EFFECT OF RECAPITALISATION ON BANK EFFICIENCY AND PRODUCTIVITY
IN GHANA

BY

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DEPARTMENT OF FINANCE

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COLLEGE OF HUMANITIES

EFFECT OF RECAPITALISATION ON BANK EFFICIENCY AND PRODUCTIVITY IN GHANA.

BY

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THIS THESIS IS SUBMITTED TO THE UNIVERSITY OF GHANA, LEGON IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE AWARD OF MASTER OF PHILOSOPHY IN FINANCE DEGREE

DEPARTMENT OF FINANCE

JULY, 2019
DECLARATION

I do hereby declare that this work is the result of my own research and has not been presented by anyone for any academic award in this or any other university. All references used in the work have been fully acknowledged.

I bear sole responsibility for any shortcomings.

FAITH AGBEMAKOR

DATE

(10162231)
CERTIFICATION

I hereby certify that this thesis was supervised in accordance with procedures laid down by the University of Ghana.

..........................................................  ............................................

DR. LORD MENSAH  DATE

(LEAD SUPERVISOR)

..........................................................  ............................................

PROF. K. A. OSEI  DATE

(CO-SUPERVISOR)
DEDICATION

This work is dedicated to my beloved parents Cephas K. Agbemakor and Dzorgbenuiue Setsoafia, and my siblings for the encouragement and support during my period of studies.
ACKNOWLEDGEMENT

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I would like once again to convey my deep appreciation to all my colleagues who have helped and motivated me throughout the research. God bless you abundantly.
ABSTRACT
Several changes in recent times have characterised the business of banking in the world which solely relied on sufficient capital to implement minimum capital requirement and to ensure banks stay competitively. The Central Bank in Ghana noticed that the minimum required capital of banks as of 2008 was not sufficient to enable them to take more significant ticket transactions. It, therefore, augmented the minimum required capital of universal banks to GH₵ 60 million on 31st December 2009 and GH₵ 120 million for new entrants in 2012. The rational was that the existing banks have to increase their capital according to their risk appetite as the country has discovered oil and gas fields, which required much capital outlay for its operations.

This study evaluated the benefit derived from 2009 revised capital of the banking industry to the banks, the impact of the macroeconomic indicators such as inflation and the growth in GDP on the banking sector and the operations of foreign and domestic banks. It covered a 11-year period (from 2005 to 2015) with data from the Ghana Bankers’ Associations, which was cross-validated from the records of the Bank of Ghana. Twenty-Two (22) out of the twenty-six (26), representing 85% of banks that have a universal banking license, were used for the research. The data on inflation and GDP growth rate, which served as macroeconomic indicators, were obtained from the IndexMundi database. The first stage geometric averages based on DEA-MPI indicated that banks were more efficient before recapitalisation than after recapitalisation. Also, there was a cumulative increase in productivity by 3.2% from 2005 to 2009 while the period 2011 to 2015 witnessed a decrease of 1.2%. Foreign banks had overall efficiency from 2005 to 2015 at 69.8% compared to 53.6% for domestic banks. The second stage used the change in total factor productivity ($\Delta MPI$) as the dependent variable against LTA (logarithm of total assets), ROE (return on equity), LTD (loans to deposits ratio), NIETA (non-interest expenditure to total assets ratio), NIM (net interest margin), GDPGR (growth rate of GDP), and OWNERSHIP as the independent variables. It was found that ROE was higher in the pre-capitalisation period than in the post-capitalisation period, indicating superior efficiency and productivity in the pre-capitalization period.
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<th>Description</th>
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</thead>
<tbody>
<tr>
<td>ADB</td>
<td>Agricultural Development Bank</td>
</tr>
<tr>
<td>BOA</td>
<td>Bank For Africa</td>
</tr>
<tr>
<td>BARODA</td>
<td>Bank Of Baroda Gh Ltd</td>
</tr>
<tr>
<td>BoG</td>
<td>Bank Of Ghana</td>
</tr>
<tr>
<td>BCC</td>
<td>Banker Charles And Cooper</td>
</tr>
<tr>
<td>BBG</td>
<td>Barclays Bank Gh Ltd</td>
</tr>
<tr>
<td>BLUE</td>
<td>Best Linearly Unbiased Estimators</td>
</tr>
<tr>
<td>CAL</td>
<td>Cal Bank Ltd</td>
</tr>
<tr>
<td>CBN</td>
<td>Central Bank Of Nigeria</td>
</tr>
<tr>
<td>CCR</td>
<td>Charnes, Cooper And Rhodes</td>
</tr>
<tr>
<td>CRS</td>
<td>Constant Returns To Scale</td>
</tr>
<tr>
<td>DEA</td>
<td>Data Envelopment Analysis</td>
</tr>
<tr>
<td>DMU</td>
<td>Decision-Making Unit</td>
</tr>
<tr>
<td>ECOBANK</td>
<td>Ecobank Ghana Limited</td>
</tr>
<tr>
<td>FBL</td>
<td>Fidelity Bank Limited</td>
</tr>
<tr>
<td>FAB</td>
<td>First Atlantic Bank Limited</td>
</tr>
<tr>
<td>FNB</td>
<td>FNB Bank Gh Ltd</td>
</tr>
<tr>
<td>GCB</td>
<td>GCB Bank Limited</td>
</tr>
<tr>
<td>GDPGR</td>
<td>Gross Domestic Product Growth Rate</td>
</tr>
<tr>
<td>GTB</td>
<td>Guaranty Trust Bank (Ghana) Limited</td>
</tr>
<tr>
<td>HFC</td>
<td>HFC Bank Ghana Limited</td>
</tr>
<tr>
<td>IIJ</td>
<td>Interdisciplinary International Journal</td>
</tr>
<tr>
<td>IMF</td>
<td>International Monetary Fund</td>
</tr>
<tr>
<td>LTD</td>
<td>Loans To Deposits</td>
</tr>
<tr>
<td>LTA</td>
<td>The Logarithm Of Total Assets</td>
</tr>
<tr>
<td>MPI</td>
<td>Malmquist Productivity Index</td>
</tr>
<tr>
<td>MENA</td>
<td>Middle East and North African countries</td>
</tr>
<tr>
<td>NIB</td>
<td>National Investment Bank Limited</td>
</tr>
<tr>
<td>NIM</td>
<td>Net Interest Margin</td>
</tr>
<tr>
<td>NDIC</td>
<td>Nigeria Deposit Insurance Corporation</td>
</tr>
<tr>
<td>NIETA</td>
<td>Non – Interest Expenditure As A Proportion Of Total Assets</td>
</tr>
<tr>
<td>Bank Name</td>
<td>Abbreviation</td>
</tr>
<tr>
<td>----------------------------------------------</td>
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<tr>
<td>Prudential Bank Limited</td>
<td>PBL</td>
</tr>
<tr>
<td>Pure Technical Efficiency Change Index</td>
<td>PTECI</td>
</tr>
<tr>
<td>Return On Assets</td>
<td>ROE</td>
</tr>
<tr>
<td>Scale Efficiency Change Index</td>
<td>SECI</td>
</tr>
<tr>
<td>Societe-Generale (Sg) Ghana Limited</td>
<td>SG-SSB</td>
</tr>
<tr>
<td>Stanbic Bank Ghana Limited</td>
<td>STANBIC</td>
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<tr>
<td>Standard Chartered Bank Ghana Limited</td>
<td>SCB</td>
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<td>Stochastic Frontier Analysis</td>
<td>SFA</td>
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<td>Stochastic Frontier Analysis</td>
<td>SFA</td>
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<td>Technical Efficiency Change Index</td>
<td>TECI</td>
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<td>Technological Change Index</td>
<td>TCI</td>
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<td>Unibank Ghana Ltd</td>
<td>UNIBANK</td>
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<tr>
<td>United Bank For Africa (Ghana) Limited</td>
<td>UBA</td>
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<tr>
<td>Universal Merchant Bank Ghana Limited</td>
<td>UMB</td>
</tr>
<tr>
<td>UT Bank Ghana Ltd</td>
<td>UT BANK</td>
</tr>
<tr>
<td>Variable Returns To Scale</td>
<td>VRS</td>
</tr>
<tr>
<td>Variance Inflation Factor</td>
<td>VIF</td>
</tr>
<tr>
<td>Zenith Bank Gh Ltd</td>
<td>ZENITH</td>
</tr>
</tbody>
</table>
CHAPTER ONE
INTRODUCTION

1.1 Overview
This chapter of the study details the background of the research and outlines its main purpose. The chapter begins with a background to the study followed by a statement of the problem, research objectives, the research questions and hypothesis, the scope and significance of the work, as well as its limitations.

1.2 Background
Banks are significant partners in the economic development of developed, developing and emerging economies globally, of which Ghana is no exception. Banks, acting as financial institutions, perform the functions of mobilisation of excess funds from the public, assessing the risk of bank management, evaluating projects undertaken by their customers, as well as monitoring the activities of management and facilitating transactions (Schumpeter, 1911). Oino (2014) emphasizes that evaluating customers’ projects and facilitating financial transactions and financial intermediation are the essential purpose for the existence of banks. For banks to be able to perform the functions as highlighted by Schumpeter (1911) effectively, they have to operate in a regulated jurisdiction that ensures an equal opportunity for all banks. The central Bank of Ghana (BOG) introduced the Universal Banking Act in 2004, which required banks to have a minimum capital for their operation at GH₵ 7 million with a compliance of date 31st December 2006, (BoG, Annual Report, 2005).

As a condition for banks to obtain the Universal Banking License which permits them to provide banking operations as such, acceptance of deposits and granting of loans to clients, financial leasing activities, financial securities investments, money transmission, issuing and payment administration (including payment cards, cheques for travellers, bankers’ draft) as well as any other function Bank of Ghana may permit (Banking Act, 2004), in 2008 introduced a new operating capital of GH₵60 million. This the BOG hoped that the new capitalisation would promote healthy competition among the banks as it would come with innovation of banking technologies. This increase in the capitalisation
seemed inadequate as the country had discovered its oil and gas fields which required much capital outlay for operations. Subsequently, the central bank increased the required minimum capital for banking operations for new banks effective 31st of December 2013 to GH₵ 120 million and required existing banks to increase their minimum capital in proportion to their risk-level in order to be significant lenders to companies in the petroleum sector.

