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Determinants of bank profitability before, during and after the financial crisis.

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Titled: "Determinants of bank profitability before, during and after the financial crisis."

Responses to the Editor's and Reviewer's comments

Reviewer's comment	**Response**
Originality: Does the paper contain new and significant information adequate to justify publication?: This study contributes to the literature by investigating the determinants of bank profitability before, during and after the financial crisis using data from the banks operating in the Economic Community of West African States (ECOWAS). It is based on a cross country analysis which provides additional insights and add to our understanding on the global effects of the crisis on bank profitability.	We are grateful for the positive and encouraging comments especially the acknowledgement that our paper provides additional insights and add to our understanding on the global effects of the crisis on bank profitability.
Relationship to Literature: Does the paper demonstrate an adequate understanding of the relevant literature in the field and cite an appropriate range of literature sources? Is any significant work ignored?: The paper demonstrates an adequate understanding of the relevant literature in the field and cites an appropriate range of literature sources. Some other cross-country bank profitability studies are suggested below: Abreu, Margarida and Mendes, Victor (2001). Commercial bank interest margins and profitability: evidence for some EU countries. Working paper Beckmann, Rainer (2007). Profitability of Western European banking systems: panel evidence on structural and cyclical determinants. Discussion Paper Series 2: Banking and Financial Studies 2007,17, Deutsche Bundesbank, Research Centre. Bourke P. (1989) Concentration and other determinants of bank profitability in Europe, North America and Australia. Journal of Banking & Finance, 13 (1), 65-79. Molyneux P. and Thornton J. (1992). Determinants of European bank profitability: A note. Journal of Banking & Finance, 16 (6), 1173-1178.	Thank you very much for your observation and suggesting additional references to us. We have now incorporated these studies within our paper. I am sure you will agree that our paper is considerably stronger because of adding these references in our paper. We are truly grateful.
Methodology: is the paper's argument built on an	Many thanks for this suggestion,

appropriate base of theory, concepts, or other ideas? Has the research or equivalent intellectual work on which the paper is based been well designed? Are the methods employed appropriate?: Here are some of the concerns in model specification: The study partitions the entire sample into before (1999-2006), during (2007-2010) and after (2011-2013) the financial crisis and reports results based on several panel regressions. Obviously, we can see there are more conversations in before period than during and after periods. Most of the studies use Lehman Brothers' bankruptcy (on September 15, 2008) as the onset of financial crisis. I would like to suggest using 2008-2010 as during period, 2005-2007 as before period, and (2011-2013) as after period, so that each period has equal observations.	which we find very useful indeed. Following your suggestion, we re-partitioned the sample as you suggested. We have now included these as part of our additional analysis, which really enhanced the strength of our paper indeed. We are very grateful for your constructive suggestion.
In Page 15 and16. Equations (1) and (2) are the same. Since Equation (3) can replace equation (2), it is suggested to remove Equation (2).	We have followed your suggestion and removed this equation. Thank you for this important comment. It really enhanced the clarity of our paper.
For robustness checking, it is suggested to use other profitability measures as banking performance, and see if the results are consistent. Other measure, such as Tobin's Q or ROE, Net interest margin, etc.	Many thanks for this important comment. Following your comment, we used ROE as an alternative measure. Please see the result in Table 3 below and Table 11 in the paper. Our main results in Table 5 have better qualitative features in terms of explanatory power and significant variables. Furthermore, Dietrich & Wanzenrid (2011) cautioned against using ROE as measure of bank profitability because it does not account for banks' leverage level. We hope you are pleased with our revision and we acknowledge that your suggestions have improved the quality of our paper indeed. Thank you.

The correct definition for Net interest margin= The difference between interest income and interest expense/total asset*100%.	Many thanks for this important observation. We have corrected the definition. We are grateful indeed for drawing our attention to this.
Table 4 shows that the correlation of LNSIZE with CAP (0.55), CR (0.48), and LQ (0.44) are moderate high; while CAP with CR (0.49), CM (0.44), and LQ (0.49) are high either. Especially, CR is highly associated with CM (0.54). It is suggested to check for multicollinearity and report VIF for selected variable pairs.	Many thanks for your comment. Following your comments, we have carried out your instruction by computing the VIF, which you can find in Table 4 below and reported in the paper. It shows an average of 2 suggesting that our analysis is free from multi-collinearity concerns. We are indeed grateful for your suggestions.
After running the fixed effect model and the random effect model, it is suggested to report Hausman test.	Many thanks for this comment. We carried out your instruction, please see the test result in Table 5 below. We have also reported this in the paper. We believe that your comment has greatly improved the quality of our paper.
Table 5, 59.23*****, you have 5 asterisks for 59.23.	We are sorry for this error. We have now removed the excess asterisks. Thank you.
MP, a measure of market power defined as the ratio of a bank total asset to the total asset of the entire banks in a country, is not significant for almost all the models. It is suggested to eliminated MP from the selected independent variables.	Many thanks for this important comment. We have now removed this independent variable. For completeness, we have included a note to indicate that we removed this variable due to its not being significant in all tables where it is not significant at all but we left it where it has a significant. Many thanks for the suggestion. We agree

	that it has improved the quality of our paper indeed.
Are results presented clearly and analysed appropriately? Do the conclusions adequately tie together the other elements of the paper?: Yes, the results are presented clearly and analyzed appropriately, and the conclusions adequately tie together the other elements of the paper.	Many thanks for this comment. We are pleased that you found our analysis and conclusion to be appropriate in bringing all the parts of the paper together nicely.
Implications for research, practice and/or society: Does the paper identify clearly any implications for research, practice and/or society? Does the paper bridge the gap between theory and practice? How can the research be used in practice (economic and commercial impact), in teaching, to influence public policy, in research (contributing to the body of knowledge)? What is the impact upon society (influencing public attitudes, affecting quality of life)? Are these implications consistent with the findings and conclusions of the paper?: This study contributes to existing literature by reporting cross country evidence from ECOWAS since many existing studies (Rumler & Waschiczek, 2010; Dietrich & Wanzenried, 2014) are based on a single country. Investigating the effects of a phenomenon such as the banking crisis on a cross-country basis provides additional insights and add to our understanding on the global effects of the crisis on bank profitability. In this sense, this study complements Didier et al. 's (2012) work on the resilience and countercyclical behaviour of emerging economies during the financial crisis, and Ghosh's (2016) cross-country analysis of the effects of uncertainty on bank performance	Many thanks for your comment. We are grateful indeed for your positive comments about our work.
Does the paper clearly express its case, measured against the technical language of the field and the expected knowledge of the journal's readership? Has attention been paid to the clarity of expression and readability, such as sentence structure, jargon use, acronyms, etc.: The overall quality of communication of the paper is good. There are some minor grammar mistakes, but it is readable and the structure of the paper is well-organized. Other comments are as follows: When citing several articles for one sentence, the references in the parenthesis should be in chronological order. For example, in Page 2, "Previous studies (Pasiouras & Kosmidou, 2007; Short, 1979; Bourke, 1989; Molyneux & Thornton, 1992; Athanasoglou et al., 2008; Flamini et al.,	Many thanks for these comments. We are pleased that you have found our work interesting and readable. We have now proofread the paper to eliminate the grammatical errors. We hope that you have found our overall response to your comment adequate. Many thanks for these important comments. We have now corrected these and we agree that we present the paper better because of your suggestions. Many thanks indeed.

2009; Dietrich & Wanzenried, 2011) have identified..” is not organized in chronological order. Check this throughout the paper. The authors use present tense and past tense interchangeably. For example, “Ivashina and Scharfstein (2010) report... Puri, Rocholl & Steffen (2011) found that the...” It is suggested to correct these grammar mistakes throughout the paper.	Thank you for your constructive comments. We have now corrected these.

