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Abstract

The relationships between bank market concentration and bank efficiency are of particular relevance in the European Union (EU), but they remain controversial. Using a panel Granger causality approach, this paper contributes to the literature, testing not only the causality running from bank market concentration to bank efficiency, but also the reverse causality running from efficiency to concentration. The results obtained confirm the relative complexity of these causality relationships, although they generally point to a negative causation running both from concentration to efficiency and from efficiency to concentration. These findings are in line with the Structure Conduct Performance (SCP) paradigm and the suggestions that the increase of the banks' market power will contribute to inefficiency, since these banks will face less competition to obtain more output results with less input costs. Our results suggest that within this panel of all 27 EU countries over a relatively long time period, from 1996 to the onset of the 2008 financial crisis, the more cost-efficient commercial and savings banks operated in less concentrated markets.

Keywords: Concentration, Efficiency, Granger causality, European banks.

JEL Classification: G21; F36; D24; L11

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1. Introduction

During the last two decades and up until the recent financial crisis, there was a clear global trend towards bank market consolidation. The global phenomena of technological innovation, bank market liberalisation and deregulation facilitated the process of bank mergers and acquisitions.

In Europe, this global process was accompanied by the efforts to establish the single European financial market, based on the belief that market competition would increase bank productivity and efficiency. Furthermore, over the past decade, the European Union banking market has also had to face the challenge of the financial consolidation and integration of 12 new member-states.

Economic theory generally accepts that in the presence of perfect information, market competition will be associated to efficiency while the existence of market power will be synonymous with less competitiveness and inefficiency.

However, financial markets are characterised by the existence of asymmetric information and in order to prevent adverse selection and moral hazard, it is recommended that trust be increased through the establishment of long-lasting relationships between the banking institutions and their clients. These lasting relationships based on trust may be associated to bank market power and may also be considered as a necessary condition of bank efficiency.

Taking these conditions into account, authors like Demirgüç-Kunt and Levine (2000) suggest that the relationship between bank market concentration and bank efficiency is complex and sometimes ambiguous: depending on the banking market specific characteristics, this relationship may be either positive or negative.

So, it is generally confirmed that bank market consolidation and bank efficiency relationships are of particular relevance in Europe, but they remain controversial (Goddard *et al*., 2007; Molyneux, 2009).

There is a strand of literature devoted to the discussion and testing of the relationships between competitiveness and efficiency of banking markets. Most of these studies concentrate on the structural approach and mainly test the structure conduct performance (SCP) hypothesis, which considers that bank market concentration is inversely related to bank market competition, which leads to greater profitability (a hypothesis supported by such authors as Bikker and Haaf, 2002; Deltuvaite *et al*., 2007; and rejected, among others, by Classens and Laeven, 2004). Other papers analyse the reverse relationship and test the possible influence of bank efficiency on market concentration, in the context of the efficient structure hypothesis (tested, among others, by Punt and Van Rooij, 2003; Weill, 2004).

However, not many works (three exceptions are to be found in Schaeck and Cihak, 2008; Pruteanu-Podpiera *et al.*, 2008; Casu and Girardone, 2009) have concentrated simultaneously on these two relationships and used Granger causality estimations to test the possible causality not only between bank concentration and efficiency, but also the reverse, i.e. between bank efficiency and market concentration.

This paper contributes to the literature by using a panel Granger causality approach to test the relationship between bank market concentration and bank efficiency in all 27 European Union countries over a relatively long time period: from 1996 to the onset of the 2008 financial crisis. Whilst the findings confirm the relative complexity of this relationship, they generally point to a negative causation running not only from concentration to efficiency, but also from efficiency to concentration.

The paper is structured as follows: Section 2 presents the theoretical background and a brief literature review; Section 3 explains the methodological framework and the data; Section 4 reports the obtained empirical results; Section 5 summarises and concludes.

2. Theoretical Background and Brief Literature Review

In the origin of the debate on the relationship between bank market structure and bank efficiency is the so-called "quiet life hypothesis" (Hicks, 1935), which states that the increase in market concentration is associated to less social results (with higher prices and restrictions in the outputs), since in the absence of competition, monopoly managers do not have to fight to obtain good results.

From then on, two distinct strands in the literature reflect the views on the relationship between market consolidation and efficiency: the structural and the non-structural approaches.

The structural approach includes two competing hypothesis. On one side is the traditional structure conduct performance (SCP) hypothesis, which derives from the industrial organisation literature (see among others, Bain, 1951) and considers that the level of bank market concentration is inversely related to the degree of bank competition. On the other side, we have the efficient structure hypothesis (supported by authors like Smirlock *et al*., 1984; Maudos, 1998), which argues that it is mainly the efficiency of the largest banks that explains the bank market consolidation.

The non-structural approach states that the bank competitive performance depends on other factors that are different from market concentration, such as the general contestability of the market, or the barriers to entry into, or exit from, the market. The non-structural approach has developed some specific models that analyse the competitive performance of the firms without using explicit information on the market structure and, in the context of the new empirical industrial organisation (NEIO) literature, include contributions of authors like Iwata (1974), Bresnaham (1982, 1989) or Panzar and Rosse (1982, 1987).

In recent years, with the global trend of bank consolidation, there has been an increase of theoretical debates and empirical analysis of the relationship between bank market concentration and bank performance.

Until the 1990s, there was a general belief that mergers did not clearly contribute to bank performance improvements and several empirical findings were consistent with the traditional SCP statements, particularly with the “quiet life hypothesis” (e.g. Berger and Hannan, 1989, 1998; Hannan and Berger, 1991; Neumark and Sharpe, 1992; Houston and Ryngaert, 1994; Pilloff, 1996).

From the year 2000, this general consensus was broken when particular attention was paid to such specific characteristics of the banking markets as the presence of asymmetric information, contagion phenomena and imperfect competition, or the specific impacts of bank concentration, competition and regulation on bank performance (among others, De Brand and Davis, 2000; Allen and Gale, 2000; Demirgüç-Kunt and Levine, 2000; Bikker and Haaf, 2002; Berger *et al.*, 2004; Weill, 2004; Hasan *et al*., 2009; Schaeck *et al*., 2009; Tabak *et al.*, 2011). Furthermore, the polemic intensified with the discussion of the relationship between European bank consolidation and bank efficiency (e.g. Diaz *et al.*, 2004; Fernandez de Guevara *et al.*, 2005; Casu and Girardone, 2006; Fernandez de Guevara and Maudos, 2007; Altunbas and Marquês, 2007; Goddard *et al*., 2007; Molyneux, 2009).