Bank of Ghana in September 2017 further increased the mandatory capital requirement of universal banks to GH₵ 400 million with the compliance deadline on the 31st of December 2018. The new capital requirement, the regulator believed, would "further develop, strengthen and support the Government's economic vision and transformation agenda" (Ghana Banking Survey, 2018). In the last decade, when the required minimum Capital was first increased to GH₵ 60 million in 2008, the industry was put on two-phase to compliance; the foreign banks were given two years while the local banks were given more lax time. All the banks met the 31st December 2013 deadline except two local banks (Ghana Banking Survey, 2017). However, the recent recapitalisation issued by the regulator brings a lot of controversy, fear and panic, among industrial players, the Ghanaian public and the representatives of local banks. The representatives of the local banks called on Government of Ghana to intervene for extension of the deadline, especially for local banks. The main difference between 2009 and the 2018 mandatory recapitalisation is while the latter had no phased deadline for any banks, the former had some laxity for the local banks, (Ghana Banking Survey, 2018).

Generally, the literature on bank recapitalisation and its effect on performance and productivity in Ghana is meagre. Only few studies have evaluated the effects of bank recapitalisation on the profitability of banks (Boahene, Dasah & Agyei, 2012; Akomea & Adusei, 2013; Kukurah, Alhassan & Sakara, 2014; Tetteh-Amemei, 2014). However, none of the studies in Ghana has looked at the effects of bank recapitalisation on the efficiency and the productivity of banks. Equally, in Nigeria, out of several studies that have examined the effects of bank recapitalisation on bank profitability,
only Dauda, Opeyimi and Gayinu (2017) assessed the effect of bank recapitalisation on efficiency and productivity of the banks.

A recent study in Japan has stated the significant role the effect of recapitalisation has on the efficiency and productivity of banks (Kasahara, Sawada & Suzuki, 2019). This study highlights that recapitalisation helped resource redistribution among high productive banks and low productive banks which helped less efficient banks to increase their productivity as the recapitalisation was effectively monitored by regulations (Kasahara, 2019). Also, Kale, Hasan and Selimler (2015) indicate that banks in Turkey improved their efficiency and productivity in light of tighter regulations which led to an increase in capital after 2001 financial crisis retrogressing the efficiency and productivity of banks in the country. Again, the importance of recapitalisation is emphasized by Degl’Innocenti, Kourtzidis, Sevic and Tzeremes (2017). They have established that bank efficiency and productivity improved in a subprime period when capital for operation was adequat but bank efficiency and productivity deteriorated during the period of 2008 global financial crises when banks were operating with inadequate capital. This suggests that it is important to determine the effect of recapitalisation on bank efficiency and productivity before seeking profitability of banks.

Further, considering that as a business organization, (including banks) to be profitable must operate productively to boost their efficiency. Productivity and efficiency are necessary and a sufficient requirement for a business organization stand up to competition and achieve its desirable profits. When a bank achieves its desirable level of productivity, it can be really difficult to change its productivity level but when a bank seeks profitability instead of attaining productivity first, it can easily change as factors that affect the profitability of a business at a point in time are variable. Productivity is significant to every bank, since it implies it could fulfill its obligations to its employees, shareholders and tax authorities and regulations as well as regulators and stay competitive, or perhaps even strengthen its competitiveness in the banking industry.
This forms the motivation to examine the effect of the 2009 recapitalisation on the efficiency and productivity of universal banks in Ghana in light of the announcement of the new minimum capital requirement with its compliance date of 31st December 2018. The study evaluated the efficiency and productivity of the entire banking sector. It further grouped banks into domestic and foreign banks and assessed their efficiency and productivity. The research also reviewed the influence of inflation and GDP growth rate and their effect on the performance of the banks. The local banks found it challenging to use the injection of fresh capital, retained earnings and offering of new shares to increase their capital base as a source of recapitalisation. The only option that appeared possible for them was business consolidation (Ghana Banking Survey, 2018).

1.3 Laws and Directives of Banking after Independence
After independence, there were three banks in Ghana: Bank of British West Africa (established in 1896, now operating as Standard Chartered Bank), Colonial Bank (created in 1917, now operating as Barclays Bank) and the Bank of Gold Coast (also established in 1953). The Bank of Gold Coast was disintegrated as the Bank of Ghana and the Ghana Commercial Bank after 1957, (Antwi-Asare & Addison, 2000). After 1957, there were various Acts by the central bank, but the first express law of the banking sector was the Bank of Ghana Act 339, which was promulgated in 1970. The law stated, among many other things, the minimum capital requirement of banks operating. The minimum regulatory capital requirement for local banks was fixed at ₵750,000.00 (which was equivalent to $735,300.00) and for foreign-owned banks ₵2,000,000.00 (which was equal to about $1,9660,800.00). This minimum requirement was in place until 1989 when new banking legislation was implemented. The government at the time enacted Legislative Instrument, LI 1329, to implement prudential directives in the banking sector, which gave birth to the Banking Law 1989 (PNDCL 225). This law brought new requirements of capital for both foreign and local banks – ₵200 million (about $740,700.00) for domestic banks and ₵ 500 million (about $ 1,851,850.00) for foreign banks, while the minimum capital requirement for development banks was ₵1 billion (about $3,703,700.00). The minimum capital was not reviewed until 1996 when the depreciation of the cedi...
against the dollar reduced the value of the ₵200 million. The equivalent of ₵200 million in 1989 was approximately $740,700.00 which reduced to about $117,000.00 in 1996. Capital adequacy ratio was 6% of adjusted risk assets and this required banks to maintain reserve funds when transferring annual profit, (Banking and Financial Law of Ghana (1998 - 2006), 2008).

The BOG enacted the Banking Act 2004 (Act 673), which brought the Universal Banking License and required banks to augment their minimum capital holding to ₵70 billion by the 31st of December, 2006. The year 2007 saw the redenomination of the Ghanaian currency with ₵10,000.00 equivalent to GHC 1.00. The Banking Act 2007 (Act738) introduced three types of banking licenses. They are General Banking License that grants the holder of this license the permission to perform Universal Banking activities and Off-shore Banking activities. Class 1 Banking License grant the holder of this license the authorization to undertake universal banking activities and Class 2 Banking License is for off-shore banking. The regulator reviewed the minimum capital upwards to GHC 60 million with 31st December 2009 deadline for foreign banks and 31st December 2012 for local ones. These were followed by several reforms from the year 2013 to 2018 in the effort to ensure sanity in the industry so that all banks in the country would operate with the same legal jurisprudence of the Ghanaian banking industry. These reforms, among many others, were implemented to ensure sanity, prudent accountability and improved financial environment in the Ghanaian banking industry and to boost investors and depositors' confidence in the banking sector in Ghana. Some of these reforms are stated below:

**Table 1. 1 Laws and Directives to Ensure Prudent Financial Sector Operations in the Ghanaian Banking Sector.**

<table>
<thead>
<tr>
<th>S/N</th>
<th>Date of Enactment</th>
<th>Law and Directive to Ensure Prudent Financial Sector Operations.</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>October 2018</td>
<td>Bank of Ghana Cyber and Information Directive</td>
<td>To ensure uninterrupted financial intermediation and to generate sufficient trust and confidence in the use of ICT and</td>
</tr>
<tr>
<td></td>
<td>Date</td>
<td>Directive</td>
<td>Description</td>
</tr>
<tr>
<td>---</td>
<td>------------</td>
<td>---------------------------------------------------------------------------</td>
<td>-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>2.</td>
<td>July 2018.</td>
<td>Fit and Proper Directive</td>
<td>To serve as a guideline for the Bank of Ghana and financial institutions to determine if an appointed individual is suitable and qualify for the position of a director of a bank as well as a significant shareholder.</td>
</tr>
<tr>
<td>3.</td>
<td>July 2018.</td>
<td>Mergers and Acquisition Directive; Exposure Draft</td>
<td>To see to it that the benefit of everybody, as well as the financial stability of the industry is assured in the events of Mergers and Acquisition.</td>
</tr>
<tr>
<td>5.</td>
<td>March 2018</td>
<td>Corporate Governance Directive (Revised Transactional Directive)</td>
<td>Seeks to provide ethical guidelines on the composition of board members and their qualification and makes information available to the board members.</td>
</tr>
<tr>
<td>7.</td>
<td>September 2017</td>
<td>New minimum Paid-up capital</td>
<td>To guarantee an extensive reform in the banking sector and to speed up, rejuvenate and enhance the financial industry in support of government transformation agenda and national economic policies without the aid from donor partners.</td>
</tr>
</tbody>
</table>
9. July 2016  Bank and Specialized Deposit-Taking Institution Act, 2016 (Act 930)  This act seeks to prevent a bank, financial holding entity, or specialized credit institution which has its required mandatory minimum capital is lower than what the BOG has stated from the institutional placement of funds, loanable funds, institutional deposit or using mergers and acquisition to increase their capital adequacy except with express written permission from the Regulator.

10. July 2016. Consumer Protection Act 2016 (Act 931)  To protect depositors from unforeseen circumstances that might result in loss of deposited funds

11. June 2016. Guideline for Financial Publication of banks & BoG Licensed financial institutions  Requires all licensed banks and other institutions licensed by the Bank of Ghana to adopt the full presentation formats for financial reporting.

Source: The author assembled them from the Bank of Ghana’s different acts.

1.4 Problem Statement
Empirical studies in the banking industry have generally assessed the ownership structure of banks, bank recapitalisation, bank performance evaluation and bank profitability. Some of these include bank productivity (Bokpin 2013; Alhassan, 2015), bank profitability (Owusu-Antwi, Mensah, Cabbre & Antwi, 2015), relations between capital and bank performance (Kumi, Amaomah & Wilful, 2013), bank profitability determinant (Munyamborena, 2013), bank governance, regulation and risk-taking (Bokpin, 2015) and performance evaluation of local and foreign banks (Ntow-Gyamfi & Laryea, 2012).