Table 1: Alternative periods for the before, during and after the financial crisis (ROA)

	Column 1		**Column 2**		**Column 3**	
ROA	**Before the crisis (2005-2007)**		**During the crisis (2008-2010)**		**After the crisis (2011-2013)**	
	Coeff	T-Stat	Coeff	T-Stat	Coeff	T-Stat
LNSIZE	0.27	4.60***	-0.09	-0.06	0.44	5.56***
CAP	0.04	1.17	0.26	5.35***	0.04	1.34
CR	-0.02	-2.38**	-0.07	-2.47**	-0.03	-1.90*
CM	-0.03	-11.42***	-0.01	-0.91	-0.01	-3.87***
LQ	-0.01	-1.68*	-0.02	-1.40	-0.01	-1.08
MP	-0.01	-0.91	0.01	0.54	-0.02	-1.68*
ΔGDP	-13.49	-2.51**	23.55	1.21	4.95	0.66
INF	-0.12	-3.49***	0.03	0.30	-0.01	-0.01
Cont	40.59	2.62***	-67.91	-1.19	-14.32	-0.64

R^2		68%		14%		**28%**
F-stat		6.99***		1.47***		**2.11*** **
Obs		**369**		**369**		**369**

Table 2: Alternative periods for the before, during and after the financial crisis (NIM)

	Column 1		**Column 2**		**Column 3**	
NIM	**Before the crisis (2005-2007)**		**During the crisis (2008-2010)**		**After the crisis (2011-2013)**	
	Coeff	T-Stat	Coeff	T-Stat	Coeff	T-Stat
LNSIZE	0.23	4.86***	0.28	4.21***	0.36	7.39***
CAP	0.21	7.50***	0.07	3.04***	0.11	4.85***
CR	0.03	2.64**	0.03	2.06**	-0.01	-1.03

CM	-0.01	-3.12***	0.01	-0.15	-0.02	-2.36**
LQ	-0.02	-4.05***	-0.01	-2.09**	-0.01	-1.67*
MP	0.02	1.79*	-0.01	-0.57	-0.01	-0.22
ΔGDP	4.65	1.00	-9.19	-1.02	3.52	0.77
INF	-0.01	-0.44	0.03	0.55	0.02	1.08
Cont	-15.12	-1.14	26.38	1.01	-10.96	-0.81
R^2		88%		65%		**83%**
F-stat		21.89***		6.33***		**14.76*** **
Obs		**369**		**369**		**369**

Table 3: Alternative measure of bank profitability= Return on average equity (ROE)

	Column 1		Column 2	
Dependent variable	**Fixed effects model ROE**		**Random effect model ROE**	
	Coeff	**T-stat**	**Coeff**	**T-Stat**
LNSIZE	1.39	4.50***	1.96	8.68***
CAP	0.54	3.22***	0.56	3.77***
CR	0.01	0.18	-0.05	-1.01
CM	-0.14	-5.17***	-0.16	-6.75***
LQ	0.21	0.65	0.04	1.34
MP	-0.01	-0.15	-0.02	-0.32
ΔGDP	-15.14	-1.20	-0.03	-0.02
INF	-0.12	-0.53	0.03	0.18
Cont	45.74	1.41	-1.49	-0.43
R^2		1%		7%
F-stat		6.16***		132.95***
Obs		1673		1673

Table 4: Variance Inflation Factor

Variable	VIF	1/VIF

LNSIZE	3.53	0.28
CR	2.81	0.35
ΔGDP	1.72	0.58
MP	1.70	0.59
CAP	1.69	0.59
CM	1.66	0.60
LQ	1.52	0.65
INF	1.18	0.85
MEAN VIF	1.98	

Table 5: Hausman Test result

Null hypothesis: H_0= difference in co-efficient not systematics

Chi –square statistics	42.69
Prob value of Chi- square	0.000
Rejection of the null hypothesis implies that Fixed effect model is suitable rather Random effect	

Dietrich, A., & Wanzenried G. (2011). Determinants of bank profitability before and during the crisis: Evidence from Switzerland. *Journal of International Financial Markets, Institutions and Money,* 21(3), 307-327

Determinants of bank profitability before, during and after the financial crisis.

Abstract

This paper reports the results of an investigation into the relationship between bank-specific, macroeconomic factors and bank profitability before (1999-2006), during (2007-2009) and after (2010-2013) the financial crisis. The results indicate that banks sustained profitable performance even during the financial crisis despite fall in loans and increasing bank liquidity. Panel data analyses results show that there is a significant relationship between bank-specific determinants (size, cost management, and liquidity) and bank profitability (ROA) before, during and after the financial crisis. However, the relationships between other bank-specific (capital strength, credit risk, and market power), macroeconomic (GDP and inflation) determinants are sensitive to both period of analysis (before, during and after financial crisis) and bank profitability measure used (ROA or NIM). Overall, these results suggest that the financial crisis did not affect the relationships between some bank-specific determinants and bank profitability.

Keywords: Banks; Profitability; International Business; Economic Community of West African States (ECOWAS); Macroeconomic environment; Financial crisis.
JEL: C23, E44, F20, G01, G21, L23.

1. Introduction

This study examines the impacts of the financial crisis on the determinants of bank profitability. Previous studies (Dietrich & Wanzenried, 2011; Flamini et al., 2009; Athanasoglou et al., 2008; Beckmann, 2007; Pasiouras & Kosmidou, 2007; Aberu and Mendes, 2001; Molyneux & Thornton, 1992; Bourke, 1989; Short, 1979) have identified several determinants of bank profitability. These determinants include bank-specific (e.g. size, capital strength, credit risk, cost management, liquidity, and bank's market power), industry-specific (ownership and concentration), and macroeconomic conditions such as growth in productivity and inflation (Athanasoglou et al., 2014; Dietrich & Wanzenried, 2014; Bolt et al., 2012; Rumler & Waschiczek, 2010; Albertazzi & Gambacorta, 2009; Bikker & Hu, 2002). According to Dietrich & Wanzenried (2011) these studies are important because of the significance of bank profitability for the stability of the banking industry on the capital markets and the economy as a whole especially in the light of the recent financial crisis.

The relationship between bank-specific, macroeconomic factors and bank profitability may differ after the financial crisis compared to the period during or before the crisis because of differences in the banking environments. For example, Ivashina and Scharfstein (2010) reported that during the financial crisis, loans to large borrowers fell by 79% relative to the peak of the credit boom. In the post financial crisis, Puri, Rocholl & Steffen (2011) found that the financial crisis induced a contraction in the supply of retail lending in Germany. More importantly, they found evidence of a significant supply side effect in that the affected banks rejected substantially more loan applications than non-affected banks. This result was particularly strong for smaller and more liquidity-constrained banks as well as for mortgage as compared with consumer loans. As a result, it is likely in the post-financial crisis

environment that factors such as bank size, liquidity, credit risk etc. may affect bank profitability differently compared to the pre-and during the financial crisis period.

The study also differs from existing studies in that it investigates the determinants of bank profitability in a uniquely different context with undeveloped banking system and severe information asymmetry. Moreover, in contrast to many existing studies such as Rumler & Waschiczek (2010) and Dietrich & Wanzenried's (2011) based one country, albeit important banking contexts, our study is based on a cross-country analysis which provides additional insights and add to our understanding on the global effects of the crisis on bank profitability. In this sense, this study complements Didier et al. 's (2012) work on the resilience and countercyclical behaviour of emerging economies during the financial crisis, and Ghosh's (2016) cross country analysis of the effects of uncertainty on bank performance. Whilst Ghosh (2016) focused on political uncertainty, our primary interest in this study is on the impacts of uncertainty due to the financial crisis on the determinants of bank profitability.

The current study contributes to this stream of literature by investigating the determinants of bank profitability before, during and after the financial crisis using data from banks operating in the Economic Community of West African States (ECOWAS). Consistent with the extant literature, this study measures bank profitability as return on assets (ROA) and net interest margin (NIM), and examines whether bank-specific and macroeconomic factors explain bank profitability before, during and after the financial crisis. The study used fixed effects panel model to recognize the cross sectional and time series elements in the data, whilst controlling for time-invariant country specific heterogeneity. Using data mainly from the Bankscope database, for all the commercial banks in ECOWAS countries, the study covers 1999 to 2013, which provides 1675 firm year observations. In line with our objective, the study partitions the entire sample into before (1999-2006), during (2007-2010) and after (2011-2013) the financial crisis and reports results based on several panel regression models estimations.

The study documents a sharp fall in bank performance during the crisis period, although banks in the region showed consistent profitable performance over the entire sampled period. These findings confirm anecdotal evidence suggesting that African financial markets were well-protected from the effects of the financial crisis. The results are consistent with recent studies showing that bank profitability is pro-cyclical and therefore sensitive to macroeconomic conditions including productivity growth and inflation (Athanasoglou et al., 2014; Dietrich & Wanzenried, 2014; Bolt et al., 2012; Rumler & Waschiczek, 2010; Albertazzi & Gambacorta, 2009; Bikker & Hu, 2002). Panel data analysis results reveal a significant relationship between bank-specific determinants (size, cost management, and liquidity) and bank profitability (ROA) before, during and after the financial crisis. The relationships between other bank-specific (capital strength, credit risk, market power), macroeconomic (GDP and inflation) determinants are sensitive to both the period of analysis and bank profitability measure used.

