now a higher value of all competition measures implies less competition.

TABLE 5: EXPLAINED VARIATION (R^2) AMONG COMPETITION MEASURES*

$(CM_i = f(CM_j)\ i \neq j,\ j = 1,...,4)$

	Across 14 Countries	Germany, France, Italy, Spain	Within 1 Country, Spain
NIMTA	.34	.35	.41
LERNER	.23	.19	.64
ROA	.34	.37	.61
H-STATISTIC	.10	.05	.22
HHI	.06	.07	.32
Sample Size	13,384	11,375	616

* All values are coefficients of determination (R^2). The H-statistic was multiplied by -1.0 so now a higher value of all competition measures implies less competition

TABLE 6: EXPLAINING COMPETITION MEASURES ACROSS 14 COUNTRIES IN EUROPE*

	Four Dependent Variables:			
Independent Variables:	NIMTA	LERNER	ROA	H-STATISTIC
Intercept	.005***	.141***	.004	-.657***
Cost Efficiency (OCTA)	.463***	-.655***	-.024***	1.486*
Growth in Real GDP (GDPGR)	-.028***	-.320***	.025***	-2.066***
Inflation Index (COL)	.092***	.379***	.105***	-1.582***
Share of Fee Income (FEEINC)	-.465***	4.870***	.404***	-1.621***
Dummy for Type of Bank (TYPEBANK)	.002***	.009	-.001	.008***
R^2	.57	.11	.16	.15

* The H-statistic was multiplied by -1.0 so a higher value of all measures implies less competition. The asterisks *, **, and *** indicate significance at the 10%, 5%, and 1% level, respectively.

TABLE 7: EXPLAINING COMPETITION MEASURES ACROSS GERMANY, ITALY, FRANCE and SPAIN*				
	Four Dependent Variables:			
Independent Variables:	NIMTA	LERNER	ROA	H-STATISTIC
Intercept	.006***	.156***	-.009***	-.635***
Cost Efficiency (OCTA)	.412***	-1.340***	-.045***	1.046***
Growth in Real GDP (GDPGR)	-.010	.085	.061***	-0.782***
Inflation Index (COL)	.111***	.760***	.110***	-1.267***
Share of Fee Income (FEEINC)	-.318***	6.204***	.502***	-.352**
Dummy for Type of Bank (TYPEBANK)	.004***	-.012	.000**	-.046*
R^2	.49	.16	.20	.04

* The H-statistic variable was multiplied by -1.0 so a higher value of all measures implies less competition. The asterisks, *, **, and *** indicate significance at the 10%, 5%, and 1% level, respectively.

TABLE 8: CORRELATIONS BETWEEN AVERAGE UNADJUSTED (CM_i) AND ADJUSTED (PPM_i) COMPETITION MEASURES FOR EUROPE*

(First column unadjusted values; Second column adjusted values; n = 14)

	NIMTA	LERNER	ROA	H-STATISTIC	HHI
NIMTA	1.00				
LERNER	.68 .83	1.00			
ROA	.55 .88	.66 .69	1.00		
H-STATISTIC	.48 .16	.24 .05	.33 .22	1.00	
HHI	.07 -.22	.39 .13	.62 .33	.26 .42	1.00

* All values are correlation coefficients (r). The H-statistic was multiplied by -1.0 so now a higher value of all competition measures implies less competition.