Only four studies have assessed the effect of the increase in minimum capital on bank productivity to the best of our knowledge (Boahene, Dasah & Agyei, 2012; Akomea & Adusei 2013; Kukurah, Alhassan & Sakara 2014). The relationship between intellectual capital and bank productivity was the only study similar to bank recapitalization and bank productivity (Alhassan & Asare, 2016). However,
none has evaluated the effects of bank recapitalisation on efficiency as well as on productivity of banks. Similarly, in Nigeria, several studies have been conducted to assess the impact of the 2005 recapitalisation (Dauda, Opeyimi & Gayinu 2017; Oluinta, 2015; Sani & Alani, 2013; Adegbaju & Olokoyo, 2008). Nonetheless, only Duada et al. (2007) has examined the effect bank recapitalisation has on the efficiency and productivity of banks in Nigeria. In Ghana, Tetteh-Amemei (2014) has studied the effect of recapitalisation and its impact on banks’ performance with 2009 as the base year of his study in which he used 22 banks as his sample size, representing about 82% of the total population of banks. However, his findings differ from those of the other three researchers from Ghana (Boahene, Dasah & Agyei, 2012; Akomea & Adusei 2013; Kukurah, Alhassan & Sakara 2014). Boahene et al. (2012) and Kukurah et al. (2014) used only two banks as the sample size for their study. None of these studies examined the efficiency and productivity of the recapitalised banks. Given that efficiency and productivity are prerequisites for the profitability of a business enterprise, it is important to determine the efficiency and productivity of the banks before seeking their profitability.

Nonetheless, no research has evaluated the efficiency and productivity of each bank as a decision-making unit (DMU), assessed the technical efficiency and pure technical efficiency of each bank, and assessed the overall year by year change in total factor productivity of the banks to determine the technological change and technical efficiency change. Further, no study has examined the performance of the banking industry on the basis of their ownership structure before and after 2009 bank recapitalization (for the best of my knowledge). As the Bank of Ghana stated a different timeline for the recapitalisation in 2009, it is good to determine if the difference in the timeline could impact the efficiency and productivity of banks differently.

Comparison between local banks and overseas banks would assist the study in discovering the significant variables that affect local banks' efficiency following the increase in the minimum capital requirement, according to the Bank of Ghana's announcement.
1.5 Purpose of the study
This research aimed to evaluate the impact of the increase in the minimum capitalisation of banks in 2009. The study looked at each bank from the perspective of being a decision-making unit and evaluated their efficiency using the CCR and the BCC model of Data Envelopment Analysis (DEA). This enabled the study to assess the production and administrative efficiency of the various banks and to further decompose production and administrative efficiency into scale efficiency. The study further considered the ownership structure of the banks as two units – local and foreign banks – to determine which unit performed better during the period of the research. Considering everything, the study evaluated the overall productivity change using the Malmquist Productivity Change (MPI) before and after recapitalisation and assessed the effect of inflation rate and effect of GDP growth rate on the performance of banks. The study further evaluated the lax in the time given the local banks in 2009 recapitalisation and the effect it had on their operations. This helps appreciate the fact that mandatory recapitalisation must be uniform for all banks no matter the ownership structure, as stated in the 2018 recapitalisation (Ghana Banking Survey, 2018).

1.6 The objectives of the study
The objectives of this study were:

1. To examine the impact of the 2009 recapitalisation of universal banks in Ghana, the productivity and efficiency of these banks;
2. To assess the performance of local banks and foreign banks before and after the 2009 recapitalisation.
3. To evaluate the impact of the macroeconomic indicators on the performance of banks before and after the 2009 recapitalisation of the Ghanaian banking industry.

1.7 Research Questions
This research was pioneered by the following research questions that helped investigate the phenomenon stated above.
1. Is there any significant difference between the efficiency and productivity of banks before and after the 2009 recapitalisation of the Ghanaian banking sector?

2. Is there any significant difference between the performance and efficiency of foreign and local banks before and after the 2009 recapitalisation?

3. Do the macroeconomic indicators have any significant influence on the productivity change as well as on the performance of the banking industry before and after the 2009 recapitalisation?

1.8 Research Hypotheses
In conformity to the tabulated objectives of the study, the following hypotheses were formulated:

\[ H1_0: \] There is no significant difference between the performance and efficiency of banks before and after the 2009 recapitalisation.

\[ H1_A: \] There is a significant difference between the performance and efficiency of banks before and after the 2009 recapitalisation.

\[ H2_0: \] There is no significant difference between the performance and efficiency of foreign and local banks before and after the 2009 recapitalisation.

\[ H2_A: \] There is a substantial difference between the performance and efficiency of foreign and local banks before and after the 2009 recapitalisation.

\[ H3_0: \] Macroeconomic indicators have no significant influence on the performance of banks before and after the 2009 recapitalisation.

\[ H3_A: \] Macroeconomic indicators have a significant influence on the performance of banks before and after the 2009 recapitalisation

1.9 Significance of the Study
There has been a lot of studies on the banking industry over the past decade though there is no research that evaluates the impact of the 2009 recapitalisation on productivity and efficiency of Ghanaian local
banks and their foreign counterparts. Besides, no study to the best of the researcher’s knowledge has investigated the individual banks as a DMU in Ghana. This study has considered each bank as a Cost Center, which incurs cost during their business operating. Their operating cost and revenue generated during the study period were evaluated.

The importance of this study is seen from the research and for policy perspectives. This study extends beyond several kinds of studies that focused on the effectiveness of local and foreign banks, the performance of banks and their ownership structure, recapitalisation, and productivity before and after their recapitalisation in 2009. It further serves as a tool of information for industrial players who may wish to make any decision in the future on recapitalisation, bank ownership and bank performance. The study also serves as a guideline for the government and the central bank, going into the future on the issues of future recapitalisation and its impact on the banking sector in Ghana. Besides, the evaluation of each bank as a DMU can provide a suitable basis for classifying banks operating in the country, rather than using accounting and financial ratios as indexes and efficiency scores are superior for performance ranking than ratio. The research is therefore particularly important since the results will contribute to the compilation of information within academia, in so far as the recapitalisation of banks, particularly in the Ghana-based banking industry, is concerned and will provide a source of information on how banks carried out their operation after the 2009 recapitalisation.

**1.10 Scope of the Study**

The data for the research was confined to the office of the Bank of Ghana and the headquarters of sampled banks in the country. The study covered eleven years, from 2005 to 2015. The year 2005 was chosen because it enabled the study to use sufficient duration, which was not used by earlier researchers. The study used 22 banks which had sufficient data covering their operation from 2005. The specific focus of the research was the 2009 recapitalisation. Thus, five years of pre-capitalisation period and five years post-capitalisation period were evaluated. The study assumed each bank as a
DMU, and its profitability and efficiency analysed using the DEA-based Malmquist Index to rank their performance and efficiency.

1.11 Limitation of the study
There are usually difficulties associated with academic studies; this study is no exception. In the first place, the investigator faced issues in the gathering of data. As the study was confined to the head offices of banks operating in Ghana, the headquarters of the central Bank of Ghana and the Head Office of the Ghana Bankers’ Association, at this point, many financial resources were needed to perform information collection. This did not, however, deter the conduct of this academic study.

1.12 Definition of Terms

**Profitability** is the extent to which a business organisation or a firm earns a financial return on its investment. It is defined by Nimalathasan (2009) as the propensity to again a return from the use of a given amount if investment. The profitability of banks is mainly influenced by the charges levied against the customer's commission received from their financial assets. Tan and Flores (2014) state that “the Return on Equity (ROE) and Return on Assets (ROA)” are the primarily the two indicators of profitability of a businesses.

**Recapitalisation** is the restructuring of the capital composition of a business organisation which helps at increasing the capital structure of a business in order to improve the financial stability of firms or the organisations. It is mostly done by altering the debt and equity combination of a firm. It is defined by Adegbaju and Olokoyo (2008) as the process of growing the debt stock of the business organisation, issuing of additional shares to both old and new shareholder to enhance the capital level of a company.

**Technical Efficiency** is the capability of a firm or business organisation to equi-proportionately reduce all inputs at a given output level and technology input-conserving or ability to radially expand all outputs at a given inputs level and the technology of production. (out-augmenting orientation), (Khrystoforova, 2017).
1.13 Chapter Disposition
The study is organised into five chapters. Chapter one provides background and overview of the study, states the problem statement, presents research questions and objectives as well as hypotheses. Other items included in Chapter one are the significance of the study, the scope of the research and the limitations of the study.

The second chapter deals with a review of both theoretical and empirical literature on recapitalisation. Arguments, criticisms, deductions and analysis made about recapitalisation are evaluated and examined in order to make inferences from them.

The third chapter of the research is devoted to the methodology used. The design of the study, the target population and the sample size, as well as the procedure for data collection are discussed. It also outlines the statistical software used to carry out the work as well as analytical techniques and study instruments used.

In chapter four, the study presents its findings and discussions of the results. The fifth chapter summarises the findings, makes conclusions and recommendations as well as proposal for further studies.
CHAPTER TWO
LITERATURE REVIEW

2.1 Introduction
Theoretical and empirical studies on bank efficiency and productivity as well as bank recapitalisation that aims at supporting distress banks in times of financial crises and how these actions impact profit productivity and bank efficiency are discussed in this chapter. The theoretical literature reviews theories that suggest various methods of raising capital for business operations. On the other hand, the empirical review evaluates published literature on bank efficiency and productivity, productivity of foreign and domestic banks and bank recapitalization and performance. Observably, there is not much literature on bank recapitalization and bank productivity.

2.2 Theoretical Literature Review

2.2.1 Modigliani and Miller Propositions I & II
The composition of capital for financing business operations in the literature was first attributed to Modigliani and Miller (1958), when they stated that the combination of debt and equity to fund business operations is inconsequential and hence referred to it as the irrelevance proposition. They argued that information symmetry and perfect financial market make it possible for every player to have every available information. Thus, the way leverage impacts a company’s value is an irrelevant proposition. In 1963, Modigliani and Miller (M & M) proposition I was expanded to include corporate income tax, giving birth to proposition Modigliani and Miller II (1963). As stated by Modigliani and Miller II (1963), the component of the corporate income tax suggests that debt is more referred to as equity because of tax deductibility that comes with debt. However, 100% of debt financing is also associated with bankruptcy cost and therefore, a combination of both debts and equity that would ensure the minimum cost of capital to yield the maximum returns must be used.