This study makes a contribution to existing literature and complements the growing number of recent studies examining the effects of the financial crisis on various aspects of banking operations (Vanquez & Federico, 2015; Athanasoglou et al., 2014; Markman & Venzin, 2014; Haas & Lelyyeld, 2014; Albertazzi & Gambacorta, 2009). Specifically, it contributes by extending studies such as Rumler & Waschiczek's (2010), Dietrich & Wanzenried's (2011) and Ekman et al.'s (2014) which investigated the determinants of bank profitability before and after the financial crisis in Austria and Switzerland. In particular, while existing studies such as Dietrich & Wanzenried (2011) examined the determinants of bank profitability before and during the financial crisis, our study, in addition examines the periods after the financial crisis.

The rest of the study is structured as follows: section 2 presents background information about the context – ECOWAS. Section 3 presents the literature review which highlights key findings from existing studies and developed theoretical expectations for the

study. Section 4 presents the methodology and data used in the study. Section 5 presents the results, and the paper concludes in section 6.

2. The ECOWAS banking environment

The ECOWAS is a regional economic bloc of countries in West Africa founded in 1975. Since 1999, the bloc consists of 15 member states (Benin, Burkina Faso, Cape Verde, Cote d'ivoire, The Gambia, Ghana, Guinea, Guines Bissau, Liberia, Mali, Niger, Nigeria, Senegal, Sierra Leone and Togo). The main purpose of the organization is to promote economic development through integration, free trade and free movement of factors of production amongst member states. The region has an estimated GDP of $721 billion and a total population of approximately 500million as at 2014 (World Bank Development Indicator, 2014).

Despite economic cooperation, countries in the bloc have distinctive characteristics and their levels of financial market development are not uniform. Countries such as Nigeria, Ghana, and Gambia have relatively high (6, 6, and 9) ratio of commercial banks branches per 100,000 adult population compared to countries such as Niger, Sierra Leone and Guinea, with low (1.5, 3, 2) ratios of commercial banks branches to adult population against the global average of 11 banks (World Bank Financial Market Development Indicator, 2014).

Based on the Structure-Conduct-Performance (SCP) theoretical framework (Molyneux et al., 1996; Short, 1979), African banks have significantly different structure and conduct compared to banks in other regions reported in the literature (Andrianova et al., 2015; Ahokpossi, 2013). The SCP suggests that banks performance is dependent on their structure (i.e. number of bank and depositors; concentration, and barriers to entry) and conduct (i.e. pricing behavior, legal attitude and tactics). In terms of structure, financial markets in Africa are undeveloped and shallow; bank lending is low because of low financial intermediation and high credit risk (Allen et al., 2011).

African financial markets have one of the lowest ratios of bank branches to population in the world (World Bank Development Indicator, 2014) and there is high market power because the markets are highly concentrated resulting in limited competition and enabling large banks to earn abnormal returns due to monopolistic competitions (Ahokpossi, 2013; Flamini et al., 2009). The reasons for high banking markets concentration in Africa include waves of privatization of public enterprises including banks, and the requirements for increased capitalization by banks to ensure market resilience (Tahir et al., 2016). The latter resulted in several mergers and restructuring in the banking sector in many African countries reducing the number of banks but improving their capital base and resilience to external shocks.

Banking conducts in Africa are also significantly different from popular norms in the literature. For example, the legal structure, institutions and financial policies are emerging and unstable (Demetriades & Fielding 2012). Investor protection is generally weak due to weak judicial system and poor enforcement of rules. Corruption is systemic which heightens banks risk profile (Habib & Zurawicki, 2002). Low financial intermediation and uncertain banking conducts are likely indicators of the high operating risks that banks in this context face which partly explain why banks in Africa have the highest net interest margin compared to banks in other regions of the world (Ahokpossi, 2013; Demetriades & Fielding, 2012; Flamini et al., 2009).

Furthermore, due to the shallow financial markets, there is a limited number of banking products, and banks revenue are less diversified relying heavily on interest income (Allen et al., 2011). These features make African banking market distinctive and justify a closer analysis of the impacts of the financial crisis on the determinants of bank profitability in the context. The next section reviews the relevant literature and formulates the theoretical predictions addressed in the study.

3. Literature review: The determinants of bank profitability

This section reviews the literature on the determinants of banks profitability. Specifically, this section reviews literature on how bank-specific and macro-economic factors affect bank profitability.

3.1 Bank-specific factors

Previous studies (Ghosh, 2016; Flamini et al., 2009; Athanasoglou et al., 2008; Pasiouras & Kosmidou, 2007; Carbó & Rodríguez, 2007; Molyneux & Thornton, 1992; Bourke, 1989; Short, 1979) have identified several banks specific determinants of bank profitability including size, capital strength, credit risk, cost management, liquidity, and bank's market power.

Size

Many studies suggest that the relationship between bank size and profitability can either be positive or negative (e.g., Dietrich & Wanzenrid, 2014; Flamini et al., 2009; Athanasoglou et al., 2008; Micco et al., 2007; Goddard et al., 2004; Molyneux & Thornton, 1992; Bourke, 1989; Short, 1979). Those arguing for a positive relationship suggest that size is associated with economies of scale (Flamini et al., 2009; Athanasoglou et al., 2008; Molyneux & Thornton, 1992; Bourke, 1989; Short, 1979) leading banks becoming more profitable as they become larger. However, some have suggested that as banks expand in size through entry into new markets or the building of new branches, they incur additional operating costs, which erode profits (Dietrich & Wanzenrid, 2014; Micco et al., 2007). Goddard et al. (2004, p. 378) state that "there is some evidence of a significant size-profitability relationship in some of the estimators, but overall the evidence for any systematic relationship between size and performance is unconvincing."

Banks in Africa face high operating costs typically due to high information asymmetry (Allen et al., 2011) which are likely to be accentuated during crisis due to lack of market confidence. Consequently, the initial cost of product development, diversification and branch expansion may be prohibitive (Shehzad et al., 2013; Ahokpossi, 2013). Higher market imperfection and uncertainty caused by the crisis may also affect cost recovery. Thus, the expected economies of scale may not materialize, resulting in a negative relationship between banks size and profitability.

On the other hand, following evidence from Flamini et al. (2009), large banks have the tendency to make abnormal profit in a monopolistic competition, more so during uncertainty, because they can charge higher lending rate and incur lower borrowing costs (Allen et al., 2011). These advantages may imply higher profitability during the crisis resulting in positive relationship between bank size and profitability. The arguments above show that the effect of size on bank profitability is an empirical issue. The conjecture in this study is that large banks, given their resources and scale advantages, have higher propensity to return to pre-crisis performance level therefore more profitable than smaller banks.

Capital strength

The capital strength of a bank indicates its capacity to meet deposit demand and sends signals to bank customers about its stability and ability to protect their savings especially during periods of uncertainty such as the financial crisis (Ghosh, 2016; Berger, 1995b). Many existing studies including Bourke (1989), Demirguc-Kunt & Huizinga (1999), and Goddard et al. (2004) report positive relationships between capital strength and banks profitability. A plausible explanation for these findings could be that well capitalized banks are in a better position to exploit market opportunities and enjoy more deposit with the potential for increased interest income and improved earnings diversification. They can also raise cheaper capital due to their size (Athanasoglou et al., 2008), and according to Aebi et al.

(2012:3218)'…. a bank with more capital would suffer less from the debt overhang problem (Myers, 1977) and would have more flexibility to respond to adverse shocks.' However, Ahokpossi (2013:8) argued that "well-capitalized banks face lower costs of borrowing and low risk of bankruptcy" suggesting that these factors may make then charge lower margin implying lower profitability.

Increased bank capitalization is a recurring theme in many African financial markets with the primary aim of enhancing bank resilience (Tahir et al., 2016). The regulatory requirement to increase bank capital base could have impact on banks' profitability (Ahokpossi, 2013). Ghosh (2016:377) suggested that "if higher capital represents a regulatory cost on banks, then we would expect a positive relationship to the extent that such costs are partly passed on to customers". In other words, the impact of regulation induced bank capital depends on banks' ability to pass on such increase to their customers. Ghosh's (2016) argument is particularly relevant in the African banking sector where banks have been regularly required to increase their capital (Tahir et al., 2016). Both Ahokpossi (2013) and Flamini et al. (2009) report positive relationship between capital strength and profitability in their studies on banks in sub-Saharan Africa suggesting the possibility that banks in Africa can pass on the cost of regulation induced capital based to their customers. However, they did not explore this issue during the financial crisis period.

The effects of the financial crisis on the relationship between banks capital strength and profitability seem ambiguous. Although well-capitalized banks may signal confidence and stability to their customers, additional capital requirement during crisis may be at higher cost and with adverse effects on bank profitability. Furthermore, the macro-prudential regulatory framework initiated during the crisis is likely to continue well after the crisis. The implications of these being that whilst the findings on the relationship between capital strength and bank profitability before the financial crisis is mixed, the relationships between these variables during and after the financial crisis are profoundly uncertain.