With regard to the empirical tests of the relationship between the bank market structure (represented by the market share or concentration indices) and bank efficiency (measured either by parametric methods, like the Stochastic Frontier Analysis, or by non-parametric methods, like the Data Envelopment Analysis), several papers tend to support the efficient structure hypothesis, underlining the importance of the relationship between bank cost efficiency and bank concentration or market share (see, among others, Goldberg and Rai, 1996; Berger and Hannan, 1997; Punt and Van Rooij, 2003; Weill, 2004; Maudos and Fernandez de Guevara, 2007).

However, not many authors have used Granger-type causality test estimations to investigate the empirical relationship between market competition and bank efficiency.

Schaeck and Cihak (2008) use a large sample of EU and USA banks and find evidence that competition Granger-causes profit efficiency of banks and increases profit efficiency at least in the USA sub-sample.

Pruteanu-Podpiera *et al.* (2008), examining the Czech bank loan market between 1994 and 2005, reject Hick's quiet life hypothesis as they find a negative relationship between competition and efficiency. Their results support the negative Granger causality, but only running from competition to efficiency and not from efficiency to competition.

Casu and Girardone (2009) apply Granger-type causality estimations to test the relationship between competition and efficiency, using bank-level balance sheet data for the commercial banks of the five largest EU countries: France, Germany, Italy, Spain and United Kingdom, between 2000 and 2005. Once again, their findings do not support the quiet life hypothesis, as the Granger causality running from market power to efficiency is positive. On the other hand, there is no clear evidence that an increase in efficiency will precede any increases in a bank's market consolidation.

3. Methodological Framework and Data

In order to test the Granger causality relationship between bank market concentration and bank efficiency, we first present the measures chosen and data used to define bank market concentration, bank cost efficiency and the adopted Granger causality approach.

Our data are sourced from the BankScope database. The sample comprises annual data from consolidated accounts of the commercial and saving banks of all 27 EU countries between 1996 and 2008. Appendix I presents the annual number of banks for each country included in our sample.

3.1. Bank market concentration

Among the possible concepts and measures of market concentration, we opt to use two of the most popular indicators: the percentage share of the total assets held by the three largest banking institutions (C3) of each EU member-state and the Helfindhal-Hirschman Index (HHI) which, also in terms of each member-state’s total bank assets, is calculated as the sum of the squares of the market shares of each of the country’s banking institutions.

For the interpretation of the HHI, we follow the general rule that considers the presence of low concentration if HHI <1000; if HHI > 1800 there is high concentration; and if 1000 < HHI < 1800 the market will be moderately concentrated.

To obtain the concentration measures: C3 and HHI, we use data sourced from the Bankscope database. The sample comprises annual data from consolidated accounts of the commercial and savings banks of all EU countries between 1996 and 2008.

The C3 and HHI results are presented in Appendix II and clearly show that, with some exceptions, there is an increase in the bank market concentration. The exceptions are to be found in the Netherlands and Greece and very particularly in certain new EU member-states, like

Bulgaria, Romania and Poland, and also in the Czech Republic, Ireland, Latvia, Lithuania, Malta and Slovakia, although less strongly.

On the other hand, and in spite of the general increase in EU bank market concentration between 1996 and 2008, the levels of concentration continue to be relatively low in the five most important EU countries: France, Germany, Spain, the United Kingdom and Italy (the latter only up to 2005), countries that clearly contribute to the majority of the banks included in our panel (see Appendix I).

3.2. *Bank efficiency*

The research into efficiency is usually based on the estimation of efficiency frontiers with the best combinations of the different inputs and outputs of the production process and then on the analysis of the deviations from the frontier that correspond to the losses of efficiency.

Most of the empirical studies on the measurement of bank efficiency adopt either parametric methods, like the Stochastic Frontier Analysis (SFA), or non-parametric methods, particularly the Data Envelopment Analysis (DEA).

Here, we will adopt the DEA methodology (developed among others by Coelli *et al*., 1998; Thanassoulis *et al*., 2007) and, still using the Bankscope database, we will follow the intermediation approach and consider that the banks' total costs will depend on three bank outputs: total loans, total securities and other earning assets; and also of three bank inputs: borrowed funds, physical capital and labour (see Appendix III for a presentation of the DEA methodology and the chosen bank outputs and inputs).

Taking the available data, the DEA frontier will be defined by the piecewise linear segments that represent the combinations of the best-practice observations, the measurement of efficiency being relative to the particular frontier obtained. If the actual production of one decision-making unit (DMU) lies on the frontier, this production unit will be considered perfectly efficient, whereas if it is situated below the frontier, the DMU will be inefficient; the ratio of the actual to the potential level of production will define the level of efficiency of any individual DMU.

Thus, with the DEA approach, the efficiency score for any DMU is not defined absolutely in comparison with a universal efficiency standard; rather, it is always defined as the distance to the particular production frontier, that is, in relation to the other DMUs that are included in the specific data set. As a consequence, DEA provides efficiency scores even in the presence of relatively few observations, which represents a great advantage in comparison with the parametric approaches (like the SFA), as the latter require the availability of sufficient observations to allow the estimation of specific production functions.

Appendix IV reports the obtained DEA yearly bank cost efficiency results of the EU countries for the time period between 1996 and 2008.

In spite of the year-on-year oscillations, there is a clear trend in many EU countries to the decrease of bank cost efficiency (particularly for some large countries like Germany and France, and other, smaller countries including Belgium, Denmark, Finland, Luxembourg, Sweden and the Netherlands). On the other hand, and above all in the case of some of the new EU member-states, there is a trend to the increase of bank cost efficiency (particularly clear for Bulgaria, Romania and Hungary).

3.3. *The panel Granger causality model*

We will follow the pioneer concept of Granger causality (Granger, 1969) and the approaches developed to analyse the existence of causality relationships among variables in panels (by such authors as Holtz-Eakin *et al.*, 1988; Weinhold, 1996; Nair-Reichert and Weinhold 2001; Kónya, 2006; Hurlin and Venet, 2008), considering the general linear panel Granger causality model:

$$y_{i,t} = \alpha + \sum_{k=1}^{K} \gamma_i^{(k)} y_{i,t-k} + \sum_{k=1}^{K} \beta_i^{(k)} x_{i,t-k} + \varepsilon_{i,t}$$

Where: y = dependent variable; x = explanatory variable; i = 1,...,N cross units; t = 1,...,T time periods; α = intercept; k = 1,...K lags; ε = error term (including not only the disturbance term, but also the individual cross-unit specific effects).