2.2.2 Static Trade-Off Hypothesis
The static trade-off hypothesis is developed from the M & M propositions II by Modigliani and Miller. This hypothesis posits that a company's debt payments are tax-deductible, which indicates that using
debt to finance business operations is less risky as compared to equity as a source of funding for business operations. The theorem argues that with debt having a lower risk than equity, it makes debt financing cheaper than equity financing. Therefore, a lower Weighted Average Cost of Capital (WACC) can be arrived at with more debts than equity in the capital mix of companies. The static trade-off theory, therefore, identifies a mixture of debt and equity where the decreasing WACC offsets a company's growing financial risk.

2.2.3 Trade-Off Theorem

Kraus and Litzenberger (1973) suggest that the proportion of debt and equity that will ensure a trade-off between the tax benefit of debt and the deadweight of bankruptcy cost must be determined in selecting the right balance of debt and equity to be used in the financing, leading to the origination of the trade-off theory. It states that the financing of corporations is partly proportionate to debt and equity. Thus, the cost and benefits associated with both will determine the combination to use. Myers (1984) states that corporations work towards achieving equilibrium of debt tax shields and bankruptcy cost and, therefore, use the trade-off theory to achieve the best debt–to–equity ratio.

2.2.4 Pecking Order Theorem

To corroborate the trade-off theory is the concept of pecking order proposed by Donaldson (1961), and updated by Myers and Majluf (1984). It states that there is a hierarchical order in choosing financing options available to corporations and the financing cost increases as information becomes asymmetrical. From the perspective of the concept of the pecking order hypothesis, Myers (1984) emphasises that retained earnings should be the first as a better option for financing due to adverse selection. If retained earnings are exhausted, then the next hierarchical order is debt financing and the last option is issuing of equity. Accordingly, retained earnings are better than debt financing, and debt financing is better than equity financing (Frank & Goyal, 2003). According to Myers (1984), the source of funding used to provide capital for business operations sends a signal to the public and investors in the financial market because of information asymmetry. The use of retained earnings
suggests the company is doing well and has sufficient funds available for investment. The use of debts suggests responsibility on the part of management to a high level, confident of meeting the fixed interest payment periodically. The issuing of equity as a source of financing is a signal to the market that since stocks value are perceived to be higher than their actual value, the firm is overvalued (Cadsby, Frank & Maksimovic, 1990).

2.2.5 Signalling Hypothesis

The signalling theory emerged from the fact that managers have private information that enables them to issue equity and there is asymmetry information that is available to investors. Ergo, their decision sends a signal to the financial market. The theory was attributed to Akerlof (1970), it was first used it in the labour and product market and was later developed and modified by Spence (1973), who argued that firms are classified based on the quality of their capital to financial market participants based the signal sent to issue equity. According to Spence (1973), a higher level of capital is an indication of an excellent prospect to the market that the company’s valuation is better than other competitors in the industry. Consequently, Ross (1977) establishes that issuing of more debts to increase capital is a signal that a firm is doing well as compared to its competitors while a lower level of debts shows a lower level of capital which is an indication that a firm is not doing well relative to its competitors. From the banking perspective, signalling theory suggests that raising capital level is an indication of a better market value of the bank, (Berger, 1995; Ommeren, 2011; Saona, 2011; Trujillo – Ponce, 2012).

2.2.6 Bankruptcy Cost Hypothesis

From the analysis of the trade-off theory, where the bankruptcy cost is a factor in determining the combination of funding, the expected cost of bankruptcy plays a significant role in bank financing. Berger (1995) establishes that if the expected cost of bankruptcy is at a minimum level, banks hold onto more equity as their source of capital as a means of supporting them in financial distress. It,
therefore, suggests that the bankruptcy cost hypothesis is positively related to the profitability of the bank in much the same way as the signalling hypothesis.

2.2.7 Risk-return hypothesis

In contrast, if a bank increases its leverage, its expected profitability will increase as well but it will be linked to a greater degree of risk. Therefore, according to the risk-return hypothesis, higher risks that come as a result of more leveraging of a company results in higher anticipated yields. In a nutshell, capital of banks as measured by equity to assets will decrease if the profit is expected to be high as banks hold on to more risks. It, therefore, establishes that there is an inverse association concerning capital and bank profitability (Dietrich & Wanzenrid, 2009; Hua & Li, 2010; Saona, 2011; Sharma & Gounder, 2012).

Hence, the process of raising capital to increase the capital stock when there is a mandatory announcement of recapitalisation and its effects on banks’ performance and profitability depend on the signals sent to investors and shareholders, the expected bankruptcy cost in using debt stock and on the expected returns that are associated with high-risk investment portfolios.

2.3 Empirical Literature Review

2.3.1 Evaluation of Banking Sector Efficiency and Productivity

Productivity is the assessment of various methods of productivity of production unit measured at a rate of output per unit. According to Daraio and Simar (2007), productivity evaluation of a production unit is the assessment of the efficiency frontier of a firm which has the potential to optimize its production resources to achieve maximum output given its inputs or to minimize its input at a given output level. The productivity and efficiency assessment of a decision making-units (DMUs) in academic studies have been attributable to earlier researchers in the 1950s (Debreu, 1951; Koopmans, 1951; Malmquist, 1953; Farrell, 1957). Two methods are commonly used to evaluate the efficiency and productivity of DMUs: a parametric approach that uses the production cost or profit frontier to
establish the productivity and the efficiency of a DMUs (Aigner, Lovell & Schmidt, 1977; Meeusen & Vandenbroeck, 1977). This method is called the Stochastic Frontier Analysis (SFA). On the other hand, a non-parametric procedure that uses the cost of production or the profit margin to measure efficiency, as well as the productivity of a DMUs is called the Data Envelopment Analysis (DEA) (Charnes, Cooper & Rhodes, 1978; Banker, Charnes & Cooper, 1984; Deprins, Simar & Tulkens, 1984).

Between the two methods for assessing efficiency, DEA has gained prominence over the years, especially in the field of finance, together with the Malmquist Productivity Index (MPI), used for evaluating change in productivity. Several studies have employed the DEA with MPI to assess the efficiency and productivity change of DMUs, notably in the banking sector (Henriques, Sobreiro, Kimura & Mariano, 2018; Jiang & He, 2018; Kamarudin, Chiun, Sufian & Anwar, 2017; Dauda, Ibrahim & Ganiyu, 2016; Kamarudin, Sufian & Nassir, 2016; Stewart, Matousek & Nguyen, 2016; Wanke, Barros & Emnouznejad, 2016b; Yilmaz & Gune, 2015; Sufian, 2011; Mathew & Zhang, 2010).

Berg, Forsund and Jansen (1992) evaluated the technical efficiency and total productivity change of banks from Norway, Finland and Sweden during the period 1980 to 1989 when the Norwegian banking system was deregulated. The study used DEA with MPI and obtained 53% growth in productivity for Finnish banks, 57% growth in productivity for Norwegian banks and 78% growth in productivity Swedish banks. The study did not decompose the total productivity change into technical change and technological change to assess the impact it has on the growth in total factor productivity.

Thota and Subrahmanya (2019) assessed the efficiency and change in total factor productivity of 53 banks in India between the period 1992 and 2018. The study employed the DEA with MPI to assess the efficiency and productivity convergence. The study established that public banks recorded higher productivity convergence than foreign and private banks, respectively. However, the study failed to decompose the total factor productivity change as measured by MPI into technical efficiency and
technological change to ascertain the main driver of total productivity. Similar to Thota and Subrahmanya (2019) is a study conducted by Mansour and Moussawi (2018) in selected Arabian countries from 2000 to 2014 to assess the efficiency and change in productivity using DEA with MPI. It established that technical efficiency was 13%, allocative efficiency was 21% while cost efficiency was 30%. The total productivity measured by MPI increased by 2.44%. This study also failed to decompose the total factor productivity change as measured by MPI into technical efficiency and technological change to ascertain the main driver of total productivity. Earlier researchers in eleven (11) Arabian countries by Moussawi and Saad (2008) established that average efficiency score was between 87% and 95% while total productivity grew in the range of 2% to 7% between 1994 and 2004. Unlike Thota and Subrahmanya (2019) and Mansour and El Moussawi (2019) who used non-parametric method of DEA with MPI which have the ability of integrating efficiency scores in pure technical efficiency and scale technical efficiency as well as decomposing the total productivity change to technical progress and technological progress, Moussawi and Saad (2008) did not do so to enable the study to indicate the various forms of progress.

On the other hand, Suzuki and Sastrosuwito (2011) and Anwar (2019) assessed the efficiency and total productivity change of the Indonesian banking industry at different periods. Anwar (2019) evaluated the cost efficiency of the Indonesia banking industry with SFA and Tobit regression. The study noted that banks’ average cost efficiency deteriorated during the study period but failed to identify the main driver of the decline in the banking industry's cost-effectiveness. Suzuki and Sastrosuwito (2011) employed DEA combined with MPI in assessing the efficiency and productivity improvements of 70 banks in Indonesia between 1994 and 2008. The study found the banks have operated at 86.6% efficiency level while productivity grew by 0.5% on average per annum. The research established that productivity growth was supported by 1.7% technological progress per annum coupled with an annual decline of efficiency by 1.1% per annum.
The productivity of Europeans banks was assessed using the MPI during three different periods: 2007 – 2008 subprime crisis, 2009 to 2010 global financial crisis and 2011 to 2012 sovereign debts crisis, (Degl’Innocenti, Kourtzidis, Sevic & Tzeremes, 2017). The study found that productivity improved during the subprime crisis period of 2007 to 2008 but declined in the global financial crisis period of 2009 to 2010 and in the sovereign debt crisis of 2011 to 2012. This study unsuccessfully did not decompose the productivity change into technical change and technological change to determine what accounted for the improvement in the subprime period and the decline in the global financial crisis as well as the sovereign debt crisis.