Based on the arguments above, this study anticipates that irrespective of the additional costs that banks may incur in meeting the capital adequacy regulations during and after the crisis, well-capitalized banks are likely to be more profitable than less capitalized banks before, during and after the financial crisis.

Credit risk

Banks encounter credit risks in two main ways: 1) when they experience significant default rates on loans (bad debts) and 2) when they are unable to meet the cash requirement of depositors due to inadequate reserves or inability to raise short-term funding (insolvency). Previous studies report mixed findings on the relationship between credit risk and bank profitability. Studies (Ahokpossi, 2013; Flamini et al., 2009) reporting positive relationship argue that it reflects the simple logic of higher risk-higher return. Thus, banks adjust their charges to reflect the calculated risk they are exposed to. Consequently, they demand higher collaterals and charge higher interest rates for high-risk transactions, and in context with high information asymmetry.

However, Bourke (1989), Molyneux & Thornton (1992) and Athanasoglou et al. (2008) conclude that credit risk has a significant negative effect on banks profitability. A plausible explanation for this finding could be that high credit risk potentially implies high bad debt which effectively means less interest income for banks, in addition to the increased cost of credit control. The rate of default is likely to be higher during the crisis thus aggravating banking risks (Didier et al., 2012). Banks respond to the perceived increase in credit risk by becoming circumspect about extending loan and credit to customers. This was the case in many banks in the developed economies affected by the crisis, and it is taking a while to get lending back to pre-crisis period. Thus, the relationship between credit risk and bank profitability during the crisis may be prolonged well after the crisis. Based on the

arguments above, theoretically, this study predicts a negative relationship between bank credit risk and profitability during and after the crisis but not before.

Cost

Studies have consistently reported significant negative relationship between bank profitability and operating costs (Athanasoglou et al., 2008; Molyneux & Thornton, 1992; Bourke, 1989) based on the argument that cost erodes profit and is negatively related to performance. Banks with high cost to income ratio are likely to report low profits, and signal management inefficiency with adverse consequences for profitability (Pasiouras & Kosmidou, 2007). This effect may become exacerbated during the financial crisis because of uncertainty which could affect operating cost, in context with high information asymmetry; consequently, theoretically, this study expects a negative relationship between cost and bank profitability before, during and after the crisis.

Liquidity

Poor liquidity management exposes banks to bankruptcy (Moyer et al., 2005). High bank liquidity may suggest lack of suitable investment opportunities and may lead to poor bank performance (Ghosh, 2016; Carbó & Rodríguez, 2007). The literature reports mixed findings on the relationship between liquidity and bank profitability. For example, Kosmidou et al. (2007) did not find any significant relationship in their study of Greek banks operating abroad, but Molyneux & Thornton (1992), Pasiouras & Kosmidou (2007) report negative relationships, while Bourke (1989) reports positive relationships between these variables.

Liquidity management will most likely pose additional risk to banks during the financial crisis and especially for banks in Africa due to significant information asymmetry, suggesting high liquidity risks (Allen et al., 2011). These also imply concern for higher propensity to default on loans and advances during the crisis than otherwise (Andrianova et

al., 2015). Consequently, banks in this region may have to maintain high liquidity to meet depositors' demand in a shallow financial market with limited opportunity for diversified income during period of uncertainty. Banks in this region seem to respond to these risks through high lending rates to cover for the additional risks (Andrianova et al., 2015; Fosu, 2013). They also concentrate on short term lending with the attendant negative effects on financial market deepening and capital market development (Allen et al., 2011; Saunders & Schumacher, 2000). Since liquid assets are associated with lower returns, and given that banks in Africa maintain high liquidity to ensure financial stability, theoretically, this study predicts a negative relationship between liquidity and profitability during and after the crisis due to the heightened banking risk. However, we cannot predict the direction of the relationship before the financial crisis.

Market power

Literature (Flamini et al., 2009; Athanasoglou et al., 2008; Molyneux & Thornton, 1992; Berger, 1995b) reports mixed findings in the relationship between market power and bank profitability. Flamini et al. (2009) argued that high market concentration should allow banks with higher market power to protect their earning even during unfavourable macro-economic conditions and possibly during the financial crisis, since they can control their operating costs whilst being able to determine their revenue. However, Ahokpossi (2013) notes that an inverse relationship is also possible if banks with high market power temporarily deliberately reduce their price to evict other competitors or if they use interest income as a loss leader. This study anticipates a positive relationship between market power and bank profitability before, during and after the crisis because market power could allow a bank greater efficiency and higher revenue especially in a monopolistic market and during period of uncertainty due to their resource advantage.

3.2 Macroeconomic factors

This section presents the literature on the macro-economic determinants of bank profitability.

Growth in gross domestic product (GDP):

There is an expectation of a positive relationship between bank profitability and the growth in GDP (Athanasoglou et al., 2014; Albertazzi & Gambacorta, 2009; Bikker & Hu, 2002). This expectation is plausible during a period of relative economic stability and growth. This is because an increase in productivity level in a country, all things being equal, should lead to increase in disposable income and create conducive atmosphere for personal and corporate investment leading to increase in bank profitability due to increase in loan and credit (Athanasoglou et al., 2014). Previous studies that report positive relationship between growth in GDP and bank profitability include Pasiouras & Kosmidou (2007), Athanasoglou et al. (2008) and Dietrich & Wanzenried (2014).

This relationship may become ambiguous during the crisis period as national productivity falls in response to the crisis, and to reduction in bank lending. This cautious attitude seems to persist well after the crisis and may lead to fall in bank profitability during and after the crisis. Consequently, this study anticipates a positive relationship between growth in GDP and bank profitability before, during and after the financial crisis.

Inflation rate

Empirical evidence on the relationship between inflation rate and bank profitability is mixed. While studies such as Dietrich & Wanzenried (2014), Ahokpossi (2013) and Flamini et al. (2009) report positive relationship, Goddard et al. (2011) indicate an insignificant relationship in their study into the persistence of bank profits. Extant literature also notes that the effects of inflation on bank profitability depend on the extent to which inflation can be

accurately anticipated and passed on to customers (Flamini et al., 2009; Athanasoglou et al., 2008) and this is likely to be poor during periods of uncertainty such as the financial crisis. This implies that banks may have to bear the increase in operating costs due to inflation. On the other hand, there may be an increase in productive activity during inflationary periods as entrepreneur may be able to make more profits. Increase in productive activity is generally a positive trend for banks in terms of loan and therefore increased profitability. Consequently, the study expects a positive relationship between these variables.

4. Data and methodology

This section explains the sources of the data and the methodology used in this study.

4.1 Data

The analysis in this study is based on the financial data for banks in the ECOWAS region obtained from the Bankscope database which is a reliable and trusted database of banks' balance sheets, income statements and relevant financial and non-financial information of thousands of banks worldwide. The data for macro-economic variables were obtained from the World Bank. The sample for this study comprised all 123 commercial banks in the ECOWAS member states available on Bankscope for the period covering 1999-2013, resulting in an unbalanced panel of 1672 firm-year observations. The panel is unbalanced because some countries' information are not available on Bankscope for the earlier years (before the crisis) and banks with incomplete information in the subsequent years were removed. The sample composition is presented in Table 1. The scope of the study was chosen based on data availability, and to cover the periods before, during and after the financial crisis, to allow deeper understanding of the impacts of the crisis on the determinants of bank profitability, which is rarely covered in the extant literature. The analysis is restricted

to commercial banks to enhance comparability, and to avoid the bias that other type of banks such as development or industrial banks may introduce.

[INSERT TABLE 1 ABOUT HERE]

4.2 Methodology

To investigate the effects of the financial crisis on the determinants of bank profitability for commercial banks in ECOWAS, this study followed the approach in Pasiouras & Kosmidou (2007) and Ahokpossi (2013) by using panel data analysis. The fixed effect panel model used recognizes bank-specific, industry and macro-economic factors for each bank in each country across the years. The model allows more observations and ensures that only time varying variables account for the changes in the dependent variable. All the time invariant unobservable factors are all accounted for in the intercept, also referred to as the fixed effect (Hill et al., 2012; Baltagi, 2012). The subscript for the country has been omitted for simplicity. The fixed effect model is specified below:

$$y_{it} = \mu_i + \beta_b X'_{bit} + \beta_d X'_{dit} + \beta_m X'_{mit} + \varepsilon_{it} \qquad (1)$$

Where y_{it} is the dependent variable, representing bank profitability of the *i*th bank at time t and the vectors X'_b , X'_d and X'_m represent bank-specific, industry and macroeconomic factors respectively as defined in Table 2 below. μ_i is the fixed effect and ε_{it} represents the error term, with the standard assumptions of the error term (i.e. $E(\varepsilon_{it} = 0); var(\varepsilon_{it}) = \sigma_{it}^2$). The study also uses the random effect model, given as equation 1 above but where $\mu_i = \bar{\mu}_1 + u_i$, and $\bar{\mu}_1$ and u_i are the population mean intercept and the

random effect element in the model respectively. u_i has the same standard assumptions of the error term as stated earlier. Hence the random effect model is restated in (2) as:

$$y_{it} = \overline{\mu}_1 + \beta_b X_{bit} + \beta_d X_{dit} + \beta_m X_{mit} + v_{it} \quad (2)$$

Where $v_{it} = u_{it} + \varepsilon_{it}$, and both error terms are not correlated with any of the explanatory variables.

