DOES BANK COMPETITION AFFECT STABILITY IN THE BANKING SECTOR AFTER THE GLOBAL FINANCIAL CRISIS?

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ABSTRACT

This paper analyses the inter-temporal competition – stability nexus after the global financial crises based on a Generalised Method of Moments with quarterly data for the period 2008 – 2015. Empirical results strongly support the "competition – stability" view after the global financial crises - that higher degree of competition boosts further bank stability conditions. Results further indicate that greater concentration has also a negative impact on bank stability. Finally, we do not find a non-linear relationship between competition and stability.

JEL Codes: C26, E32, E43, G21, H63.

Keywords: Bank stability, Competition, Boone indicator, Panel Data, GMM.

1. INTRODUCTION

The effect of banking competition on financial stability within a country has been an issue of active debate in academic and policy circles. This debate intensified in the collapse of Lehman Brothers in the US in 2008 and the need for bailouts for a number of European banks as a consequence, while many banks failed and others lost their profitability and required additional capitalisation [Beck, et al., (2013)]. There are a number of studies which have attempted to answer the question on whether bank competition has an impact on financial stability. However, the results are far from being conclusive since they depend heavily on the data, as well on the period and countries analysed [Kasman and Carvallo, (2014), Bushman, et al., (2016)].

Two stylised facts motivate our focus on this question. First, problems of banks being "too-big-too-fail has already emerged as the 6 largest banks hold nearly 80% of the market share. Second, at a ratio of nearly 16.2% for the whole market and 22.2% for the large banks, the Herfindahl–Hirschman index (HHI) suggests that the Albanian banking sector is "moderately concentrated". Similarly, evidences (See also Graph 1 in Appendix A) show that there is a relatively close relationship between the degree of market power and the extent to which banks are exposed to greater instability, which suggests that competition foreheads bank fragility over time. Therefore, the effect of the

[1] *Note: The views expressed herein are of the author and do not necessarily reflect the views of the Bank of Albania.*

regulatory framework on competition and banks' risk-taking incentives and ultimately bank stability make it a particularly interesting environment in which to study the competition-stability nexus.

From an empirical point of view only a few papers are loosely related to the research question we address in the case of Albania. For example, the most relevant work is by Dushku (2016)[2] who investigates the link between competition (measured by Lerner Index) and bank risk-taking (measured by Z-Score) for 15 banks operating in Albanian banking system during the period 2004 – 2014. However, while the Z-score can be interpreted as the number of standard deviations by which a bank is removed from insolvency, the NPL ratio focuses only on credit risk, but leaves out concerns with regards to liquidity and capital risk, or other sort of risks that is linked to the market in which banks operate. Hence, neither of them is a perfect substitute indicator to account for actual bank distress or the probability of default, which are without doubt the most appropriate concepts to define bank risk [Fu, et al., (2014), Kick and Prieto (2015)]. Another concern, as Beck, et al., (2013) reveal, is that Z-Score and Lerner both include profitability in the numerator and any positive relationship between the two might thus be mechanical rather than economically meaningful.

Against this background, the existing literature provides a fairly comprehensive review on competition-stability nexus, but of these cases still one question needs to be answered empirically as there is no evidence on the nature of this relationship in the case of a small-opened emerging economy, namely Albania, and in particular after the GFC. The main question, thus, addressed in this paper focuses on how competition affects bank stability after the GFC. The paper makes use of a sample with quarterly data for 16 banks operating in the Albanian financial sector over the period 2008 – 2015. The empirical estimation approach follows a five-step procedure. First, we constructed a new composite individual bank stability indicator as explained by Shijaku (2016). Second, we estimate a competition indicator as suggested by Boone (2008), and calculated in the case of Albania by Shijaku (2017). Then, our specified model is estimated based on the Generalised Method of Moments (GMM) approach. In addition, we deepen our empirical analysis by checking for a possible non-linear relationship between competition and stability in the case of Albanian banking sector. Finally, we use also other alternative structural and non-structural measure of competition, such as the Lerner index and the efficiency-adjusted Lerner index, as well as the profit elasticity and the HHI.