A deeper analysis of the banking operations in China to assess the convergence of technical efficiency and productivity change between the period of 1997 to 2007 was conducted which found that the growth of total factor productivity was between 3.5% and 20.3% averagely during the period of the study, (Matthews & Zhang, 2010). The growth in the total factor productivity was attributed to improved technological progress (Matthews & Zhang, 2010). The study, however, did not indicate whether technical change decreased or remained constant over the period. It also, failed to reveal the contribution of technical efficiency to the improvement in the technological progress of the banks. The findings of Matthews and Zhang (2010) was similar to their compatriots, Tan and Floros (2013) between 2003 and 2009 who established that technical efficiency was about 89% while productivity increased by 0.6%. Similar to Matthews and Zhang (2010), Tan and Floros (2013) never decomposed the change in total factor productivity into technological progress and technical progress.

Henriques et al. (2018) assessed the efficiency and productivity change of the Brazilian banking industry from 2012 to 2016 using both CCR model and the BCC model. Their findings show, on average, 51.4% efficiency score for the CCR model and 69.8% efficiency for the BCC of a sample of 37 banks. Jiang and He (2018) evaluated the efficiency and productivity of 17 listed banks on the Chinese Stock Exchange from 2012 to 2017 using DEA – MPI. Their results indicate that 12 banks improved their technical efficiency, three of which had their technical efficiency remain the same
while there was 1.0% drop in technical efficiency of two banks. Kamarudin, Chiun, Sufian and Anwar (2017a) assessed Islamic banks’ efficiency and productivity change in Southern Asian countries with a two-stage procedure using the BCC model of DEA combined with MPI and panel regression and concluded that the efficiency scores and productivity change of the evaluated DMUs increased during the period. The efficiency of banks in Vietnam over eleven years (between 1999 and 2009) was assessed using both CCR model and the BCC model of DEA with bootstrap regression and established that the efficiency of banks is directly associated with bank size, (Stewart, Matousek & Nguyen, 2016). The research established that the larger the bank, the greater the performance rating and efficiency scores. Similarly, Yilmaz and Gune (2015) assessed the pure technical efficiency of Islamic banks in Turkey between 2007 and 2013 using the CCR-1 and BCC-1 model of DEA. The findings show that some of the Islamic banks are inefficient, while others are efficient. In Sufian’s (2011) findings establish that the reduction in efficiency of banks in Malaysia was essentially due to technological decline and not a decline inefficiency. The study covered 11 years from 1994 to 2004 using DEA.

In Africa, the study on the efficiency and productivity in the banking sector is scanty. Kamau (2011) used DEA with MPI to assess the productivity and efficiency of 40 commercial banks in Kenya between the period of 1997 and 2009. The study established that the financial industry was not 100% efficient due to inadequate technological progress and challenges of economies of scale. The 2008 global financial crisis and non-performing loans were noted to have been the major contributor to the decline in productivity of four banks considered as the biggest in South Africa, (Maredza & Ikhide, 2013). However, the total factor productivity of the banks progressed because of factors such as size of the banks, non-interest income and operational efficiency. The study employed the Hicks-Moorsteen Index on bank data of the four banks from 2000 to 2010 (Maredza & Ikhide, 2013. Further, Dauda et al. (2016) examined the benefit of recapitalisation in Nigeria using DEA. They found that most banks achieved 100% efficiency and increased productivity after recapitalization, outperforming
the periods before the recapitalization. Wanke, Barros and Emnouznejad (2016b) studied bank efficiency by using fuzzy DEA in Mozambique from 2001 to 2011. They found that factors such as capital cost, labour cost, inflow of deposits and loan advance helped explain efficiency better. They argued that for banks to increase their efficiency, their human capital compensation of employees should be reduced. A recent study by Nartey, Osei and Sarpong-Kumankoma (2019) on bank productivity in Africa revealed that the decrease in bank productivity in Africa was mainly accounted for by inadequate technological progress. The study, however, did not discover the contribution of technical change to total productivity change of the banks. This study employed biennial MPI with regression analysis using 120 banks from 24 African countries between the period of 2007 and 2017. These findings confirm an earlier study by Kamau (2011) in Kenya.

In Ghana, Isshaq and Bokpin (2012) examined the influence of profit expansion on the cost-effectiveness of banks using the SFA and found that profit efficiency of banks is not associated with bank location, the size of banks or the cost of operation and profitability ratios. However, estimating efficiency scores using SFA is presumed to be unrealistic as it requires single input with multiple outputs or multiple inputs with a single output (Odeck, 2007), unlike DEA that uses multiple input and output at the same time. Likewise, Bopkin (2013) used SFA to examine the profit and cost efficiencies 26 commercial banks in Ghana from 1999 to 2007. The study found the foreign-owned banks to be more cost-efficient than the locally owned banks. However, he observed that the foreign banks were inevitably not the most efficient in terms of profitability. Akoena, Aboagye and Antwi-Asare (2013) assessed the technical and scale efficiencies of the 16 universal banks in Ghana using DEA 2000 and 2006. The study established the size of banks is inversely proportional to their efficiency as that smaller banks recorded 98% efficiency while were larger banks 97.7% efficiency. The very first study in Ghana, that evaluated bank efficiency and productivity using DEA with MPI that enabled it to decompose efficiency into scale efficiency change, technological change and pure efficiency change was by Alhassan (2015). The study established that productivity progress was due
to diversification of income while market concentration led to retrogression of productivity (Alhassan, 2015). None of the reviewed literature considered the effect of an increase in minimum capital requirement on the productivity of banks. This study addressed the impact of recapitalization of the banking sector on the efficiency and productivity of banks taking each bank as a DMU. The study further integrated overall efficiency into technical efficiency, scale efficiency and pure technical efficiency to determine if is due to superior production or increase in an administrative capacity in the banking sector. It further decomposed the total productivity into technological progress and technical efficiency change as in the case of Alhassan (2015). This current study therefore basically evaluated the effect of the 2009 recapitalisation of banks on the efficiency and productivity considering each bank as a DMU, their ownership structure and the Ghanaian banking industry as a whole.

2.3.2 Evaluation of Profit-Oriented Efficiency and Productivity of Banks

Nearly, all available studies on efficiency and productivity of banks have paid much attention to technical efficiency and productivity, cost efficiency and productivity as well as revenue efficiency and productivity. A couple of studies that assessed profit-oriented efficiency and productivity of banks include Nahm and Vu (2013), Juo et al. (2016), Restrepo-Tobón and Kumbhakar (2017) as well as Restrepo-Tobon and Sánchez-González (2018).

Nahm and Vu (2013) assessed the efficiency and productivity of 56 Vietmanse deposit-taking institutions from 2000 to 2006 and found the productivity growth of Vietnamese banks was moderate due to improved technological progress and technical efficiency. However, scale efficiency negatively affected productivity growth. The study further found central bank policies such as minimum capital requirement and regulation on deposit-taking do not affect the productivity growth of the banks. Unlike Nahm and Vu (2013), Juo et al. (2016) used Slack-Based Measurement (SBM) procedure to evaluate profit productivity. This study, however, ignored the exogenous factors that accounted for the growth in the profit productivity of banks despite using inputs and outputs that determine total revenue and total expenses of the banks.
Also, Restrepo-Tobón and Kumbhakar (2017) used a new methodical approach to demonstrate how overall profit efficiency is a function of revenue and cost efficiencies using data from the US banking industry from 2000 to 2010. The study established that profit efficiency was 96.5%, while 3.5% of profit inefficiency was as a result of 1% revenue inefficiency and 2.5% cost inefficiency. It further established both cost and revenue efficiencies are related to profit efficiency and productivity and not to each other. The study, however, never stated the effect of technological progress and change in technical efficiency on bank productivity.

Contrary to Restrepo-Tobón and Kumbhakar (2017), Restrepo-Tobon and Sánchez-González (2018) estimated the profit efficiency and profit productivity banks in Colombia from 2001 to 2013 by computing revenue and cost efficiencies independently. The procedure used solves the misspecification challenges of the traditional non-standard profit function. The study found profit efficiency and productivity to have improved significantly as a result of improved revenue efficiency. Similar to Restrepo-Tobón and Kumbhakar (2017), it was further established that cost and revenue efficiencies are related to profit efficiency and productivity and not to each other.

The current study looked at profit efficiency and profit productivity of the Ghanaian banking sector as a result of the 2009 recapitalization by considering the operating revenue and the operating cost of the banks.

2.3.3 Efficiency and Productivity of Domestic and Foreign Banks

Assertions explaining the difference in the efficiency and productivity between foreign and domestic banks based on the banking literature has been established in the past decades (Havrylchyk, 2004; Sturm & Williams, 2004; Oguchi et al., 2007; Yao, Han & Feng, 2008). The efficiency and profit productivity of domestic banks versus their foreign counterparts usually depend on the economy in which the banks operate. In developed economies, host or domestic banks strive and perform better than foreign banks. On the other hand, foreign banks usually perform better than the domestic ones in

Bouzgarrou et al. (2018) examined the profit productivity of foreign and local banks in the French financial industry during the 2008 financial crises which spanned from 2000 to 2012. The results indicate that foreign banks did better than local banks while the foreign banks from advanced economies had superior performance than those from emerging economies. The study further proved with its robustness check that lagged profit productivity had a positive effect for foreign banks while it had negative effects for domestic ones in the study that used 105 domestic banks and 65 foreign banks and employed return on assets, return on equity and net interest margin as a proxy for profitability (Bouzgarrou et al., 2018). Their findings were not different from those of Luo, Dong, Armitage and Hou (2015) in another developed economy, China. They employed an index of foreign bank branch index that captured the geographical proximity of banking competition. In three classification of the commercial banks in the Chinese banking sector, the index rated the foreign banks higher than the domestic ones in terms of improved profit productivity and banking efficiency (Luo, Dong, Armitage & Hou, 2015).