[INSERT TABLE 2 ABOUT HERE]

The study reports the results of both the fixed and random effect models and used the Hausman test to decide the appropriate model to rely on in the analyses. The test compares the coefficient estimates from the fixed and random effects models and assumes that in both models there is no correlation between the error term and any of the explanatory variables. Thus, in large samples, the estimates of the coefficients are consistent. When this assumption is violated, random effects estimates are no longer consistent whilst fixed effects estimates are, thus converge to the true value of the parameters. Rejecting the null hypothesis of no correlation between the error term and the explanatory variables therefore supports the use of the fixed effect model (Hill et al., 2012; Baltagi, 2012). See appendix 1 for the test result. The next section presents and discusses the results.

5. Results and discussion

5.1 Descriptive statistics

Table 3 presents the descriptive statistics which are also shown in graph form in Figure 1. Table 3 shows that there is considerable variation in both the dependent and

independent variables statistics. The features of the sample as indicated in the descriptive statistics in Table 3 are mainly similar to those in previous studies (Flamini et al., 2009; Ahokpossi, 2013) from the same context with few exceptions due mainly to the fact that this current study focuses on the ECOWAS sub-region. For example, the mean (standard deviation) for ROA of 3.36 (4.21) is similar to the 2.35(3.00) reported in Flamini et al. (2009). Banks in the region seem to face high credit risk (CR) as indicated in the mean (standard deviation) value for CR of 30.94 (33.48) which compares well with the reported figures in Flamini et al. (2009) 57.40 (26.80) and Ahokpossi (2013) 63.53 (57.94). The banks in the sample are also similar in size given the mean value of 10.99 compared to 11.70 in Flamini et al. (2009) although their variation and range are different. It is also important to note in Figure 1 the increase in CM, CR and LQ around 2007-2009 and the sharp drop in GDP and ROA about the same period while inflation is generally rising. Figure 1 also shows a general rise in bank size and capital strength.

[INSERT TABLE 3 ABOUT HERE]

[INSERT FIGURE 1 ABOUT HERE]

5.2 Correlation analysis

Table 4 presents the correlation analysis. None of the variables are highly correlated, the highest correlation between bank size and capital strength is at 0.55 which is far lower than the 0.80 threshold (Hair et al., 1995). Many variables including cost are negatively correlated with the dependent variables. Larger banks are also likely to have higher credit risk and higher operating costs as indicated in the positive correlation of 0.84 and 0.39 respectively. ROA is negatively correlated with operating costs (-0.24) indicating that higher operating inefficiency is associated with lower operating profit. The low correlation in Table

4 removes any concern about potential multicollinearity in the investigation. Notwithstanding, we compute the variance inflation factor for the independent variables in the model (see appendix 2 for the tabulated result) and the figures showed a highest of 3.53 for bank size and lowest value of 1.18 for inflation with an average value of 1.98 lower that the popular threshold of 10 (Hair et al., 1995) which may indicate concern for multicollinearity.

[INSERT TABLE 4 ABOUT HERE]

5.3 Regression results

This section presents the regression results of the relationship between bank-specific, macro-economic and bank profitability. Each of the Tables 5-7 has three columns each for a distinct regression model. The results in Table 5 is for the entire sample with column 1 for ROA fixed effect model, column 2 for ROA random effect model and column 3 for NIM fixed effect model. Fixed effect estimation results are presented for the other tables because the Hausman test supports fixed effect models. As indicated in each of the Tables 6 and 7, columns 1, 2 and 3 present the results for before, during and after the financial crisis respectively.

Table 5 presents the regression results for the entire sample. The table shows that the adjusted R^2 varies from 21%-30%. The F-statistics showed that the models are statistically significant at 1% level. The results in Columns 1 and 2 of Table 5 show a statistically significant positive relationship between bank size (LNSIZE), capital strength (CAP) and negative relationship between credit risk (CR) cost management (CM), liquidity (LQ) and bank profitability, measured as ROA. There is also a significant negative relationship

between inflation (INF) and bank profitability but only in respect of the fixed effects model. Results in Column 3 of Table 5 also show a significant positive relationship between CAP, LQ, MP, gross domestic product and bank profitability, measured by net interest margin (NIM).

[INSERT TABLE 5 ABOUT HERE]

The results in Table 6 show that the adjusted R^2 varies from 27% (after the financial crisis), 54% (during the financial crisis) to 70% (before the financial crisis). The F-statistics results imply that the models are statistically significant. The results show that LNSIZE has a significant and positive relationship with profitability before (Column 1), during (Column 2) and after (Column 3) the financial crisis. CAP also has a positive and significant relationship with bank profitability but only before (Column 1) and during (Column 2) the financial crisis. The results in Table 6 also show that there is a significant negative relationship between CM, LQ and bank profitability before, during and after the financial crisis. INF also has a significant but negative relationship with profitability but only during the financial crisis while CR is also negatively associated with profitability during and after the financial crisis periods only. MP and GDP are not associated with bank profitability before, during and after the financial crisis.

[INSERT TABLE 6 ABOUT HERE]

The fixed effects model results of the relationship between bank-specific, macro-economic factors and profitability using net interest margin (NIM) as the dependent variable are presented in Table 7. Similar to the results reported in Table 6, the results show variation

in the relationship between the determinants from one period to the other. For example, the results show a significant positive relationship between LNSIZE, CAP and INF during (Column 2) and after the financial crisis (Column 3). The results also show significant positive associations in respect of CR (during financial crisis), LQ (before and during the financial crisis), GDP (before and during financial crisis) and MP (after financial crisis). The results also show negative and significant relationships in respect of CM (before and after the financial crisis).

[INSERT TABLE 7 ABOUT HERE]

Table 8 presents summary comparing the results of the effect of bank-specific and macro-economic factors on bank profitability using ROA and NIM as dependent variables before, during and after the financial crisis. The results show that LNSIZE and CAP in most cases, have a positive and significant relationship with profitability while CM and LQ have mostly a significant and negative relationship with bank profitability. However, there appears to be no relationship between MP, GDP and bank profitability in most cases (see Table 8, Columns 1, 2 and 3). In respect of CR, the overall evidence is mixed as in three cases the relationship is significant but not in other three cases.

5.4 Discussion

The findings from the study suggest that bank size is a significant determinant of bank profitability irrespective of the financial crisis and measure of profitability used. The only the exception is the period before the financial crisis when bank profitability is measured by NIM. These results which indicate that larger banks are more profitable than smaller ones are consistent with the economies of scale argument which suggest that larger banks, due to their

size, can benefit from reduction in cost of operation due to size advantage. The finding of positive relationship is consistent with the results in some previous studies including Short (1979), Bourke (1989), Molyneux & Thornton (1992), Athanasoglou et al. (2008) and Flamini et al. (2009). However, our findings are inconsistent with the assertion by Goddard et al. (2004, p 378) that '…. overall the evidence for any systematic relationship between bank size and performance is unconvincing' as well as the results reported by Micco et al. (2007) and Dietrich & Wanzenrid (2014). Compared to a study by Dietrich & Wanzenrid (2011) in respect of the relationship between bank size and profitability during the financial crisis, our study results differ in that while we report a positive relationship, they found a negative relationship. We suspect that their use of dummy variable to measure bank size may have driven their result as we expect large banks to remain profitable during and after the crisis due to economies of scale and better resources.

Our results which show a significant positive relationship between bank capital strength and ROA (before and during) and NIM (during and after) the financial crisis are consistent with the findings reported by Berger (1995b), Bourke (1989), Demirguc-Kunt & Huizinga (1999), and Goddard et al. (2004). In the sub-Saharan context, Flamini et al. (2009) also report a positive relationship between bank capital strength and bank profitability. However, our results of a positive relationship during the financial crisis contradict the suggestion by Dietrich & Wanzenried (2011) who state that increase in Swiss banks' deposits could not be turned into profits during financial crisis because of the low demand for credit and limited opportunities for investments during the crisis leading to the reported negative relationship in their study.