The empirical findings provide strong evidence supporting the "competition-stability" view that greater degree of competition improves further bank stability conditions. This implies that there is no trade-off between competition and bank stability in the banking sector in Albania. A number of robustness checks confirm also our main findings that support the "completion-stability" view. Results further indicate that greater concentration has also a negative impact

[2] *Note (2006) applies the Panzar-Rosse methodology to measure the competition degree in the Albanian banking system during the period 1999 - 2006. The author finds that Albanian banks operate in monopolistic competition conditions.*

on bank stability. By contrast, we find no evidence of a non-linear relationship in the competition-stability nexus. Finally, with regards to the control variables, we find that macroeconomic conditions are relatively important for bank stability. Similarly, bank stability is also conditional to improving operation efficiency and capital structure of the banks.

The rest of the paper is structured as follows. Section 2 summarises the literature review. Section 3 presents the methodology with regards to model specification and data. The main results are presented in Section 4. The material concludes in section 5.

2. METHODOLOGY APPROACH

2.1. THE EMPIRICAL APPROACH

The empirical specified model draws on the extensive review of previous studies related to bank fragility by Betz, et al., (2014) and Black, et al. (2016), and in particular by Shijaku (2016). However, this study departs from them, as it deepens further the empirical analyses by including also a proxy of competition instead of market size. Therefore, the model is specified as follows:

$$CAELS_{i,t} = \alpha + B_1 * GDP'_{j,t} + \beta_2 * PSRISK'_{j,t} + \beta_3 * BOONE'_{j,t} + \beta_4 * EFFICIENCY'_{i,t} + \beta_5 * LEVERAGE'_{i,t} + \varepsilon_{i,t} \quad (1)$$

Where, is our stability indicator of bank i at time t, with i = 1, …, N and t = 1, …, T, expressed as a function of a set of explanatory variables that includes a set of macroeconomic variables that account for state of economy, such as output (*GDP*) and primary sovereignty risk (*PSRISK*); market-specific variable that accounts for the degree of competition (*BOONE*); and bank-specific explanatory variables, namely operational efficiency (*EFFICIENCY*) and capital structure of the bank (*LEVERAGE*); α is a constant term. β is a vector of coefficients to be estimated. is an error terms that is assumed to be identically and independently distributed with mean of 0 and variance $\sigma_u^2 A = \pi r^2$.

One potential problem with Equation [1] is the over-identification problems. To correct for this issue, the estimation approach is based on the GMM approach as proposed by Arellano and Bond (1991) and Arellano and Bover, (1995)[3]. This approach is also virtuous to deal with potential endogeneity problems [Anderson and Hsiao (1981)]. The instrument variable is based on the past information of , and to limit the number of instruments, we restrict at 4 the lag range used in generating the instruments as suggested by Roodman (2006). First, AR(1) and AR(2) are the Arellano-Bond tests for first and second order

[3] *Han and Phillips (2010) suggest GMM is constructed to be able to achieve partial identification of the stochastic evolution and to be robust to the remaining un-modelled components.*

autocorrelation of the residuals. One should reject the null hypothesis of no first order serial correlation and not reject the null hypothesis of no second order serial correlation of the residuals. Then, the Sergan and Hensen test is used for over-identifying restrictions based on the sample analogy of the moment conditions adapted in the estimation process, thereby as to determine the validity of the instrument variables (i.e. tests of the lack of serial correlation and consistency of instruments variables).

2.2. DATA

The sample data for this study consists in quarterly data gathered and complied by the Bank of Albania, which is taken from balance sheet and income statement items of 16 banks operating in Albania. The strength of the dataset is its sample coverage and reliability of information. It covers all banks operating in Albania in the last two decade. The sample consists of 960 quarterly data for 16 banks operating in Albania, since 2001 Q1.