Habib (2015) assessed the efficiency and profit productivity of banks in Pakistan from 2009 to 2013 to determine if the military regime and the revolutionary transition in the banking industry have any influence on the performance of the banking industry. The study divided the banking sector into four: public banks, private banks, specialised banks and foreign banks (Habib, 2015). The study found that domestic, public and private commercial banks performed better than foreign banks on the scale of analysis that ranked banks according to the values of their average total and fixed assets, return on equity as well as average operational assets. However, foreign banks did better on their return on fixed assets than domestic banks (Habib, 2015).

In a comprehensive research conducted by Uiboupin (2004) among ten Central and Eastern European (CEE) countries that involved 219 banks, findings indicate that the entry of foreign banks had a lower
impact on the profit productivity on the local banks and further increased the administrative cost of banking transaction. In Saudi Arabia, Saif-Alyousfi, Rohani and Asish (2017) assessed the efficiency and profit productivity of local and foreign banks from 2000 to 2014 with pooled OLS and fixed-effects models. It was found that local banks did better than their foreign counterparts. This was due to the fact that foreign banks undertook riskier investment portfolio as compared to domestic banks. Besides, the operation and the administrative expenditure of the foreign banks were statistically significant but inversely associated with profitability (Arabia, Saif-Alyousfi, Rohani and Asish, 2017) noted.

As already reviewed above, Bopkin (2013) reveals that foreign banks are more cost-efficient than the local banks, though in terms of profit efficiency, foreign banks are not necessarily better than local banks. His study on Ghanaian banks further indicates that organisational and administrative variation between foreign and local banks suggest differences in cost and size, mechanisms and economies of scale for foreign and domestic banks.

Alnaa et al. (2016) conducted a comparative study of three local banks and foreign banks to determine which type outperformed the other using the return on equity, return on assets, capital adequacy and management efficiency (ME) between 2008 and 2014. In their analysis, the foreign banks outclassed the local banks on the ROE, ROA and CA while the local banks excelled with their ME. Alnaa et al. (2016) argued based on their findings that local banks should be given a lesser minimum capital. An earlier study by Tetteh (2014) and Saka, Aboagye and Gemegah (2012) confirmed the findings of Alnaa et al. (2016) that foreign banks did better than the local ones in Ghana. Tetteh (2014) used key bank-specific indicators that proved that the revenue of the foreign banks was significantly higher than that of local banks. The research employed unbalanced panel data of 27 banks covering their operation from 2003 to 2012 (Tetteh, 2014). Saka et al. (2012) employed the DEA approach with Tobit regression to evaluate the effect of foreign banks entering the Ghanaian banking sector and its
focus on the local banks between 2000 and 2008. They concluded that the coming of the foreign banks had a positive impact on the efficiency of domestic banks.

Chen and Liao (2011) found that foreign banks outclassed domestic ones in economies where the sector is less competitive and the domestic banks did better than the foreign banks where the banking industry is more competitive. These findings were based on a cross country study of 70 countries between a period of 1992 to 2006 across developing and developed economies. Cull, Peria and Verrier (2017) of IMF confirmed findings of Chen and Liao (2011) that foreign-owned banks are more efficient and effective in terms of their liquidity creation, financial stability and performance in developing and emerging economies. They pointed out that in times of financial crises in the home country of their business operation, they provide adequate funds to stabilize the economy.

In Nigeria, Jinadu et al. (2018) explored the link between ownership and performance of multinational banks from 2010 to 2014. It was found that ownership is significant in corporate performance but negatively related. Jinadu et al. (2018) argued that to improve corporate performance of multinational banks and the performance of domestic banks, concentration on ownership should be reduced and foreign banks be encouraged to enter the Nigerian banking industry.

2.3.4 Assessment of Bank Recapitalization, Productivity and Performance

By conventional wisdom, Bank Recapitalisation can be said to be the restructuring of banks’ long-term financial resources through capital injection, issuing of shares, stocks, bonds or debts to enhance the finances of the bank while bank performance can be said to be how the resources of the banks are used to achieve the objectives set by the banks.

Adegbaju and Olokoyo (2008) define recapitalisation as the increment in the debt stock or offering of additional shares to the current shareholders or a combination of the two approaches to increase the capital stock of a business organisation. There are several studies on bank recapitalisation and bank performance at the country level (Francisco & Sonia, 2014; Bakare, 2011; Akomea & Adusei, 2013)
and cross-country level (Raluca & Alexandru, 2016; Nacuer & Omran, 2010; Ernovianti & Ahmad, 2017). However, in countries where the same data was used, there are inconclusive and inconsistent findings. While some researchers found positive and statistically significant relations between bank recapitalization and bank performance (Bakare, 2011; Nacuer & Omran, 2010; Ernovianti & Ahmad, 2017; Hasan Kale & Selimler, 2015; Akomea & Adusei, 2013; Kukurah, Alhassan & Sakara, 2014; Nacuer & Kandil, 2009; Dauda, Opeyimi & Gayinu, 2016), others demonstrated otherwise (Francisco & Sonia, 2014; Ibrahim, Mohammed & Sani, 2012; Shehu & Nuraddeen, 2011; Sadiq, Fatima, Bukonla & Mobolaji, 2018; Tetteh-Ametei, 2014). Interestingly, other researchers found no change before and after recapitalisation (Tunde, 2015; Adegbaju & Olokoyo, 2008; Alalade, Adekunle & Oguntodu, 2016).

Francisco and Sonia (2014) examined mandatory recapitalisation by the Central Bank of Portugal, mainly financed by capital injection by the Central Bank of Portugal and the Portuguese government. The research employed a secondary data obtained from Central Bank of Portugal's Credit Database and was analysed using regression model which allowed for fixed effect estimator for the comparison of credit supply of the recapitalised against non-recapitalized banks. Francisco and Sonia (2014) concluded that though the policy made funds available for the recapitalised banks and increased their credit supply to firms, it has a negative correlation with the buffer stocks of the recapitalised banks. The above findings were corroborated by Nacuer and Omran (2010) as well as Ernovianti and Ahmad (2017). Nacuer and Omran (2010) assessed factors that trigger bank performance in some selected banks from Middle East and North African countries and found that bank recapitalisation and bank credit risk-taking remain significant variables in determining the performance of banks, using General Method of Moment specification. They specified that a higher capital level that comes as a result of recapitalisation increases bank performance. They argued that all macroeconomic variables were insignificant with bank performance but for inflation, they suggest that bank recapitalisation is mainly the catalyst for the increase in bank performance. They also point out that in countries that have a
well-established banking sector, banks enjoy the lower cost of operation. Ernovianti and Ahmad (2017) evaluated the impact of capital injection in the form of recapitalisation of banks during crises on the performance of banks. Their study covered a 19-year period from 1997 to 2015 across 45 banks from three countries: Indonesia, Malaysia and Thailand. Their data were obtained from yearly accounts of the banks, the World Bank and global economic websites. The panel data obtained were analysed using Panel regression and the fixed effects model of the generalised least squares estimation techniques. Ernovianti and Ahmad (2017) revealed that recapitalisation through direct capital injections is positively significant with GDP, inflation as well as political stability and has increased efficiency of recapitalised banks in the three different economies.

Kale, Hasan and Selimler (2015) studied the impact of the regulatory regime’s increase in the operation capital on banks' efficiency and profit productivity in Turkey using the 2001 financial distress as the base year for the study. They considered 1997 to 2000 as the unstable period and 2002 to 2013 as the stable period. Bank productivity improvements were evaluated by the Malmquist Productivity Index (MPI), which was based on the Data Envelopment Analysis (DEA) of the banks. The study further used regression analysis to determine the impact of bank-specific variables and other economic indicators for measuring their effects on banks’ profitability. From the two methods of analysis, it was found that banks’ efficiency and productivity increased as a result of recapitalisation that comes from Capital injection. Kale, Hasan and Selimler (2015) also noted that monitoring and supervision are other reform activities that have impacted efficiency and profit productivity positively.

In Ghana, Tetteh-Ametei (2014) evaluated the effect of 2009 recapitalisation on banks’ performance and their effect on the macroeconomy in general. The study covered 7 years between 2006 and 2013, using secondary data obtained from the Bank of Ghana Annual Reports for 22 banks sampled from the 26 banks in the country. The research used the Generalized Methods of Moment as the model for estimation and the student’s t-test as an indicator of equality in the efficiency of the banks before and after recapitalisation. He concluded that the increase in the mandatory capital had not improved
performance. This suggests that bank recapitalisation had an adverse effect on bank performance in Ghana. The findings of Tetteh-Ametei (2014) contradict earlier studies conducted in Ghana that established bank recapitalisation to have positively and substantially impacted banks’ performance (Boahene, Dasah & Agyei, 2012; Akomea & Adusei, 2013; Kukurah, Alhassan & Sakara, 2014).

Boahene et al. (2012) studied the determinant of profitability among six banks sampled purposively among the banks in the country operating from 2005 to 2009 and identified capital to be positive and significant with the profitability of banks. They used secondary data acquired from the final accounts of the six selected banks. A fixed-effect panel model of regression analysis was used. They found that bank recapitalisation improved the performance of the selected banks. A year later, Akomea and Adusei (2013) examined the recapitalisation of banks in Ghana and found that bank recapitalisation brought about bank consolidation and the consolidation improved performance and efficiency of the banking sector. Kukurah, Alhassan and Sakara (2014) followed this by delving into the benefits got by GCB Bank and Ecobank from the 2009 recapitalisation in Ghana. They used accounting ratios to analyse and evaluate banks' efficiency and performance while the t-test was employed to determine whether there were any significant variations in pre and post-recapitalisation ratios. In conclusion, Kukurah et al. (2014) posit that Net profit margin, management efficiency, earning per shares, returns on equity and returns on assets increased for both banks which led to increase in their efficiency and performance. It, therefore, suggests that recapitalisation policy is useful to strengthen the banking sector and to ensure stronger and larger capital base for banks and provides the opportunity for eliminating weaker banks (Kukurah et al., 2014). Their findings are based on data from the final accounts of both banks from the year 2005 to 2010.