The results of the relationship between credit risk (CR) and profitability which show no significant relationship before the financial crisis but becoming negative and statistically significant during and after the financial crisis when profitability is measured by ROA suggest that the financial crisis increased banking risks and these had significant negative

effects on bank profitability. These findings are consistent with the findings reported Bourke (1989), Molyneux, and Thornton (1992) and Athanasoglou et al. (2008) and Dietrich & Wanzenried (2011) confirming the high banking risk during the crisis and its negative effects on bank profitability. Our findings may be peculiar to Africa where banking infrastructure is weak. The high credit risk in this market is magnified in terms of the generally low lending and focus on short term lending. On the other hand, the results conflict with the findings in Flamini et al. (2009) who report positive relationship.

This study reports a negative relationship between cost of operation and bank profitability which is rather standard and supports the finding in several previous studies including Athanasoglou et al. (2008), Bourke (1989), Molyneux & Thornton (1992). This indicates that banks that are able to control their operating costs are likely to be more profitable. This finding is consistent with the reported results in Dietrich & Wanzenried (2011) for both before and after the crisis.

Furthermore, our findings which generally show a significant negative relationship between liquidity and bank profitability are consistent with the view that poor liquidity management exposes banks to bankruptcy and credit risks (Moyer et al., 2005) with negative pressure on profitability. These findings are consistent with results from previous studies including Carbó & Rodríguez (2007), Molyneux & Thornton (1992), Pasiouras & Kosmidou (2007) all of whom have reported negative relationships but conflicts with the results from Bourke (1989) who found a positive relationship between the bank liquidity and profitability.

The lack of statistically significant relationship between bank profitability and market power reflects the inconsistencies in the result from previous studies (Ahokpossi, 2013; Athanasoglou et al., 2008; Molyneux & Thornton, 1992; Berger, 1995b). The lack of significance is consistent with the result in Flamini et al. (2009) who reported the absence of direct effect of market power on bank profitability when this was measured as ROA, in their study of African banks. However, the statistically significant positive relationship between

bank market power and NIM supports Molyneux & Thornton (1992) findings but conflicts with Ahokpossi (2013) who reported a negative relationship between these variables.

The results which suggest that GDP growth had a significant positive relationship with bank profitability (NIM) before and during the financial crisis means that the financial crisis had no restrictive influence on productive activity and indeed banks were able to expand their interest income during the period. However, this relationship changed to insignificant after the financial crisis. A plausible explanation for this could be that the end of the crisis led to reduction in the level of banking risks, which was ultimately reflected in the reduced interest income following the end of the crisis.

The positive and significant relationship between inflation and NIM during the financial crisis is consistent with previous findings by Dietrich & Wanzenried (2011), Ahokpossi (2013), and Flamini et al (2009) but conflicts with the reported findings in Goddard et al. (2011). The result reflects banks' ability to pass on the additional cost due to inflation to their customer especially in a concentrated banking market thereby enhancing their profitability. Overall the financial crisis seems to affect the relationship between inflation and profitability depending on the focus of the analysis (i.e. before, during or after the crisis), and the measure of bank profitability used.

5.5 Additional analysis

This section reports a number of further analyses and robustness checks in this study. First, given that some authors (Haas & Lelyyeld, 2014) assume that the financial crisis started in September 2008 following the collapse of the Lehman Brothers, we re-partitioned the sample so that pre-crisis (2005-2007), crisis (2008-2010) and post-crisis (2011-2013) have equal number of observations. Tables 9 and 10 present the results of these analyses. The findings are similar to our main results reported in Tables 6 and 7 with a few exceptions for example, capital strength which was significant before the financial crisis with ROA is now

not significant. Similarly, bank size which was significant during the financial crisis under ROA appears to be insignificant in these additional analyses amongst other findings. A possible explanation for these variations in findings could include the variations in the observations used in the analyses with more observations being preferred.

[INSERT TABLE 9 ABOUT HERE]

[INSERT TABLE 10 ABOUT HERE]

Secondly, we used return on equity (ROE) as alternative measure of bank profitability in addition to ROA and NIM. Table 11 below presents the result of this analysis. It shows that our main result presented in Table 5 has better qualitative features in terms of the explanatory power of the models and the number of significant independent variables. Dietrich & Wanzenrid (2011) also cautioned against using ROE as the main determinant of bank profitability because it does not account for bank leverage level.

[INSERT TABLE 11 ABOUT HERE]

Thirdly, since previous studies (Ahokpossi, 2013; Flamini et al., 2009) suggest that the relationship between bank size and profitability may be non-linear, we used the square of size measure in additional analysis reported in Table 12 below. The negative and statistically insignificant relationship between $Lnsize^2$ and ROA did not support this assertion. Fourthly, Ahokpossi (2013) suggested that the effect of market power might become evident through interaction with banks' operating cost. Banks with high market power may be able to depress their cost better. We explored this issue by interacting our measure of market power with operating cost. In column 1 Table 12, MP*CM showed positive but statistically insignificant

relationship with ROA but showed statistically significant negative relationship with NIM. Thus, whilst the dis-economies of scale argument is supported by the NIM result, it is not with the ROA result.

[INSERT TABLE 12 ABOUT HERE]

Finally, in un-tabulated additional analysis following the approach in Ahokpossi (2013), we examined the impacts of legal origin on our analysis and found that our results are robust to this consideration. This finding is plausible in the context given the efforts at integrating member states financial markets.

6. Summary and Conclusion

This study reports the results of the ECOWAS cross-country analysis of how bank-specific, macroeconomic determinants affect bank profitability (measured by ROA and NIM) before (1999-2006), during (2007-2009) and after (2010-2013) the financial crisis. Using a panel data of 1673 firm-years' observations from 1999-2013, the results show that bank-specific factors mostly determine bank profitability. The results show that banks remained profitable during the financial crisis despite fall in loans and increasing bank liquidity. Regression analysis results show that bank-specific determinants (size, cost management, and liquidity) and bank profitability (ROA) are significant before, during and after the financial crisis. The relationships between other bank-specific (capital strength, credit risk, market power), macroeconomic (GDP and inflation) and bank profitability depend on both the period of analysis (before, during and after financial crisis) and bank profitability measure used (ROA or NIM).

Our findings should be interpreted in the light of the limitations of the study. For example, the classification of the period in our analysis into before, during and after may be problematic because it is debatable as to when the financial crisis started and ended. Moreover, the financial crisis started and ended on different dates in different countries. However, we tried to alleviate this problem by dividing our time period following previous research by Dietrich & Wanzenried (2011) rather than use our own classification. Further, our study is also limited because we only considered commercial banks and future studies may consider the inclusion of other banks including development banks.

Despite these limitations, our study contributes by complementing existing studies where there is mixed evidence of the determinants of bank profitability before and during financial crisis (Vazquez & Federico, 2015; Athanasoglou et al., 2014; Markman & Venzin, 2014; Haas & Lelyyeld, 2014; Albertazzi & Gambacorta, 2009). In particular, we extend the existing research by investigating the determinants of bank profitability before, during and after the financial crisis since our knowledge is limited to the period before and during financial crisis. In addition, we also contributed to existing literature by reporting cross-country evidence from ECOWAS since many existing studies (Dietrich & Wanzenried, 2011; Rumler & Waschiczek, 2010) are based on a single country. Investigating the effects of a phenomenon such as the banking crisis on a cross-country basis provides additional insights and add to our understanding on the global effects of the crisis on bank profitability. In this sense, this study complements Didier et al.'s (2012) work on the resilience and countercyclical behaviour of emerging economies during the financial crisis, and Ghosh's (2016) cross-country analysis of the effects of uncertainty on bank performance.