To test the Granger non-causality from x to y, the null hypothesis is $H_o : \beta_i = 0, \forall i = 1,..., N$

The alternative hypothesis states that there is a causality relationship from x to y for at least one cross-unit of the panel: $H_1 : \beta_i = 0, \forall i = 1,..., N_1; \beta_i \neq 0, \forall i = N_1 + 1, N_1 + 2..., N; (0 \leq \frac{N_1}{N} \leq 1)$.

Before proceeding with the panel Granger causality estimations, we test the stationarity of the series, using two panel unit root tests: the Levin, Lin and Chu (2002) and the Im, Pesaran and Shin (2003).

The Levin, Lin and Chu (2002) may be viewed as a pooled Dickey-Fuller test, or as an augmented Dickey-Fuller test, when lags are included and the null hypothesis is the existence of non-stationarity. This test is adequate for heterogeneous panels of moderate size, like the panels used in this paper, and it assumes that there is a common unit root process. The results reported in Appendix V-A clearly allow us to reject the existence of the null hypothesis.

The Im, Pesaran and Shin (2003) test estimates the t-test for unit roots in heterogeneous panels and allows for individual unit root processes. It is based on the mean of the individual Dickey-Fuller t-statistics of each unit in the panel and assumes that all series are non-stationary under the null hypothesis. Appendix V-B presents the results obtained with this test and confirm the rejection of the non-stationarity.

4. Results Obtained

In our panel Granger-type causality test estimations, we will first use panel ordinary least squares (OLS) estimations and fixed-effects panel estimations (following among others Wooldridge, 2002; Baltagi, 2008).

To test the panel dynamics of the model, we will also use Generalised Method of Moments (GMM) one-step "difference" and two-step "system" estimations, following the contributions of Holtz-Eakin *et al.* (1988), Arellano and Bond (1991), Blunder and Bond (1998) and Windmeijer (2005).

4.1. Results obtained with panel OLS and fixed-effects estimations

Table 1 reports the obtained results with panel ordinary lest squares (OLS) robust estimations and panel fixed-effects robust estimations, both for the causality running from bank market concentration to bank efficiency (Tables 1 A and 1 B) and for the causality running from efficiency to concentration (Table 1 C and 1 D).

In all situations, the relatively high F statistics and R-squared values allow us to conclude that the results are statistically significant. A more careful observation of the R-squared values obtained with fixed-effects estimations reveals the relative cross-section homogeneity of the panel, since the cross-section evolution (represented by the R-squared "between") is always more important than the time evolution (represented by the R-squared "within").

In addition, the results reported in Table 1 show that both DEA bank cost efficency and bank market concentration (the latter measured either by the percentage share of the total assets held by the three largest banking institutions of each member state, C3, or by the Helfindhal-Hirschman Index, HHI, calculated as the sum of the squares of the market shares of each of the country's banking institutions) clearly depend on their own past levels, with a positive signal associated to the first lags and a negative signal associated to the second lags.

From the first half of Table 1 (1 A and 1 B), it is also clear that the bank concentration of the previous year (first lags) has a negative and statistically significant influence on bank cost efficiency, while the influence of the second lags is not statistically significant. Moreover, in all situations, the obtained causality Granger coefficients, although not very high, are negative, revealing that an increase in bank concentration is associated to less bank efficiency.

With reference to the causality running from DEA cost efficiency to bank concentration (Table 1 C, for the C3 measure and Table 1 D for the HHI), the results obtained are statistically stronger than those obtained for the causality running from concentration to efficiency. There is now a negative influence, both of the first and second lags of bank efficiency on bank concentration. The importance of this influence is reinforced by the relatively high and always negative values of the Granger coefficients, which seems to indicate that the most efficient banks are those that are obliged to compete in less concentrated bank markets

4.2. Results obtained with GMM one-step "difference" and two-step "system" estimations

In order to test the robustness of the previous results and the panel dynamics of the model, we also apply Generalised Method of Moments (GMM) one-step "difference" and two-step "system" robust estimations. The results obtained are presented in Table 2.

With regard to the causality running from bank market concentration (also measured by the C3 and the HHI) to DEA bank cost efficiency, the results (presented in Tables 2 A and 2 B), although statistically less strong than those reported in Table 1, reveal that, in spite of the oscillations in the signs of the considered two lags, the joint-influence represented by the Granger coefficients is also always negative and relatively high.

In contrast, for the causality running from efficiency to concentration, the results are not only statistically less robust, again presenting some oscillations in the lags' signals, but also they are not in line with the previous results. Now the Granger coefficients are always positive, revealing that an increase in efficiency could be associated to the consolidation of the banking institutions' market power.

In order to analyse the robustness of these results obtained with GMM panel estimations and compare them with the results previously obtained with panel OLS and fixed-effects estimations, we apply F (and Wald) tests, supposing in all situations the joint-hypothesis $\beta_1 = \beta_2 = 0$. The results obtained are reported in Table 3, which also summarises the values of the Granger coefficients.

The first part of Table 3 reveals the results for causality running from market concentration to bank efficiency, allowing us to conclude that there is a clear negative relationship, which means that in all situations, the increase of market consolidation will contribute to less bank efficiency.

However, regarding the causality running from bank efficiency to market concentration, the results presented in the second part of Table 3 are contradictory: using OLS and fixed-effects estimations, we obtain a negative influence, but a positive influence is obtained if we apply dynamic GMM estimations. The comparison of the F and Wald tests results allows us to confirm that with our panel, OLS and fixed-effects results are more robust and can validate the negative causality running from bank cost efficiency to bank market concentration. Furthermore, a more careful observation of the values of these tests (for OLS and fixed-effects estimations) indicates that the causality running from efficiency to concentration is more robust than the reverse causality running from concentration to efficiency.

5. Summary and conclusions

This paper aims to provide new empirical evidence on the rather controversial relationship between bank market concentration and bank efficiency. The main contributions are to be found in the application of a panel Granger causality approach, using annual data from the consolidated accounts of the commercial and savings banks of all 27 European Union countries collected from the Bankscope data base for the time period 1996-2008.