The empirical study focuses on the period 2008 Q2 – 2015 Q3, as the second half of 2008 marks the beginning of pass-through effects of GFC in the Albanian economy[4]. That includes a panel with 448 observations and 28 periods. The variables used for empirical analysis are approximated as follows. The bank stability indicator, bank-specific and market-specific variables are estimated individually for each bank. CAELS represents the bank stability condition estimated as explained by Shijaku (2016). It is transformed into an index, taking as the base year the average performance during the year 2010. EFFICIENCY is proxy as gross expenditure to gross income ratio. LEVERAGE presents the total equity to total asset ratio of individual banks. BOONE is a non-structural competition index variable as explained Shijaku (2017). It is transformed also into an index, taking as the base year the average performance during the year 2010 and enters the model as log-transformed. The macroeconomic variables are aggregated indicators that represent the state of the economy. GDP represents the real gross domestic production deflating with the Consumer Price Index (CPI). PSRISK represents the spread between domestic 12 month T-Bills and the German 12 month T-Bills. Both interest rates are transformed in real terms by subtracting the respective domestic and German annual inflation rate. All the data are of end-period values. They are log-transformed, besides PSRISK. Further, the dataset developed for this paper has several sources. Data on GDP are taken from the Albanian Institute of Statistics. Data on the domestic T-Bills rate are taken from the Ministry of Finance. Data on German 12 months T-Bills rate and German CPI are taken from Bloomberg. The rest of the data are taken from Bank of Albania.

Finally, prior to the empirical estimation, all the data have been subject to a unit root test procedure on the argument to understand their properties, and

[4] *The Albanian economy was not affected directly by the GFC, but the spill-over effects through financial and trade linkages were immediately transmitted from 2008 Q04, which at the same time provides a justification why we choose to the empirical estimation from this period.*

also to be sure that their order of integration fulfils the criteria for our empirical estimation approach. The latter is a pre-required condition in order to receive consistent and unbiased results. Therefore, the unit root test approach includes the Augmented Dickey-Fuller (ADF) and the Phillips-Peron (PP) Fisher Chi-square tests. The reason is twofold. First, these tests are built on the same null hypothesis that the panel variables are stationary. Second, they are mostly used for unbalanced panel model, as it is our sample.

3. EMPIRICAL RESULTS

3.1. MAIN RESULTS

This section reports the main results of our empirical approach as specified in Equation [1]. First, as reported in Table 3 in Appendix, the results of the unit root test suggest that EFFICIENCY and LEVERAGE are integrated of order zero I(0) and thus enter the model specification in level. The other variables are found to pose non-stationary properties and are integrated of order one, I(1). Therefore, they enter the model in their first difference, since this approach transforms them into a stationary stance[5]. Second, as reported in Table 6 in Appendix, we estimate 2 regressions. In each regression we use the same measure of competition, but to some methodological changes. First, column [1] reports the results of a linear relationship between competition and stability. Second, column [2] presents the results with regards to a possible non-linearity relationship, which is yet again estimated based on the GMM approach as explained previously. The model makes uses of 'White Cross-Section' standard errors and covariance (d.f. corrected). At the bottom of the table, we report the diagnostic test results for the GMM estimation. They suggest that in our case the requirements are met as suggested by the p-values of the AR(1) and AR(2) tests. In addition, the Sergan and Hensen test suggests that the instruments used in all the specifications are appropriate. This means that our model is properly specified and that the empirical analyses are robust and consistent with the GMM estimation criterion.

A glance at the results confirms that stability conditions of banks react relatively to the responses of other explanatory variables according to the predictions obtained from the theory[6]. They accomplish also previous findings as analysed in chapter one. For example, the coefficients of the variables linked to the

[5] *These results are robustness also to other unit root test approaches, including the Im, Pesaran and Shin W-stat test and Fisher test. Data can be provided upon request.*