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Appendix

1. Hausman Test result

Null hypothesis: H_0= difference in co-efficient not systematics

Chi –square statistics	42.69
Prob value of Chi- square	0.000
Rejection of the null hypothesis implies that Fixed effect model is suitable rather Random effect	

2. Variance Inflation Factor

Variable	VIF	1/VIF
LNSIZE	3.53	0.28
CR	2.81	0.35
ΔGDP	1.72	0.58
MP	1.70	0.59
CAP	1.69	0.59
CM	1.66	0.60
LQ	1.52	0.65
INF	1.18	0.85
MEAN VIF	1.98	

Table 1: Sample description

Panel A: Number of banks per country

Number	Country	Number of Banks per country	Observation per Country (1999-2013)	Percentage of total observation
1	Benin	10	150	8.13
2	Burkina Faso	10	150	8.13
3	Cape Verde	3	45	2.43
4	Cote D'Ivoire	13	195	10.56
5	Gambia	9	135	7.32
6	Ghana	22	330	17.89
7	Guinea	5	75	4.07
8	Guinea Bissau	2	30	1.63
9	Liberia	5	75	4.07
10	Mali	7	105	5.69
11	Niger	5	75	4.07
12	Nigeria	10	150	8.13
13	Senegal	10	150	8.13
14	Sierra Leone	6	90	4.88
15	Togo	6	90	4.88
	Total	**123**	**1845**	**100**

Panel B:Number of observation by period

	Entire sample	Before	During	After
Expected number of observation	1845	984	369	492
Less missing observation	172	128	13	31
Total Observations in the study	1673	856	356	461

Table 2: Variable definition

VARIABLES	Description	Sign
DEPENDENT		
ROA	The return on total assets of banks given as profit after tax divided by assets	
NIM	The difference between interest income and interest expense/total asset %.	
INDEPENDENT		
BANK SPECIFIC FACTORS		
LNSIZE (size)	The natural log value of the bank's total assets	**+ve/-ve**
CAP (capital strength)	Defined as equity to total assets	**+ve**
CR (credit risk)	Defined as net loans to deposits and short-term funding	**-ve**
CM (cost management)	This is the total operating cost divided by total income	**-ve**
LQ (liquidity)	Defined as liquid assets divided by total customer and short-term funding	**-ve**
INDUSTRY FACTOR		
MP (market power)	This is a measure of market power defined as the ratio of a bank total asset to the total asset of the entire banks in a country. Also as the square of the total asset.	**+ve/-ve**
MACRO-ECONOMIC		
ΔGDP (productivity growth)	The annual percentage change in real gross domestic product	**+ve/-ve**
INF (Inflation)	Growth rate in consumer price index	**+ve/-ve**

Table 3: Descriptive statistics

	ROA	NIM	LNSIZE	CAP	CR	CM	LQ	MP	*ΔGDP*	INF
Mean	3.36	6.74	10.99	6.23	30.94	40.48	23.60	0.01	1.55	6.90
Maximum	24.11	51.46	26.21	98.80	246.27	314.29	109.75	0.65	3.52	34.70
Minimum	-40.51	-1.80	6.72	-97.08	0.00	-19.75	0.00	0.00	-2.30	-4.40
Std. Dev.	4.21	13.44	9.20	9.73	33.48	37.80	35.66	0.03	0.69	7.40
Observations	1673	1673	1673	1673	1673	1673	1673	1673	1672	1673

Table 4: Correlation matrix

	ROA	NIM	LNSIZE	CAP	CR	CM	LQ	MP	⊿GDP	INF
ROA	1.00									
NIM	-0.04	1.00								
LNSIZE	0.17	0.22	1.00							
CAP	0.21	0.22	0.55	1.00						
CR	0.09	0.18	0.48	0.49	1.00					
CM	-0.24	0.28	0.39	0.44	0.54	1.00				
LQ	0.04	0.23	0.44	0.49	0.27	0.36	1.00			
MP	0.08	0.07	0.34	0.13	0.23	0.12	0.12	1.00		
∆GDP	0.04	0.08	-0.04	0.00	-0.12	-0.08	0.00	-0.03	1.00	
INF	0.03	0.01	-0.08	0.01	-0.17	-0.11	0.11	-0.05	0.15	1.00

Table 5: Regression result for the entire sample

	Column 1		Column 2		Column 3	
Dependent variable	**Fixed effects model ROA**		**Random effect model ROA**		**Fixed effect model NIM**	
	Coeff	**T-stat**	**Coeff**	**T-Stat**	**Coeff**	**T-Stat**
LNSIZE	0.36	2.45***	0.22	10.48***	-0.06	-0.84
CAP	0.12	9.50***	0.12	10.36***	0.09	2.27**
CR	-0.02	-3.11***	-0.02	-3.79***	0.01	0.81
CM	-0.04	-17.63***	-0.04	-20.05***	-0.05	-7.36***
LQ	-0.01	-3.55***	-0.01	-3.44***	0.04	4.22***
MP	-1.54	-0.35	-1.43	-0.39	2.46	2.72***
ΔGDP	0.06	0.39	-0.01	-0.07	1.68	3.59***
INF	-0.04	-2.14**	-0.01	-0.69	-0.02	-0.39
Cont	0.83	1.41	0.54	1.09	-3.46	-2.04**
R^2		30%		24%		21%
F-stat	6.35***		59.23***		3.16***	
Obs	1673		1673		1673	

ROA defined as profit before tax divided by total assets. NIM is the difference between interest income and interest expense %. LNSIZE is the natural log of bank's total assets. CAP is a measure of capital strength, calculated as equity to total assets. CR is a measure of credit risk and is the ratio of net loans to deposits and short-term funding. CM is the total operating cost to total income. LQ is a measure of liquidity, calculated as liquid assets to customer and short-term funding. MP is a measure of market power defined as the ratio of a bank total asset to the total asset of the entire banks in a country. Δ GDP is the annual percentage change in real gross domestic product. INF is the yearly growth in consumer price index. *, **, *** indicate significance at 10%, 5% and 1% level respectively.

Table 6: Fixed Effects- ROA as the Dependent Variable

	Column 1		Column 2		Column 3	
ROA	**Before the crisis (1999-2006)**		**During the crisis (2007-2009)**		**After the crisis (2010-2013)**	
	Coeff	T-Stat	Coeff	T-Stat	Coeff	T-Stat
LNSIZE	0.30	2.36***	0.35	2.58***	0.27	5.03***
CAP	0.04	2.95***	0.53	13.52***	-0.01	-0.70
CR	0.01	0.67	-0.10	-4.53***	-0.03	-2.24**
CM	-0.04	-23.93***	-0.06	-7.43***	-0.02	-3.59***
LQ	-0.01	-2.57***	-0.03	-4.04***	-0.02	-2.18**
ΔGDP	-0.02	-0.26	-0.89	-1.10	0.16	0.45
INF	0.01	0.25	-0.18	-2.17**	0.02	0.13
Cont	0.44	1.10	5.77	2.09**	-2.04	-0.37
R^2	70%		54%		27%	
F-stat	15.65***		4.20***		2.33***	
Obs	**856**		**356**		**461**	

ROA defined as profit before tax divided by total assets. NIM is the difference between interest income and interest expense %. LNSIZE is the natural log of bank's total assets. CAP is a measure of capital strength, calculated as equity to total assets. CR is a measure of credit risk and is the ratio of net loans to deposits and short-term funding. CM is the total operating cost to total income. LQ is a measure of liquidity, calculated as liquid assets to customer and short-term funding. MP is a measure of market power defined as the ratio of a bank total asset to the total asset of the entire banks in a country. Δ GDP is the annual percentage change in real gross domestic product. INF is the yearly growth in consumer price index. *, **, *** indicate significance at 10%, 5% and 1% level respectively. We deleted MP as it was not significant in any of the regression in this table.

Table 7: Fixed Effects- NIM as the Dependent Variable

	Column 1		Column 2		Column 3	
NIM	**Before the crisis (1999-2006)**		**During the crisis (2007-2009)**		**After the crisis (2010-2013)**	
	Coeff	T-Stat	Coeff	T-Stat	Coeff	T-Stat
LNSIZE	-0.25	-1.67*	0.22	5.55***	0.34	10.43***
CAP	0.01	0.05	0.08	4.80***	0.09	6.46***
CR	0.02	0.65	0.03	3.64***	0.01	1.80*
CM	-0.08	-6.52***	-0.01	-0.45	-0.01	-1.95**
LQ	0.06	3.84***	-0.01	-2.01**	-0.01	-0.81
MP	0.01	0.67	0.08	0.004	1.82	2.82***
ΔGDP	2.02	2.58***	0.69	1.98**	0.27	1.16
INF	-0.04	-0.52	0.15	4.62***	0.20	4.75***
Cont	**-3.98**	**-1.33**	**-0.42**	**-0.42**	**-3.23**	**-1.48**
R^2		**18%**		**74%**		**77%**
F-stat	**2.44*****		**8.51*****		**12.94*****	
Obs	**856**		**356**		**461**	

ROA defined as profit before tax divided by total assets. NIM is the difference between interest income and interest expense %. LNSIZE is the natural log of bank's total assets. CAP is a measure of capital strength, calculated as equity to total assets. CR is a measure of credit risk and is the ratio of net loans to deposits and short-term funding. CM is the total operating cost to total income. LQ is a measure of liquidity, calculated as liquid assets to customer and short-term funding. MP is a measure of market power defined as the ratio of a bank total asset to the total asset of the entire banks in a country. Δ GDP is the annual percentage change in real gross domestic product. INF is the yearly growth in consumer price index. *, **, *** indicate significance at 10%, 5% and 1% level respectively.