While Tetteh-Ametei (2014) and Akomea and Adusei (2013) used a large sample size in their studies, Kukurah et al. (2014) and Boahene et al. (2012) used a sample of two and six banks sampled purposively. It can, therefore, be deduced that the differences in their findings are attributable to the sample size used (Kukurah et al., 2014; Boahene et al., 2012) and different in the duration (Tetteh-
Ametei, 2014; Boahene et al., 2012). Besides, Tetteh-Ametei (2014) and Boahene et al. (2012) used more than 90% of the population size of the banks in the country. The variation in the results can also be explained by the study period used. Akomea and Adusei (2013) looked at one year after the recapitalisation and eight years before the recapitalization. Consequently, it is not prudent to compare these two periods, for one year after recapitalisation is not enough to determine the impact of the recapitalisation.

In Nigeria, several studies have examined the benefits derived from the 2005 recapitalisation that reduced the banks in the country to 25 from the initial 87 banks. However, these studies produced incomplete and inconsistent results. The difference in their findings can be explained by their variable sample sizes and the durations as well as the different study design employed. While some authors concluded that the policy had a beneficial effect on the performance and efficiency of banks (Ashamu & Durowoju, 2009; Bakare, 2011; Olalekan & Adeyinka, 2013; Okpala, 2013; Alalade, Adekunle & Oguntodu, 2016; Dauda, Opeyimi and Gayinu, 2016), others found that bank recapitalization has adverse effects on banks’ efficiency and performance (Shehu & Nuraddeen, 2011; Ibrahim et al., 2012; Sadiq et al., 2018). However, few authors established that bank recapitalisation does not affect the performance and efficiency of banks (Adegbaju & Olokoyo, 2008; Sani and Alani, 2012; Tunde, 2015).

Ashamu and Durowoju (2009) assessed whether the previous bank recapitalisation reforms between 1994 and 2004 had improved the performance of 24 banks in Nigeria and found that bank recapitalisation has a favourable effect on the efficiency and performance of the 24 sampled banks with statistically significant results (Ashamu & Durowoju, 2009).

Later studies also found the same correlation between recapitalisation and efficiency and bank performance. For instance, Bakare (2011) used available data from Nigeria’s Central Bank database. He observed that there was a negative first-order serial autocorrelation among the selected explanatory variables when tested using the Durbin Watson Test. In the regression analysis, Bakare (2011)
concluded that the average capital for banks in the country had increased and the economy had grown by 5% over the period of recapitalization. They established that the recapitalization was positively and significantly related to bank performance (Bakare, 2011).

Okpala (2013) found that recapitalisation impacted the performance of banks and the economy of the country as a whole positively. The study revealed that lending to the industrious sectors of the economy increased to 87% and the increment was solely accounted for by the recapitalisation (Okpala, 2013). This led to an increase in competition among banks and business activities and this influenced GDP, economic growth and development significantly (Okpala 2013).

To support the above findings, Alalade, Adekunle and Oguntodu (2016) later explored the effect of the 2005 recapitalisation three years after the policy was implemented using bank performance as the main variable. They used judgmental sampling procedure to choose three banks from a population of 24 banks in the industry. The secondary data was acquired from the Nigerian Stock Exchange and the annual financial report of the selected banks. In the ordinary least square used for the analysis, bank profitability was used as the dependent variable and the explanatory variables were Return on Assets, non–performing Assets and Return on Equity. The Standard Error Test, the student t-test, the F–Test and the Durbin Watson test as well as the p-value were used to test the hypothesis that “there is no significant relationship between bank recapitalisation and bank performance” (Alalade et al., 2016, pp. 13). The results from the analysis indicate a positive and statistically significant relationship between bank recapitalisation and bank performance (Alalade et al., 2016). An increase in bank capital is an indication of prudent bank performance in terms of profitability and robust liquidity, better service to the public, reliable industrial performance and prudent economic growth (Alalade et al., 2016).

Dauda et al. (2017) studied the impact of the 2005 recapitalisation in Nigeria just like other scholars. He considered the period from 2000 to 2004 as the pre- capitalisation period and 2006 to 2010 as the post – capitalisation period. They used Data Envelopment Analysis (DEA), while Wages and Salaries,
Interest Income and Interest Expenses were the input variables and Earning Assets, Fixed Assets and Total Deposit were the output variables. From the output orientation approach, the results of the DEA showed that recapitalisation is positively and statistically significant with bank efficiency and profit productivity as most banks achieved almost 100% efficiency after recapitalisation (Dauda et al. 2017). The above findings contradict those by Shehu & Nuraddeen (2011), Ibrahim et al. (2012) and Sadiq et al. (2018) who found that recapitalisation is inversely associated with bank performance. Shehu and Nuraddeen (2011) studied the effect of the 2005 recapitalisation on the efficiency of the banks in Nigeria. From the population of the 25 banks that emerged from the recapitalisation, five were selected for the study using the stratified random sampling technique. Secondary data from the annual reports and the final accounts of the sampled banks were used for the research and it was found that the recapitalization policy did not impact the performance of Nigerian banks (Shehu & Nuraddeen, 2011). This finding is consistent with later findings by Ibrahim et al. (2012) and Sadiq et al. (2018).

Ibrahim et al. (2012) also assessed the 2005 recapitalisation in Nigeria and considered pre – capitalisation period of 5 years against post capitalisation period of 5 years. The Nigerian Central Bank and its Deposit Insurance Commission provided the information used for the study that covered the period between 2000 and 2009. In the t-test used for the analysis, they found that the recapitalisation decreased the interest margin, the returns on earning and the return on assets and cost of funding banks in the sector. They, therefore, concluded that recapitalization of the banking sector did not improve the performance of the banking sector. Ibrahim et al.’s (2012) study was corroborated by Sadiq et al. (2018) who sampled eight banks in Nigeria and assessed their performance from 2000 to 2013. Panel data collected from a secondary source was used for the study which employed ordinary least squares regression as its analytical tool. It was concluded that the return on equity, net profit ratio, basic earnings per share were positively related with the dependent variable. The ratio of cost to income and the dummy variable that measures the outcome of recapitalisation on bank efficiency and
performance were negatively correlated with return on assets indicating additional bank capital has adversely affected banks’ performance as well as banks’ profitability.

Adegaju and Olokoyo (2008) examined the relevance of the 2001 recapitalisation of banks in Nigeria and their effects on performance and efficiency. They analysed the financial reports of all banks in Nigeria from 1998 to 2004, taking 2001 as the base year for the study. It was deduced from the study that return on equity fell on average after recapitalization, indicating that shareholders received less after the policy than before. However, the yield on earning assets on average rose after 2001 recapitalisation indicating that banks earned more after the policy (Adegaju & Olokoyo, 2008). It, therefore, indicates that shareholders received lesser dividends after recapitalisation as banks reported earnings for the period fell, signalling that shareholders were worst off after the increase in the required minimum capital of banks.

Sani and Alani (2012) conducted a pre and post-recapitalisation assessment of eight Nigerian banks, using purposive sampling from a population of 24 banks that operated banking transactions from 2002 to 2008. The study discovered that no correlation existed among margin of profit before tax, return on total assets, return on earnings assets and dividend shared (Sani & Alani, 2012). However, they observed an increase in regulatory capital which shows a direct association with return on equity and interest income on loans and advances. Sani and Alani (2012) therefore established that the increase in the regulatory capital produced mixed findings which were consistent with an earlier finding by Adegaju and Olokoyo (2008) and later study by (Tunde, 2015).

Tunde (2015) assessed the effect of mandatory recapitalisation and the performance of banks using the 2005 Nigerian banking recapitalisation as the bank period of the base year. The study considered 2000 – 2004 as pre–capitalisation regime and 2006 – 2010 as the post–capitalisation regime. However, only six banks out of the 25 that survived from the policy were used for the study. From the accounting ratios used for the study, recapitalization of banks (consolidation of banks to meet to the minimum required capital) led to a decrease in net profit margin, the yield on earning assets, returns on equity,
returns on assets and performance as well as the efficiency after consolidation of two or more banks, (Tunde, 2015). Also, there was an increase in the cost of capital and physical assets of banks. It was found that the relationship between total assets, management of assets and operational efficiency with bank recapitalisation and consolidation was negative while the relationship between physical assets of banks and cost of borrowing in the capital market was positive (Tunde, 2015). It can be inferred from Tunde (2015) and Sani and Alani (2012) that the similarity in their findings was due to the homogeneity in their sample size; six and eight banks respectively.

In Tanzania, Lotto (2018) evaluated the relationship between capital adequacy and bank recapitalisation and their impact on performance of banks in Tanzania from 2009 to 2014. The study employed a two-stage least squares method of estimation using secondary data from the published final statements and a simultaneous equation. Working on the assumption that banks made decisions based on capital adequacy and risk-taking in investment portfolios simultaneously, Lotto used Durbin–Watson test to ensure endogeneity of capital adequacy and risk-taking in investment portfolio. The results from the findings indicated a favourable and significant relationship between banks’ capital and performance (Lotto, 2018).

Similar results were found in Egypt and Kenya, which established that bank recapitalisation is positively and significantly associated with bank efficiency and bank performance (Naceur & Kandli, 2009; Mathuva, 2009).

In Egypt, the effect of mandatory recapitalisation on bank performance, intermediation and profitability was studied. Naceur and Kandli (2009) observed 28 banks from 1989 to 2004 using data from the Bureau van Dijk’s banks cope and World Bank World Development Indicators as the financial and macro data, respectively. The results of the study pointed to the fact that efforts made by the Central Bank of Egypt to implement the regulatory capital requirement in the banking industry have improved bank efficiency and performance significantly. The period recorded many significant improvements in the area of higher capital-to-assets ratio, an increase in managerial efficiency,
improvement in liquidity and low inflation. Recapitalisation is found to be positively related to profitability as it also reduced the implicit cost of the banks in the country (Naceur & Kandli, 2009). Bowa (2015) examined the impact of bank capitalisation on liquidity creation, the performance of the banks and economic stability. He used annual financial statements and data from Kenyan Central Bank that covered 42 out of the 43 banks in Kenya between 2010 to 2014. Multiple regression approach was employed to carry the analysis, which established that banks that were well capitalised create sufficient liquidity and increase performance (Bowa, 2015). He argued that a better liquidity is also a direct result of bigger bank size, improved capital ratio and asset quality. In other words, improved liquidity is positive and statistically correlated with bank size, capital ratio and asset quality (Bowa, 2015).