For bank market concentration, we opt to use two popular measures: the C3, that is, the percentage share of the total assets held by the three largest commercial and savings banks of each EU member-state and the Helfindhal-Hirschman Index (HHI), calculated for each EU country as the sum of the squares of all the country’s commercial and savings banking institutions’ market shares. The results obtained with both measures reveal that with some exceptions, there is a general trend to the increase of EU bank market concentration during the considered period. However, for the largest EU countries (France, Germany, Spain, the United Kingdom and Italy), the levels of concentration remain relatively low.

To measure bank cost efficiency, we use the DEA non-parametric estimations and following the intermediation approach, considering three bank outputs: total loans, total securities and other earning assets; and three bank inputs: the price of the borrowed funds, the price of capital and the price of labour. The results show that in spite of some year-on-year oscillations and the specific cases of some EU member-states, the general trend is for the bank cost efficiency to decrease, a trend that is particularly evident in the last years of the considered period.

In order to test statistically the panel Granger causality between EU bank market concentration and the cost efficiency of the EU banks, we consider models with two lags both of the dependent and independent variables and use different panel robust estimation techniques: OLS, fixed effects, GMM one-step “difference” and GMM two-step “system”.

The results obtained with these techniques confirm the complexity of the relationships between bank market concentration and bank cost efficiency in the panel of the 27 EU countries. Similarly to the Granger causality results obtained by, for example, Casu and Girardone (2009), there are not only clear oscillations in the influences of the first and second lags of the variables, but specifically for the causality running from bank efficiency to market concentration, there are also some contradictions in the results obtained with different estimation techniques.

However, a careful comparison of the obtained Granger coefficients and the values provided by the F and Wald tests allows us to conclude that the causality running from concentration to efficiency is clearly negative. These results are in line with the SCP paradigm, and the suggestions that the banks acting in more concentrated markets will contribute to inefficiency as a result of their lesser efforts to acquire more outputs with less costs (Berger and Hannan, 1998; Bikker and Haaf, 2002; Schaeck and Cihak, 2008; Chortareas *et al.*, 2010).

In addition, with regard to the causality running from bank cost efficiency to bank market concentration, the obtained Granger coefficients and the values of the F and Wald tests also provide evidence of the importance of this relationship. Nonetheless, the obtained results do not allow us to validate the efficient structure hypothesis. They are more in line with the arguments for the possibility of the smaller banks being more effective than the larger banks (Goddard *et al.*, 2001), or those findings that suggest that even when larger banks have higher performance, this advantage decreases in concentrated markets (Tabak *et al.*, 2011). To summarise, our results suggest that in the panel comprising all 27 European Union countries, between 1996 and 2008, the more cost-efficient banks operated in less concentrated markets.

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Appendix I – Yearly number of banks by EU country

	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Austria	72	122	124	124	129	140	142	146	154	153	162	162	147
Belgium	97	91	75	73	68	69	72	73	72	71	58	47	34
Bulgaria	16	19	22	21	25	27	28	29	30	30	29	22	21
Cyprus	17	23	25	21	23	23	24	18	17	16	11	11	9
Czech Rep.	28	28	25	25	27	28	27	26	31	27	25	25	20
Denmark	113	113	117	118	123	116	113	112	129	120	123	121	109
Estonia	16	18	8	8	10	10	11	11	12	11	11	12	10
Finland	11	12	12	12	14	13	12	14	19	16	11	11	12
France	345	323	312	306	308	305	295	283	292	283	256	237	204
Germany	827	830	818	791	771	737	708	682	675	677	685	675	593
Greece	29	35	33	30	26	26	31	34	55	35	33	30	29
Hungary	34	33	34	37	39	35	37	33	33	36	35	31	26
Ireland	34	36	40	40	42	44	46	47	63	51	50	47	40
Italy	200	219	219	228	216	229	232	240	363	304	226	222	199
Latvia	21	25	24	24	25	26	27	30	33	36	36	36	33
Lithuania	11	13	13	14	16	16	16	17	17	17	18	18	15
Luxembourg	122	123	117	123	112	100	96	92	93	91	92	105	80
Malta	9	9	10	8	10	9	9	14	16	17	18	17	14
Netherlands	64	58	57	55	50	55	61	60	77	58	57	54	41
Poland	47	51	47	49	50	45	48	52	73	56	45	43	37
Portugal	41	44	44	43	37	36	33	32	44	34	31	31	25
Romania	8	11	27	30	31	30	31	29	32	29	29	28	27
Slovakia	19	23	24	20	22	20	21	19	19	25	17	17	16
Slovenia	29	29	24	26	25	23	20	20	23	29	23	22	21
Spain	206	216	207	198	204	213	211	208	256	192	184	151	136
Sweden	16	15	17	21	22	104	103	103	101	103	99	92	78
UK	191	196	200	195	195	197	204	206	257	203	190	170	148

Appendix II – Concentration measures: C3 and Herfindahl-Hischman Index (HHI)

C3 = percentage share of the total assets held by the three largest banking institutions:

	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Austria	42.28	46.12	58.71	59.64	54.26	56.40	50.14	50.14	42.84	50.12	45.57	49.84	45.05
Belgium	32.40	31.41	44.75	58.77	58.84	59.38	59.38	54.00	54.92	44.92	54.87	56.82	57.25
Bulgaria	78.59	62.84	55.10	52.88	52.88	48.57	42.49	38.37	34.01	33.38	31.14	32.59	30.37
Cyprus	64.73	61.49	60.84	61.36	52.08	50.55	53.64	66.62	65.92	72.44	77.36	72.89	71.89
Czech Rep.	50.68	49.99	46.33	51.33	55.75	54.63	53.71	54.17	41.63	42.47	41.77	42.13	40.58
Denmark	52.80	46.74	46.88	43.11	50.00	56.01	57.17	58.36	52.60	59.80	59.06	60.89	60.38
Estonia	42.25	40.39	75.83	77.06	77.98	80.54	80.58	80.69	86.99	87.11	88.17	84.99	89.29
Finland	73.67	76.35	78.06	74.08	76.14	83.78	87.60	80.54	74.51	74.69	79.52	79.45	79.4
France	24.56	27.77	28.93	34.96	34.19	35.79	31.35	31.81	30.29	32.87	33.90	35.05	36.61
Germany	18.74	16.03	21.75	22.68	24.83	24.08	21.11	21.96	22.08	25.51	27.97	32.78	36.08
Greece	48.29	45.19	43.02	39.71	41.20	41.11	39.4	38.41	24.02	36.59	35.58	38.19	37.67
Hungary	39.21	45.94	33.60	32.49	30.37	32.20	33.96	39.03	39.66	37.64	39.25	37.67	35.26
Ireland	57.68	58.00	48.35	50.95	50.64	45.96	49.87	47.69	35.84	42.16	43.44	43.03	43.95
Italy	19.05	20.26	23.80	24.24	25.55	27.97	25.55	25.28	24.51	34.25	44.09	49.38	48.47
Latvia	41.90	41.55	49.77	46.27	39.28	35.97	36.38	32.79	30.43	32.67	35.76	33.60	35.30
Lithuania	51.37	51.09	58.95	70.92	69.44	66.43	64.76	56.17	53.25	51.23	50.49	47.70	46.58
Luxembourg	17.05	16.64	17.92	17.34	18.06	19.44	22.29	22.03	21.28	21.13	20.71	16.78	18.9
Malta	91.28	91.48	90.80	96.41	89.93	92.27	91.18	80.82	79.05	78.00	68.85	81.26	80.51

Netherlands	72.29	78.75	81.86	81.28	80.50	81.86	85.40	78.45	65.99	73.22	80.55	71.67	64.27
Poland	47.46	39.18	39.03	39.15	33.09	36.22	33.49	30.49	20.03	31.27	30.79	33.42	28.4
Portugal	32.46	28.90	30.56	31.00	45.10	42.92	46.01	48.25	41.15	54.49	56.48	54.00	53.78
Romania	96.56	85.88	60.93	63.28	58.69	55.34	53.98	58.79	50.89	50.86	49.44	52.14	47.75
Slovakia	71.20	62.95	50.94	57.74	57.72	56.66	56.80	57.34	62.12	45.87	56.82	52.38	55.02
Slovenia	41.63	44.77	45.80	42.42	45.54	51.81	51.97	59.51	56.74	52.77	49.06	50.93	48.18
Spain	31.36	33.82	33.63	38.46	38.21	36.51	32.81	31.89	31.44	36.11	32.98	33.15	32.72
Sweden	43.01	47.21	46.17	46.31	47.48	47.18	49.58	48.51	56.27	58.03	57.67	56.75	54.78
UK	28.24	26.96	22.32	25.46	24.59	24.95	27.95	28.14	23.46	30.85	29.10	33.09	35.57

Helfindhal-Hirschman Index (HHI) = sum of the squares of all the country's banking institutions' market shares:

	1996	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**
Austria	913	1023	1281	1564	1622	1626	1419	1229	941	1221	1049	1311	1084
Belgium	758	733	1035	1659	1628	1900	1638	1336	1375	978	1445	1499	1499
Bulgaria	2487	1972	1395	1394	1242	1040	846	827	745	741	690	756	673
Cyprus	1799	1613	1560	1608	1356	1278	1315	1837	1899	2199	2719	2242	2308
Czech Rep.	1182	1160	1113	1289	1366	1321	1282	1296	935	1015	1018	1004	1004
Denmark	1209	1106	1106	1017	1268	1479	1519	1511	1194	1577	1542	1615	1570
Estonia	1014	997	2274	2411	2516	2867	2828	2849	3720	4025	4218	3378	3378
Finland	2237	2335	2375	2236	2386	3767	4311	2877	1947	2511	2758	2793	2857
France	420	455	472	595	581	601	513	537	519	586	626	649	682
Germany	283	262	344	355	385	376	320	341	336	390	392	535	624
Greece	1099	981	914	792	896	899	869	856	485	870	812	853	845
Hungary	806	869	665	643	589	645	660	796	835	821	885	857	798
Ireland	1375	1410	1071	1171	1172	1023	1129	1081	815	886	963	1006	1065
Italy	333	326	397	412	431	469	437	411	401	591	807	1051	1025
Latvia	907	822	1028	932	847	865	828	744	660	716	750	697	735
Lithuania	1368	1329	1500	1944	1823	1696	1613	1362	1265	1256	1174	1079	1057
Luxembourg	301	299	333	330	346	371	398	392	366	381	365	276	318
Malta	3731	3759	3699	4156	3578	3680	3706	2683	2437	2370	1938	2639	2606
Netherlands	2061	2541	2647	2569	2543	2581	3232	2620	1597	2110	2418	1895	1701
Poland	962	714	794	687	597	731	668	583	377	612	613	645	550
Portugal	663	584	624	629	1025	997	1103	1158	1036	1273	1393	1310	1327
Romania	4249	2626	1733	1582	1388	1324	1254	1408	1160	1150	1102	1103	972
Slovakia	2127	1766	1240	1486	1443	1308	1301	1330	1437	978	1306	1202	1253
Slovenia	927	1032	1043	901	1017	1195	1218	1338	1234	1080	1130	1195	1087
Spain	464	502	507	600	645	600	515	500	482	654	565	561	563
Sweden	1148	1255	1243	1239	1253	1225	1298	1281	1575	1632	1598	1605	1563
UK	502	493	423	463	466	480	514	517	397	542	529	612	654

Appendix III - Data Envelopment Analysis (DEA)

DEA was originally presented in Charles *et al.* (1978), assuming constant returns to scale, which can be accepted as optimal but only in the long run. Later, Banker et al. (1984) introduced an additional convexity constraint (λ) and allowed for variable returns to scale. Following also Coelli *et al*. (1998), Thanassoulis (2001) and Thanassoulis *et al.* (2007), we can assume that at any time t, there are N decision-making units (DMUs) that use a set of X inputs ($X = x_1, x_2, ..., x_k$) to produce a set of Y outputs ($Y = y_1, y_2, ..., y_m$), thus obtaining the DEA input-oriented efficiency measure of every *i* DMU, solving the following optimisation problem:

$$\begin{aligned} &\min_{\theta,\lambda} \theta_i \\ s.t. \quad &\sum_{r=1}^{N} y_{mr}^{t} \lambda_r^t \geq y_{mi}^t \\ &\sum_{r=1}^{N} x_{kr}^{t} \lambda_r^t \leq \theta_i x_{ki}^t \\ &\lambda_r^t \geq 0 \\ &\sum_{r=1}^{N} \lambda_r^t = 1 \end{aligned}$$

The DEA approach provides, for every *i* decision-making unit (DMU, here every country's banking sector), a scalar efficiency score ($\theta_i \leq 1$). If $\theta_i = 1$, the DMU lies on the efficient frontier and will be considered an efficient unit. On the contrary, if $\theta_i < 1$, the DMU lies below the efficient frontier and will be considered an inefficient unit; moreover, ($1- \theta_i$) will always be the measure of its inefficiency.