[6] *However, as instrumenting is technically difficult in the Arellano-Bond model, we also apply a standard a panel Ordinary Least Square (OLS) approach with random effect and with fixed effect, including the lagged dependent variable as an additional regressor. The former included also some fixed effect factors that distinguish for two important components, namely small versus large banks and foreign-owned versus domestic-owned. Results came out to be relatively similar to our findings through the difference GMM approach, while findings through means of fixed effects were more consistent and robust to the estimation through random effects. Results are also relatively robust and similar to findings when CAELS is estimated based on the simple average approach rather the PCA approach and the model is estimated with panel first difference GMM with the second step difference approach. Finally, they are also robust to the estimation of the two-step GMM estimation approach.*

macroeconomic patterns bear relatively the same level of significance on bank stability as previously. The coefficient of GDP is positive in all regressions, suggesting that an increase in economic growth boosts bank stability. The coefficient of primary sovereignty risk, presented by PSRISK, is yet again statistically significant and negative in both regressions. However, at the given magnitude of the coefficients, these results indorse yet again that the interest rate pass-through effect on bank stability is negative, but relatively low. Second, bank-specific factors are also found to impact bank stability as previously reported. In addition, the coefficients of both EFFICIENCY and LEVERAGE are statistically significant. The magnitude of the coefficients indicates yet again that there is a trade-off between operational efficiency and capital in terms of bank stability. This is another confirmation that bank stability increases through improving operational efficiency and a better capital structure.

Table 6 summarises also the effects of competition through the Boone indicator. As mentioned by Shijaku (2017), it emphasizes the effect of an increase in marginal cost on the decrease in market shares. The results indicate that the coefficient of Boone indicator is significantly positive suggesting that competition improves bank stability conditions, given that higher value of the Boone indicator signifies a higher degree of competition. At the same time, since Boone indicator is significant, changes of marginal cost have more effects on profits, which means that market share is subject to more competition. Similarly, as competition in the banking sector increases it is likely to boost the franchise value and encourage banks to lower their overall risk exposure, thus confirming the competition-stability view in the case of Albania. These findings are consistent with the "competition-stability view" of other recent studies [Berger and Bouwman (2013), Fiordelisi and Mare (2014), Schaeck and Cihak (2014)] that greater bank competition is associated with higher bank stability. However, this finding is different to those of Dushku (2016), thus revealing that the stability – competition nexus has changed after the GFC.

Finally, following Jiménez, et al., (2013, Liu, et al., (2013), Fu, et al., (2014), Kasman and Kasman (2015), we use also a quadratic term of the measures of competition to capture a possible non-linear relationship between competition and bank stability. Results, as reported in Table 6, column [2] in Appendix, reveal an important consideration that we did not find evidence of non-linearity relationship between competition and stability in the case of Albanian banking system, thus rejecting Martinez-Miera and Reputto (2010) model. However, one important consideration is that as our measures for competition mainly focus on the lending market, it should be kept in mind that these conclusions are quite subject to loan markets.

3.2. ROBUSTNESS CHECKS

In an attempt to further enrich our analysis and as a complementary proof we run a number of robustness checks on our main model, as specified in Equation (1), but this time we use five different alternative measures as proxy for bank competition, which are then used also as explanatory variables to get

more robust results. For example, column [3] in Table 6 in Appendix shows the impact of competition, as measured by an alternative Boone indicator that includes also bank capital (Equity) in the estimation of the TCF model, on bank stability [See also Equation (B.1 and B.2)][7]. The results are relatively similar to those as in the previous sections re-confirming that greater degree of bank competition due to increasing operational efficiency would improve bank stability conditions.

On the other hand, as a robustness check, we also use the estimates of marginal cost from Equation (8) to calculate the Lerner index [LERNER][8] and the efficiency-adjusted Lerner index [LERNER*][9], as well as to estimate the profit elasticity [PROFITELASTICITY]10, the results of which are respectively reported in column [4], [5] and [6]. These results show that the LERNER and LERNER* are negatively related to CAELS. The impact is also significant. As mention previously, since the Lerner index is inversely proportional to CAELS, it appears that the negative sign for both these competition measures show that increases in the degree of bank pricing power are positively related to individual bank stability in Albanian banking sector. By contrast, the coefficient of PROFITELASTICITY exhibits a positive sign, suggesting that lower elasticity of profit would boost bank stability. These results provide yet again another strong supportive evidence for the competition-stability view, re-confirming as previously that greater degree of bank competition improves bank stability conditions.