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Table 8: Fixed Effects- Comparison of ROA and NIM as the Dependent Variables

	Column 1		Column 2		Column 3	
ROA	**Before the crisis (1999-2006)**		**During the crisis (2007-2009)**		**After the crisis (2010-2013)**	
	ROA	NIM	ROA	NIM	ROA	NIM
LNSIZE	Yes (+)	No	Yes (+)	Yes (+)	Yes (+)	Yes (+)
CAP	Yes (+)	No	Yes (+)	Yes (+)	No	Yes (+)
CR	No	No	Yes (-)	Yes (+)	Yes (-)	No
CM	Yes (-)	Yes (-)	Yes (-)	No	Yes (-)	Yes (-)
LQ	Yes (-)	Yes (+)	Yes (-)	Yes (-)	Yes (-)	No
MP	No	No	No	No	No	Yes (+)
ΔGDP	No	Yes (+)	No	Yes (+)	No	No
INF	No	No	Yes (-)	Yes (+)	No	Yes (+)

ROA defined as profit before tax divided by total assets. NIM is the difference between interest income and interest expense %. LNSIZE is the natural log of bank's total assets. CAP is a measure of capital strength, calculated as equity to total assets. CR is a measure of credit risk and is the ratio of net loans to deposits and short-term funding. CM is the total operating cost to total income. LQ is a measure of liquidity, calculated as liquid assets to customer and short-term funding. MP is a measure of market power defined as the ratio of a bank total asset to the total asset of the entire banks in a country. Δ GDP is the annual percentage change in real gross domestic product. INF is the yearly growth in consumer price index. *, **, *** indicate significance at 10%, 5% and 1% level respectively. Yes (+) indicates statistical significance positive relationship. Yes (-) indicates statistically significant negative relationship and No indicates absence of statistically significant relationship.

Additional analysis

Table 9: Fixed Effect- Equal observations and 2008 as start of the crisis (ROA)

	Column 1		Column 2		Column 3	
ROA	**Before the crisis (2005-2007)**		**During the crisis (2008-2010)**		**After the crisis (2011-2013)**	
	Coeff	T-Stat	Coeff	T-Stat	Coeff	T-Stat
LNSIZE	0.27	4.60***	-0.09	-0.06	0.44	5.56***
CAP	0.04	1.17	0.26	5.35***	0.04	1.34
CR	-0.02	-2.38**	-0.07	-2.47**	-0.03	-1.90*
CM	-0.03	-11.42***	-0.01	-0.91	-0.01	-3.87***
LQ	-0.01	-1.68*	-0.02	-1.40	-0.01	-1.08
MP	-0.01	-0.91	0.01	0.54	-0.02	-1.68*
ΔGDP	-13.49	-2.51**	23.55	1.21	4.95	0.66
INF	-0.12	-3.49***	0.03	0.30	-0.01	-0.01
Cont	40.59	2.62***	-67.91	-1.19	-14.32	-0.64
R^2		68%		14%		**28%**
F-stat		6.99***		1.47***		**2.11*****
Obs		**369**		**369**		**369**

ROA defined as profit before tax divided by total assets. NIM is the difference between interest income and interest expense %. LNSIZE is the natural log of bank's total assets. CAP is a measure of capital strength, calculated as equity to total assets. CR is a measure of credit risk and is the ratio of net loans to deposits and short-term funding. CM is the total operating cost to total income. LQ is a measure of liquidity, calculated as liquid assets to customer and short-term funding. MP is a measure of market power defined as the ratio of a bank total asset to the total asset of the entire banks in a country. Δ GDP is the annual percentage change in real gross domestic product. INF is the yearly growth in consumer price index. *, **, *** indicate significance at 10%, 5% and 1% level respectively.

Table 10: Fixed Effect- Equal observations and 2008 as start of the crisis (NIM)

	Column 1		Column 2		Column 3	
NIM	**Before the crisis (2005-2007)**		**During the crisis (2008-2010)**		**After the crisis (2011-2013)**	
	Coeff	T-Stat	Coeff	T-Stat	Coeff	T-Stat
LNSIZE	0.23	4.86***	0.28	4.21***	0.36	7.39***
CAP	0.21	7.50***	0.07	3.04***	0.11	4.85***
CR	0.03	2.64**	0.03	2.06**	-0.01	-1.03
CM	-0.01	-3.12***	0.01	-0.15	-0.02	-2.36**
LQ	-0.02	-4.05***	-0.01	-2.09**	-0.01	-1.67*
MP	0.02	1.79*	-0.01	-0.57	-0.01	-0.22
ΔGDP	4.65	1.00	-9.19	-1.02	3.52	0.77
INF	-0.01	-0.44	0.03	0.55	0.02	1.08
Cont	-15.12	-1.14	26.38	1.01	-10.96	-0.81
R^2		88%		65%		**83%**
F-stat		21.89***		6.33***		**14.76*****
Obs		**369**		**369**		**369**

ROA defined as profit before tax divided by total assets. NIM is the difference between interest income and interest expense %. LNSIZE is the natural log of bank's total assets. CAP is a measure of capital strength, calculated as equity to total assets. CR is a measure of credit risk and is the ratio of net loans to deposits and short-term funding. CM is the total operating cost to total income. LQ is a measure of liquidity, calculated as liquid assets to customer and short-term funding. MP is a measure of market power defined as the ratio of a bank total asset to the total asset of the entire banks in a country. Δ GDP is the annual percentage change in real gross domestic product. INF is the yearly growth in consumer price index. *, **, *** indicate significance at 10%, 5% and 1% level respectively.

Table 11: ROE as an alternative measure of bank profitability

	Column 1		Column 2	
Dependent variable	**Fixed effects model ROE**		**Random effect model ROE**	
	Coeff	**T-stat**	**Coeff**	**T-Stat**
LNSIZE	1.39	4.50***	1.96	8.68***
CAP	0.54	3.22***	0.56	3.77***
CR	0.01	0.18	-0.05	-1.01
CM	-0.14	-5.17***	-0.16	-6.75***
LQ	0.21	0.65	0.04	1.34
MP	-0.01	-0.15	-0.02	-0.32
ΔGDP	-15.14	-1.20	-0.03	-0.02
INF	-0.12	-0.53	0.03	0.18
Cont	45.74	1.41	-1.49	-0.43
R^2		1%		7%
F-stat		6.16***		132.95***
Obs		1673		1673

ROE is defined as profit before tax divided by total equity. LNSIZE is the natural log of bank's total assets. CAP is a measure of capital strength, calculated as equity to total assets. CR is a measure of credit risk and is the ratio of net loans to deposits and short-term funding. CM is the total operating cost to total income. LQ is a measure of liquidity, calculated as liquid assets to customer and short-term funding. MP is a measure of market power defined as the ratio of a bank total asset to the total asset of the entire banks in a country. Δ GDP is the annual percentage change in real gross domestic product. INF is the yearly growth in consumer price index. *, **, *** indicate significance at 10%, 5% and 1% level respectively.

Table 12: Non-linear size relationship and interaction of operating cost & market power

	Column 1		Column 2	
Dependent variable	**Fixed effects model ROA**		**Fixed effect model NIM**	
	Coeff	**T-stat**	**Coeff**	**T-Stat**
LNSIZE	0.31	2.06**	-1.39	-2.64**
$LNSIZE^2$	-0.01	-0.85	0.06	2.21**
CAP	0.13	9.59***	0.11	2.32**
CR	-0.02	-3.10***	0.04	2.14**
CM	-0.04	-17.48***	0.07	8.36***
LQ	-0.01	-3.59***	0.04	4.02***
MP*CM	0.14	0.92	-1.39	-2.59**
ΔGDP	0.01	0.44	0.71	1.35
INF	-0.03	-1.90*	-0.12	-1.98**
Cont	0.22	0.67	2.61	2.18**
R^2		30		16
F-Stat	6.40***		3.32***	
Obs	1673		1673	

ROA defined as profit before tax divided by total assets. NIM is the difference between interests income and interest expense %. LNSIZE is the natural log of bank's total assets. $LNSIZE^2$ is the square of LNSIZE to capture the non-linearity of the relationship between size and profitability. CAP is a measure of capital strength, calculated as equity to total assets. CR is a measure of credit risk and is the ratio of net loans to deposits and short-term funding. CM is the total operating cost to total income. LQ is a measure of liquidity, calculated as liquid assets to customer and short-term funding. MP is a measure of market power defined as the ratio of a bank total asset to the total asset of the entire banks in a country. Δ GDP is the annual percentage change in real gross domestic product. INF is the yearly growth in consumer price index. *, **, *** indicate significance at 10%, 5% and 1% level respectively.