In the present study, the data are sourced from the Bankscope database and the sample comprises annual data from the consolidated accounts of the commercial and savings banks of all EU countries between 1996 and 2008.
For the DEA estimates, we define the outputs and the input prices of the cost function using the following variables:

Dependent variable = Total cost (TC) = natural logarithm of the sum of the interest expenses plus the total operating expenses

Outputs:

1. **Total loans** = natural logarithm of the loans
2. **Total securities =** natural logarithm of the total securities
3. **Other earning assets =** natural logarithm of the difference between the total earning assets and the total loans

Inputs:

1. **Price of borrowed funds** = natural logarithm of the ratio interest expenses over the sum of deposits
2. **Price of physical capital** = natural logarithm of the ratio non-interest expenses over fixed asset
3. **Price of labour** = natural logarithm of the ratio personnel expenses over the number of employees

Appendix IV – Yearly Data Envelopment Analysis (DEA) cost efficiency measures of the EU member states

	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Austria	0.702	0.629	0.595	0.760	0.720	0.616	0.643	0.694	0.676	0.707	0.662	0.678	0.715
Belgium	0.950	0.887	0.903	0.983	0.826	0.911	0.793	0.958	0.594	0.819	0.672	0.463	0.478
Bulgaria	0.149	0.270	1.000	1.000	1.000	1.000	1.000	0.970	0.937	0.832	1.000	1.000	0.915
Cyprus	1.000	1.000	1.000	1.000	1.000	1.000	0.914	0.725	0.695	0.679	0.837	0.800	0.937
Czech Rep.	0.945	0.803	0.579	0.632	0.859	0.741	0.681	0.716	0.838	0.897	1.000	1.000	1.000
Denmark	0.926	0.853	0.830	0.785	0.668	0.525	0.607	0.776	0.780	0.734	0.928	0.722	0.536
Estonia	1.000	0.864	0.730	0.647	0.717	0.765	0.621	0.587	0.760	0.777	0.893	0.711	0.669
Finland	0.783	1.000	1.000	1.000	0.737	1.000	0.687	0.677	1.000	0.905	1.000	0.845	0.579
France	0.818	0.699	0.687	0.739	0.552	0.547	0.578	0.576	0.531	0.577	0.606	0.597	0.712
Germany	0.948	0.889	1.000	0.981	0.772	0.762	0.887	0.934	0.956	0.776	0.821	0.699	0.606
Greece	0.754	0.685	0.643	0.604	0.734	0.781	0.949	1.000	1.000	1.000	1.000	0.967	0.991
Hungary	0.334	0.298	0.365	0.367	0.539	0.504	0.402	0.485	0.434	0.433	0.523	0.500	0.495
Ireland	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	0.951	1.000	1.000	0.849	0.959
Italy	1.000	0.872	1.000	1.000	0.975	0.802	0.921	0.924	1.000	0.958	0.984	0.741	0.740
Latvia	1.000	1.000	0.990	1.000	1.000	0.947	0.885	0.910	0.991	0.827	0.839	0.721	0.729
Lithuania	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	0.900	0.778
Luxembourg	0.879	0.690	0.730	0.696	0.654	0.508	0.564	0.697	0.673	0.757	0.523	0.544	0.524
Malta	1.000	0.911	0.953	0.888	0.932	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
Netherlands	1.000	1.000	1.000	0.874	0.764	0.759	0.748	0.852	0.822	0.779	0.821	0.882	0.564
Poland	0.700	0.591	0.708	0.596	0.597	0.604	0.528	0.593	0.616	0.605	0.985	1.000	0.928
Portugal	0.894	0.808	0.836	1.000	0.824	0.638	0.538	0.438	0.512	0.562	0.641	0.599	0.584
Romania	0.612	0.596	1.000	1.000	1.000	1.000	1.000	1.000	0.986	0.925	0.886	0.998	0.855
Slovakia	1.000	0.823	0.596	0.613	0.639	0.658	0.715	0.753	0.833	0.839	0.953	0.902	1.000
Slovenia	0.803	0.732	0.712	0.868	0.856	0.842	0.675	0.620	0.585	0.808	0.855	0.873	0.809
Spain	1.000	1.000	1.000	1.000	1.000	0.997	1.000	1.000	1.000	1.000	1.000	1.000	1.000
Sweden	0.632	0.675	0.708	0.724	0.514	0.638	0.677	0.695	0.589	0.626	0.695	0.509	0.440
UK	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000

Appendix V – Panel unit root tests

Appendix V-A - Levin, Lin and Chu (2002) (LEVINLIN) tests

Variables	coefficient	t-star	P > t	obs.
Cost efficiency. (DEA)	-0.43473	-4.25875	0.0000	312
Concentration (C3)	-0.25417	-5.02867	0.0000	312
Herfindahl-Hischman Index	-0.28545	-6.12162	0.0000	312

Appendix V-B - Im, Pesaran and Shin (2003) (IPSHIN) tests

Variables	t-bar	W[t-bar]	P-value	obs.
Cost efficiency. (DEA)	-1.819	-1.618	0.053	312
Concentration (C3)	-1.762	-1.314	0.094	312
Herfindahl-Hischman Index	-1.815	-1.600	0.055	312

Table 1 – OLS robust and fixed-effects robust panel estimations

Table 1 - **A -** Dependent variable: **Cost Efficiency (DEA)**; explanatory variable: **Concentration (C3)**