Finally, we also examine the impact of bank concentration on the stability of Albanian banks using the HHI[11]. The results are reported in Table 6, Column (7) in Appendix A. The negative coefficient for the HHI indicator supports a negative link between market power and bank stability. This suggests that lower bank concentration ratio leads to a decrease in bank insolvency risk, and therefore a higher degree of bank stability. That is that the less concentrated the banking system is the more stable banks are. By contrast, based on the size of the respectively coefficients, we find that the impact of bank concentration is relatively higher that the extent to which competition effects bank stability. On the one hand, it is very clear that the results remain as those analysed in the previous sections, as in all the regressions, we find that bank market power is negatively related to bank stability, meaning that there is a positive relationship between higher degree of competition and stability. These results support both theories of competition-stability view and concentration-fragility view in the case of Albania showing that banks under less degree of market power are, on average, more stable. On the other hand, the usage of the alternative competitiveness proxy should be treated as a robustness check of the results which further strengths our conclusions in terms of competitions.

[7] *See also Shijaku (2017).*

[8] *Following Fiordelisi and Mare (2014) we calculated the Lerner index as* $LERNER_{it} = \frac{P_{i,t} - MC_{i,t}}{P_{i,t}}$. *The index is a linear straight forward indicator that takes the value between 0 and 1, with lower value indicating greater degree of competition.*

[9] *[See also Equations (B.3) in Appendix B for the approach used to estimate this index].*

[10] *[See also Equations (B.4) in Appendix B for the approach used to estimate this index].*

[11] *It is calculated using bank total asset as inputs* ($\mathrm{HHIA} = \sum_{i=1}^{n} s_i^2$, *where s represents the market share of each bank in total assets in the market). It can range from 0 to 1.0, moving from a huge number of very small firms to a single monopolistic producer. Increases of the index generally indicate a decrease in competition and an increase of market power, and vice versa.*

4. CONCLUSIONS AND POLICY IMPLICATIONS

The developments in the banking market leading to the financial crisis in 2008 heightened new great challenges for bank stability and systemic risk and competition policies. Therefore, this paper fills in the information gap of analysing whether competition improves or reduces banking stability for banks operating in the Albanian banking system during the period 2008 – 2015. Although there have been several articles we improve on the existing literature along three crucial dimensions. First, in contrast to other bank-level studies, we use the most direct measure of bank stability available, which is generated from the unique supervisory dataset collected by the Bank of Albania to which we analyse the bank competition-stability nexus. Then, we use a set of alternative proxy of competition indicators, namely the Boone indicator, the Lerner index; and the efficient-adjusted Lerner index, profit elasticity and the Herfindahl index.

The main results provide strong supportive evidence that banks' behaviour towards greater competition has been crucial for boosting bank stability in the aftermath of GFC, thus bolstering the "competition – stability" view. From a policy point of view, findings suggest that bank competition and soundness go hand in hand with each other and that higher pricing power during instability periods could simultaneously lead to higher bank stability. Results appear to hold for a wide array of other alternative model specifications, estimation approaches and variable construction. In addition, we find also that during this period bank concentration is inversely correlated to bank stability, thus supporting the view that a more concentrated banking system that easies market power is more vulnerable to systemic instability. For policymakers analysing bank competition, these results are crucial not only for the stability of the financial sector, but also for the whole economy. Therefore, if one is to boost bank stability during crises period than it is fundamentally essential to increase profit margins (franchise value) as results imply that intense competition in the banking sector is associated lower riskier loan portfolios.

Contrary to the above mentioned results, we provide evidence that do not support a non-linear relationship between competition and stability in the aftermath of GFC in the case of Albania banking system. This is different to the findings of Dushku (2016), thus confirming that the GFC has changed the competition – stability nexus to a linear interaction. Therefore, we suggest that perfect competition is the desirable market structure in order to promote great stability in the banking sector in the case of Albania. In addition, as for other control variables, our results confirm that supervisors and policy-makers should carefully monitor macroeconomic risks since lower economic growth and higher sovereignty risks are associated with greater bank instability. Our results further indicate a negative linkage between operational efficiency and bank stability implying that lower efficiency banks are more destine to bank instability. Finally, our results show that supervisors should be also aware of capital structure of banks as higher capital ratio significantly boosts the state of bank stability conditions.

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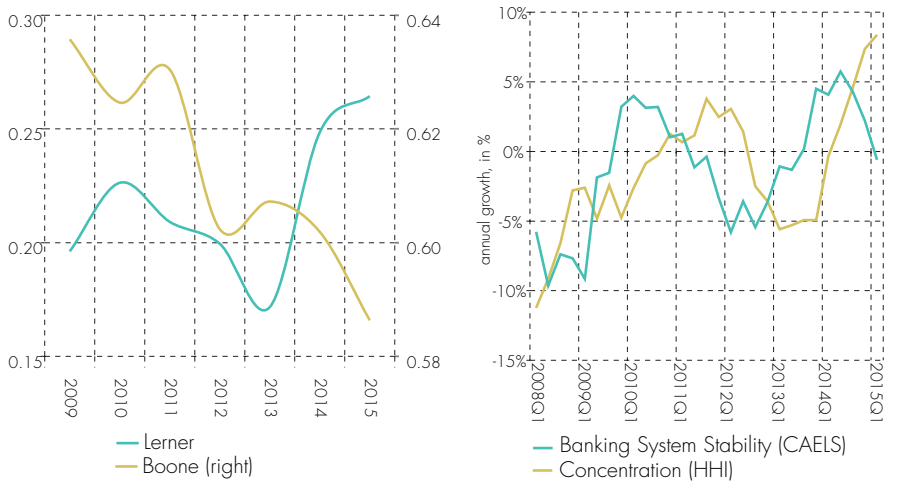
APPENDIX A

Graph 1 Bank competition and bank stability, 2008 -2015



Source: Bank of Albania, Author's calculations.

Table 1 Panel Unit Root Test

Variable	ADF - Fisher Chi-square			PP - Fisher Chi-square		
	Intercept	Intercept and Trend	None	Intercept	Intercept and Trend	None
ΔCAELS	[0.0000]	[0.0000]	[0.0000]	[0.0018]	[0.0000]	[0.0000]
ΔGDP	[0.0000]	[0.0000]	[0.0000]	[1.0000]	[0.0000]	[0.0000]
ΔPSRISK	[0.0000]	[0.0000]	[0.0000]	[0.0000]	[1.0000]	[0.0000]
ΔBOONE	[0.0000]	[0.0000]	[0.0000]	[0.0000]	[1.0000]	[0.0000]
EFFICIENCY	[0.0000]	[0.0000]	[0.9649]	[0.0000]	[0.0000]	[0.8965]
LEVERAGE	[0.0000[	[0.0007]	[0.0001]	[0.0000]	[0.0006]	[0.0010]

Note: Δ is a first difference operator. Probabilities for Fisher tests are computed using an asymptotic Chi-square distribution. All other tests assume asymptotic normality.

Source: Author's calculations

Table 6 Empirical Results based on GMM approach

Model Estimation	Banking System						
	[1]	[2]	[3]	[4]	[5]	[6]	[7]
ΔGDP	0.7827*	0.9494**	0.8169*	0.5475*	0.7000*	0.7092*	0.9319*
ΔPSRISK	-0.053*	-0.0549**	-0.0534*	-0.0301*	-0.0312*	-0.0543*	-0.0279*
ΔBOONE	0.171*	0.1996					
ΔBOONE^2		-0.0313					
ΔBOONE*			0.0581*				
LERNER				-0.2042**			
LERNER*					-0.0312***		
PROFITELASTICITY						0.0304	
HHI							-0.9244*
EFFICIENCY	-0.304*	-0.4118***	-0.2962***	-0.1351	-0.3839*	-0.2946**	-0.2252***
LEVERAGE	0.328**	0.5674**	0.3114***	0.2042***	0.4864*	0.0522	0.4215*
Cross-sections	16	16	16	16	16	16	16
Instrument rank	20	20	20	20	20	20	20
No. of observations:	448	448	448	493	434	480	480
J-statistic	11.9	8.6	17.6	18.4	15.8	12.0	18.5
Probability of J-statistic	0.37	0.57	0.28	0.19	0.33	0.29	0.19
AR(1)	0.02	0.03	0.07	0.00	0.00	0.00	0.59
AR(2)	0.26	0.49	0.45	0.11	0.14	0.21	0.53