	OLS robust			Fixed effects robust		
	coef.	**t**	**P>|t|**	**coef.**	**t**	**P-value**
Cost Efficiency (DEA) t-1	.5263633	7.93	0.000	.5057128	7.10	0.000
Cost Efficiency (DEA) t-2	-.1233941	-1.68	0.093	-.1189304	-1.64	0.101
Concentration (C3) t-1	-.0963136	-1.91	0.058	-.0994759	-1.78	0.076
Concentration (C3) t-2	.021301	0.58	0.561	.0111042	0.26	0.795
constant	.1251456	0.65	0.515	.1898091	0.87	0.387
	R-squared: = 0.6556			**R-squared**: within = 0.2681 between = 0.8075 overall = 0.4465		
	F (42, 306) = 31.25 (Prob. > F = 0.0000)			**F test** = 15.06 (Prob. > F = 0.0000)		
Number of observations	349			349		
GRANGER COEFFICIENT	**-0.07501**			**-0.08837**		

Table 1 - **B -** Dependent variable: **Cost Efficiency (DEA)**; explanatory variable: **Herfindahl-Hischman Index (HHI)**

	OLS robust			Fixed-effects robust		
	coef.	**t**	**P>|t|**	**coef.**	**t**	**P-value**
Cost Efficiency (DEA) t-1	.5275357	7.91	0.000	.5066752	7.10	0.000
Cost Efficiency (DEA) t-2	-.1211041	-1.64	0.101	-.1167477	-1.61	0.108
Herfindahl-Hischman Index (HHI) t-1	-.0669345	-1.88	0.061	-.0709854	-1.79	0.074
Herfindahl-Hischman Index (HHI) t-2	.0282319	1.19	0.236	.0230154	0.83	0.409
constant	.1089059	0.43	0.669	.1875666	0.66	0.510
	R-squared: = 0.6552			**R-squared**: within = 0.2670 between = 0.8503 overall = 0.4607		
	F (42, 306) = 31.45 (Prob. > F = 0.0000)			**F test** = 15.24 (Prob. > F = 0.0000)		
Number of observations	349			349		
GRANGER COEFFICIENT	**-0.0387**			**-0.04797**		

Table 1 - **C -** Dependent variable: **Concentration (C3)**; explanatory variable: **Cost Efficiency (DEA)**

	OLS robust			Fixed-effects robust		
	coef.	**t**	**P>|t|**	**coef.**	**t**	**P-value**
Concentration (C3) t-1	.3973741	5.21	0.000	.4034421	5.40	0.000
Concentration (C3) t-2	-.1040931	-2.63	0.000	-.1133291	-2.72	0.007
Cost Efficiency (DEA) t-1	-.1542698	-2.71	0.009	-.1454805	-2.54	0.011
Cost Efficiency (DEA) t-2	-.0517916	-1.01	0.313	-.0412945	-0.83	0.408
constant	2.644861	8.26	0.000	2.657002	8.93	0.000
	R-squared: = 0. 8884			**R-squared**: within = 0.2736 between = 0.8988 overall = 0.6411		
	F (42, 306) = 129.31 (Prob. > F = 0.0000)			**F test** = 17.58 (Prob. > F = 0.0000)		
Number of observations	349			349		
GRANGER COEFFICIENT	**-0.20606**			**-0.18678**		

Table 1 - **D -** Dependent variable: **Herfindahl-Hischman Index (HHI)**; explanatory variable: **Cost Efficiency (DEA)**

	OLS robust			**Fixed-effects robust**		
	coef.	**t**	**P>|t|**	**coef.**	**t**	**P-value**
Herfindahl-Hischman Index (HHI) t-1	.3701803	4.96	0.000	**.3808761**	**5.23**	0.000
Herfindahl-Hischman Index (HHI) t-2	-.1166078	-3.23	0.001	**-.1287665**	**-3.39**	0.001
Cost Efficiency (DEA) t-1	-.2106903	-2.58	0.010	**-.2019141**	**--2.37**	0.018
Cost Efficiency (DEA) t-2	-.1084359	-1.52	0.131	**-.0886066**	**-1.25**	0.214
constant	5.16621	8.85	0.000	**5.127808**	**9.54**	0.000
	R-squared: = 0.9050			**R-squared**: within = 0.2644 between = 0.8813 overall = 0.6262		
	F (42, 306) = 120.78 (Prob. > F = 0.0000)			**F test** = 18.41 (Prob. > F = 0.0000)		
Number of observations	349			349		
GRANGER COEFFICIENT	**-0.31913**			**-0.29052**		

Table 2 – Dynamic Arellano-Bond one-step and two-step difference robust GMM estimations

Table 2 - **A -** Dependent variable: **Cost Efficiency (DEA)**; explanatory variable: **Concentration (C3)**

	ONE-STEP robust			**TWO-STEP robust**		
	coef.	**z**	**P>|z|**	**coef.**	**z**	**P>|z|**
Cost Efficiency (DEA) t-1	-.2307228	-0.96	0.335	.2023616	1.03	0.302
Cost Efficiency (DEA) t-2	-.7987793	-2.35	0.147	-.4709125	-2.67	0.008
Concentration (C3) t-1	.4389177	0.72	0.472	-.3765633	-1.05	0.295
Concentration (C3) t-2	-.6801813	-0.83	0.406	.0107036	0.04	0.967
constant				1.080684	0.89	0.373
Wald	chi2(3) = 14.01 (Prob. > chi2 = 0.007)			chi2(3) = 8.34 (Prob. > chi2 = 0.080)		
Arellano-Bond test for AR(1) in first differences:	z = -0.60 Pr > z = 0.545			z = -1.21 Pr > z = 0.225		
Arellano-Bond test for AR(2) in first differences:	z = 1.22 Pr > z = 0.221			z = 1.58 Pr > z = 0.115		
Sargan test of overid. restrictions:	chi2(8) = 10.00 Prob > chi2 = 0.265			chi2(20) = 200.83 Prob > chi2 = 0.000		
Hansen test of overid. restrictions:	chi2(8) = 10.43 Prob > chi2 = 0.236			chi2(20) = 23.68 Prob > chi2 = 0.257		
Number of observations	322			349		
GRANGER COEFFICIENT	**-0.24126**			**-0.26953**		

Table 2 - **B -** Dependent variable: **Cost Efficiency (DEA)**; explanatory variable: **Herfindahl-Hischman Index (HHI)**

	ONE-STEP robust			TWO-STEP robust		
	coef.	**z**	**P>|z|**	**coef.**	**z**	**P>|z|**
Cost Efficiency (DEA) t-1	-.1814663	-0.71	0.476	.1904537	0.91	0.365
Cost Efficiency (DEA) t-2	-.8598875	-2.55	0.011	-.4566697	-2.27	0.023
Herfindahl-Hischman Index (HHI) t-1	.3799142	0.86	0.392	-.3570972	-1.69	0.090
Herfindahl-Hischman Index (HHI) t-2	-.3894479	-0.74	0.460	.1444793	0.78	0.434
constant				1.180253	0.88	0.380
Wald	chi2(3) = 14.04 (Prob. > chi2 = 0.007)			chi2(3) = 7.51 (Prob. > chi2 = 0111)		
Arellano-Bond test for AR(1) in first differences:	z = -0.68 Pr > z = 0.495			z = -1.52 Pr > z = 0.128		
Arellano-Bond test for AR(2) in first differences:	z = 1.30 Pr > z = 0.192			z = 1.22 Pr > z = 0.222		
Sargan test of overid. restrictions:	chi2(8) = 9.48 Prob > chi2 = 0.303			chi2(20) = 171.08 Prob > chi2 = 0.000		
Hansen test of overid. restrictions:	chi2(8) = 10.05 Prob > chi2 = 0.261			chi2(20) = 23.78 Prob > chi2 = 0.252		
Number of observations	322			349		
GRANGER COEFFICIENT	**-0.00953**			**-0.21262**		

Table 2 - **C -** Dependent variable: **Concentration (C3)**; explanatory variable: **Cost Efficiency (DEA)**

	ONE-STEP robust			TWO-STEP robust		
	coef.	**z**	**P>|z|**	**coef.**	**z**	**P>|z|**
Concentration (C3) t-1	.0346158	0.10	0.917	.4237308	1.85	0.065
Concentration (C3) t-2	-.2927328	-0.73	0.468	-.2704449	-0.77	0.444
Cost Efficiency (DEA) t-1	.0789884	0.25	0.803	-.1036814	-0.44	0.661
Cost Efficiency (DEA) t-2	.4414392	1.62	0.105	.3501303	1.57	0.116
constant				3.281716	4.08	0.000
Wald	chi2(3) = 5.12 (Prob. > chi2 = 0.275)			chi2(3) = 7.06 (Prob. > chi2 = 0133)		
Arellano-Bond test for AR(1) in first differences:	z = -0.98 Pr > z = 0.328			z = -1.37 Pr > z = 0.172		
Arellano-Bond test for AR(2) in first differences:	z = 1.15 Pr > z = 0.248			z = 1.33 Pr > z = 0.184		
Sargan test of overid. restrictions:	chi2(8) = 14.13 Prob > chi2 = 0.079			chi2(20) = 122.33 Prob > chi2 = 0.000		
Hansen test of overid. restrictions:	chi2(8) = 12.46 Prob > chi2 = 0.132			chi2(20) = 22.64 Prob > chi2 = 0.307		
Number of observations	322			349		
GRANGER COEFFICIENT	**0.520428**			**0.246449**		

Table 2 - **D -** Dependent variable: **Herfindahl-Hischman Index (HHI)**; explanatory variable: **Cost Efficiency (DEA)**

	ONE-STEP robust			TWO-STEP robust		
	coef.	**z**	**P>|z|**	**coef.**	**z**	**P>|z|**
Herfindahl-Hischman Index (HHI) t-1	.2324312	0.89	0.374	.5899106	3.88	0.000
Herfindahl-Hischman Index (HHI) t-2	-.4062913	-1.23	0.220	-.215635	-0.75	0.443
Cost Efficiency (DEA) t-1	-.0262511	-0.05	0.959	-.2495609	-0.75	0.455
Cost Efficiency (DEA) t-2	.6675242	1.53	0.126	.3697278	1.54	0.123
constant				4.37762	2.96	0.003
Wald	chi2(3) = 10.33 (Prob. > chi2 = 0.035)			chi2(3) = 31.47 (Prob. > chi2 = 0.000)		
Arellano-Bond test for AR(1) in first differences:	z = -1.78 Pr > z = 0.074			z = -1.49 Pr > z = 0.137		
Arellano-Bond test for AR(2) in first differences:	z = 1.17 Pr > z = 0.240			z = 0.64 Pr > z = 0.520		
Sargan test of overid. restrictions:	chi2(8) = 12.16 Prob > chi2 = 0.144			chi2(20) = 139.55 Prob > chi2 = 0.000		
Hansen test of overid. restrictions:	chi2(8) = 14.36 Prob > chi2 = 0.073			chi2(20) = 23.17 Prob > chi2 = 0.281		
Number of observations	322			349		
GRANGER COEFFICIENT	**0.641273**			**0.120167**		

Table 3 – Granger coefficients and F (Wald) tests

	OLS robust	Fixed effects robust	ONE-STEP robust	TWO-STEP robust
A-Dep. var : **Cost Efficiency (DEA)**; expl.var: **Concentration (C3)**	**-0.07501** F(2, 306) = 1.82 Prob > F = 0.1641	**-0.08837** F(2, 318) = 1.65 Prob > F = 0.1939	**-0.24126** chi2(2) = 6.64 Prob > chi2 = 0.0362	**-0.26953** chi2(2) = 1.39 Prob > chi2 = 0.4983
B- Dep. var: **Cost Efficiency (DEA)**; expl. var: **Herfindahl-Hischman Index (HHI)**	**-0.0387** F(2, 306) = 2.00 Prob > F = 0.1367	**-0.04797** F(2, 318) = 1.66 Prob > F = 0.1916	**-0.00953** chi2(2) = 4.18 Prob > chi2 = 0.1239	**-0.21262** chi2(2) = 2.88 Prob > chi2 = 0.2364
C- Dep var: **Concentration (C3)**; expl var: **Cost Efficiency (DEA)**	**-0.20606** F (2, 306) = 5.88 Prob > F = 0.0031)	**-0.18678** F (2, 318) = 5.21 Prob > F = 0.0059	**0.520428** chi2(2) = 4.39 Prob > chi2 = 0.1114	**0.246449** chi2(2) = 2.47 Prob > chi2 = 0.2902
D- Dep var: **Herfindahl-Hischman Index (HHI)**; expl var: **Cost Efficiency (DEA)**	**-0.31913** F(2, 306) = 6.25 Prob > F = 0.0022	**-0.29052** F(2, 318) = 5.33 Prob > F = 0.0053	**0.641273** chi2(2) = 5.11 Prob > chi2 = 0.0779	**0.120167** chi2(2) = 2.48 Prob > chi2 = 0.2894