Table shows bank-level GMM regressions statistics on the empirical results of the estimations. Haussmann tests (J-Statistics and the Probability of J-Statistics) investigates the validity of the instruments used, and rejection of the null-hypothesis implies that instruments are valid as they are not correlated with the error term. The Arellano and Bond test results also require significant AR(1) serial correlation and lack of AR(2) serial correlation (See also Kasman and Kasman, 2015). The Probability appears in parentheses [ ] below estimated coefficients.

Source: Author's Calculations

APPENDIX B

As a robustness test, we estimate an alternative measure of the marginal cost in the Boone indictor formula[12] following Leon (2014) and re-specify Equation (7) to include also additional control variable, namely bank capital. The specified model is expressed as follows:

$$B1 \quad \begin{aligned} lnTC_{it} &= \alpha_0 + \alpha_1 lnQ_{it} + 0.5\alpha_2 (lnQ_{it})^2 + \sum_{j=1}^{3} \beta_j lnP_{it_j} \\ &+ \sum_{j=1}^{3}\sum_{k=1}^{3} \delta_{jk} lnP_{it_j} * lnP_{it_k} + \sum_{j=1}^{3} \gamma_j lnQ_{it} * lnP_{it_j} \\ &+ \tau_1 Trend + 0.5\tau_2 (Trend)^2 + \tau_3 Trend * lnQ \\ &+ \omega_1 lnE_{it} + 0.5\omega_2 (lnE_{it})^2 + \omega_3 lnE_{it} * lnQ + CRISIS + \varepsilon_{it} \end{aligned}$$

Where, is total equity of bank *i* at time *t*. This model is estimated based on the OLS approach. Then, assuming that inputs' prices are still homogeneous, Equation (4) is re-expressed as follows:

$$B2 \quad MC_{it} = \frac{TC_{i,t}}{Q_{i,t}} \left[\hat{\alpha}_1 + \hat{\alpha}_2 lnQ_{it} + \sum_{j=1}^{3} \hat{\gamma}_j lnP_{it_j} + \omega_3 lnE_{it} + \tau_3 Trend \right]$$

The most important finding, as reported in Shijaku (2017), is that marginal costs, which are calculated based on different approach, have a relatively high level of correlation, which is also statistically significant. This means that changing methodology and augmenting the TCF model does not change the results and that banking sector in Albania exhibits competitive patterns. Following Clerides, et al., (2015) and Kasman and Kasman (2015) we estimated the efficiency adjusted Lerner index at the bank level, as follows:

$$B3 \quad Efficiency - Adjusted\ LERNER_{it} = \frac{\pi_{i,t} + TC_{i,t} - MC_{i,t} * Q_{i,t}}{\pi_{i,t} + TC_{i,t}}$$

Where, is the profit of bank i at time t, and other are as previously defined. Similar to the conventional Lerner index, the Adjusted Lerner index also ranges from 0 to 1, with larger values implying greater market power. Then, Clerides, et al., (2015) measure the profit elasticity by deriving from the efficiency adjusted Lerner index by solving for in equation (B.3) and differentiating with respect to , as follows:

$$B4 \quad Profit\ Elasticity_{it} = \frac{Q_{i,t} * MC_{i,t}}{Q_{i,t} * MC_{i,t} - TC_{i,t} * (1 - Adjusted\ LERNER_{it})}$$

Hence, the efficiency adjusted Lerner index and the profit elasticity are two closely related concepts.

[12] *The results are provided upon request.*