2.3.5 The Impact of Capital Adequacy on Bank Profitability and Performance

Capital adequacy has been defined by Abdul (2017, pg 2) as “sufficiency of the amount of equity to absorb any unexpected shocks that a bank may face”. Otherwise, the proportion of a bank's capital to its risk-weighted assets and liabilities is measured as the sum of Tier I and Tier II capital all divided by Risk-weighted Assets. The BOG has set the minimum capital adequacy ratio for banks in Ghana at 10%, as recommended by the Basel Agreement (Bank of Ghana [BoG], 2018).

Several empirical studies have sought to find the link between capital adequacy and bank profitability as well as performance. Naceur, Marton and Roulet (2018) inspired by the Basel III framework, analyze the impact of capital adequacy on bank development following the 2008 U.S. economic crisis. The study covered 1341 banks from 23 countries, including the USA and Europe with its primary focus on the USA (1040 banks) and a secondary focus on European countries (340). The data was collected from IMF, Bloomberg and S&P Global Market Intelligence databases (Naceur, Marton & Roulet, 2018). In order to assess the effect of assets growth and liquidity creation on bank development, static panel regression was used. The findings illustrated that capital adequacy is
inversely linked to the performance of bank development and liquidity creation for banks in Europe but not for banks in the USA (Naceur, Marton & Roulet, 2018).

Berger and Bouwman (2013) evaluated the impact of capital adequacy on banks’ performance in a time of financial crisis in terms of bank survival and their market share in the USA. The study was conducted on the period from 1984 to 2010, where the sector witnessed two financial crises, three market crises and two regular periods (termed as the fake crises) (Berger & Bouwman, 2013). The study tested the hypothesis of the impact of banks’ financial exigency and capital on their efficiency during economic recessions using data collected from 1984 to 2010. From the analysis of results, it was inferred that sufficient equity capital provides the possibility of small banks higher level of surviving their market segment at all-time but for medium–size and large banks, capital is the primary catalyst that enhances their performance during the financial crisis and banks’ soundness is an outcome of the right capital base (Berger & Bouwman, 2013).

Bitar, Pukthuanthong and Walker (2017) sampled 1992 banks from OCED countries (Excluding USA) between 1999 and 2013 to determine the influence of capital adequacy on profitability and efficiency of banks. They found that higher capital is directly proportionate to increase in bank profitability and efficiency. They argue based on their findings that an increase in equity capital is the primary catalyst in risk reduction that leads to efficiency and banks’ profit. This confirms earlier results of positive and statistically significant association with capital adequacy ratio and bank profitability (Berger, 1995; Athanasoglou, Brissimis & Delis, 2008; Kosmidou, Tanna & Pasiouras, 2008; Sufian, 2011; Chortares, Girardone & Ventouri, 2011; Capranu & Ilhatov, 2014; Tan, 2016; Sufian, 2016). Berger (1995) used annual data from 1983 to 1989 with a three-year lag of the value of capital and earning to test the effect of capital ratio and return on equity and bank profitability. The study employed regression analysis and concluded that capital ratio is positively related to equity and bank profitability.
Chortares et al. (2011) examined monitoring and supervision system on the performance of banks in 22 European Union countries from 2000 to 2008. A three-stage analysis involving DEA followed by truncated regressions and generalised linear models were employed on the data acquired from the database of the Bankscope of Bureau of van Dijk. Their findings indicate that an efficient regulatory system leads to improved capital adequacy ratio and is positively related to bank efficiency as well as productivity which improves profitability (Chortares et al., 2011).


Tran, Lin and Nguyen (2016) assessed the statistical relationships among the creation of liquidity, mandatory capital and bank profits of the US banking sector. The study used an unbalanced panel for all banks that operated from 1996 to 2013 and revealed that regulatory capital and liquidity creation is positively related to bank profitability (Tran et al., 2016). However, they argued that the relation established is only valid during the non-banking crisis and for small banks.

In Nigeria, capital adequacy is established to be directly and strongly linked with bank performance and profitability (Owopufi, Kayode & Adeyefa, 2014; Amahalu, Okoye, Nweze, Obi & Okika, 2017; Udom & Eze, 2018).

Findings in South Africa by (Nyoka, 2017), also corroborated others that have a positive relationship between capital adequacy and bank profitability. The hypothesis of a direct and statistically significant association between bank capital and bank profitability was tested. It was found that capital ratio, return on equity and return on assets related positively with bank performance (Nyoka, 2017). Therefore, it can be identified from the study that the findings support the assertion that there is a relationship between positively capital adequacy and bank profitability, (Nyoka, 2017).
2.3.6 Capital Injection by Central Government and Banks’ Financial Performance.

In the past three decades, several financial crises have been witnessed across the globe. Governments responded in diverse ways to find solutions to the crises to prevent them from having ripple effects on the macroeconomics and the financial stability of their countries in order to ensure a healthy financial sector to promote economic activities. Most governments injected capital in the way of recapitalising banks and financial institutions, which aims at liquidity creation (Contessi and El-Ghazaly, 2011). Between 1970 and 2007, International Monetary Fund (IMF) Economists, Luc Laeven and Fabian Valencia, identified 42 financial crises, 32 of which were responded to by government capital injection or government recapitalisation (Contessi and El-Ghazaly, 2011). According to empirical works of literature, whereas some of these capital injections into the financial sector helped solve the problems, others yielded no desirable results with the effect of ensuring a stable economic environment.

Berger, Bouwman, Kick and Schaeck (2016) studied capital injection and liquidity support offered to German banks by regulatory authorities in the form of financial bailout to help them in liquidity creation. They further examined how this impacted the performance of recipient banks during financial distress. Berger et al. (2016) divided the sector into three: public–sector, private–sector and cooperatives banks. The study concluded that regulatory intervention is negatively correlated with liquidity creation, while capital support is uncorrelated with liquidity creation (Berger et al., 2016).

Several authors have researched the economic consequence of the Troubled Assets Relief Program (TARP) when the Central government of USA used a public fund of $700 billion to recapitalize public sector banks during the 20007 – 2010 financial crisis to stimulate and attenuate the macroeconomic activities, bank performance and credit creation (Farrugio, Michalak & Uhde, 2013; Harris, Huerta & Ngo, 2013; Li, 2013; Montgomery & Takahashi, 2014; Song & Uzmanoglu, 2016; Berger, Makaew & Roman, 2016; Berger, 2018).

Berger (2018) established that the policy worked in the short-term by producing some social benefits but in the long-term, real economic benefits of the program were offset by an increase in systemic
risks. Berger, Makaew and Roman (2016) found that banks that benefited from TARP increased their credit creation at a very intensive margin. They point out that in conformity with the moral hazard hypothesis, risk lovers and aggressive borrowers benefited more while the risk-averse and conservative borrowers gained little from the program.

Li (2013) found that TRAP directly quickened credit creation of the capitalised banks more than non-capitalised banks. Farrugio, Michalak and Uhde (2013) established from their study that TRAP injection of capital into the banking sector served as an obstacle in ensuring a stable financial environment. They argued that regulatory support is a recipe for increasing systemic risk among banks.

In India, Bhatia (2017) reviewed the recapitalisation of public banks in the country by using the recapitalisation in the 1990s and early 2000 as the subject of analysis. In his view, recapitalisation of the public sector banks was a bad idea that would not yield any benefit for the financial sector and the Indian economy. Bhatia (2017) established his argument from the premise that the 1990s and the early 2000 recapitalisation created a moral hazard whereby banks were motivated to riskier lending with the notion that the central bank would bail them out in any financial crisis. Thus, to conclude, Bhatia (2017) observed that capital injection by the central government was uncorrelated with the banks’ performance.

A later study by Manu, Gnanendra and Ayushi (2018) confirmed parts of the revelations made by Bhatia (2017) about recapitalisation by Central Bank of India. From the statistical test conducted using Paired Sample t-test, it was concluded that earnings per share and net non-performing assets after the capital injection were statistically significant with the performance and profitability of the banks that received the fund. The fund also helped reduce the NPA of public sector banks which led to their profitability and economic growth (Manu, Gnanendra & Ayushi, 2018). However, they argued that the policy was not enough to enhance the profits of banks, which is consistent with (Bhatia, 2017). In a cross-country study conducted by Gerhardt and Vennet (2016) in 114 banks operating in Europe
that were supported by capital injected by their governments during financial crises, it was found that
the banks that received the liquidity support hardly improved their performance after the capital
injection. The research considered twenty-two European countries between 2006 and 2013 using logit
regression.

In Japan, the government injected capital to recapitalised public banks and its aftermath effects is not
different from findings in other countries (Montgomery & Shimizutani, 2009). Montgomery &
Shimizutani, (2009) found that the policy helped improve the capital adequacy of all banks in the
country, reducing loans and increasing credit creation of local banks. These deductions were based on
a linear regression analysis performed on a sample of 109 banks whose annual financial records were
obtained from the balance sheet from the year 1990 to 1999 fiscal year, distinguishing the local banks
from the foreign ones to ensure the presence of homogeneity of the sampled banks (Montgomery &
Shimizutani, 2009). It is worth noting that the first capital injection that the government provided did
not yield the desirable increase of capital adequacy nor reduce the non-performing loan and liquidity
creation. The second round of the recapitalisation by the government impacted the policy but did not
lead to the restructuring of the financial sector (Montgomery and Shimizutani, 2009).

2.4 Macroeconomic Indicators and Profit Productivity
Inflation rate and the rate at which the Gross Domestic Product (GDP) grows are the two major
indicators of the macroeconomic environment of a country. These two indicators influence the growth
rate of business and have a significant impact on the profit productivity of banks and other businesses
in an economy. The inflation rate measures the average yearly changes in the consumer price indices
while Gross Domestic Product Growth measures the rate of growth in the total production of goods
and services in the country on an annual basis. The effect of inflation rate on the profitability of banks
is found in the literature to be uncertain. While some academicians and researchers established
positive association with the profitability of banks (Kosmidou et al., 2005; Naceur & Omran, 2011;
Hasanov, Bayramli and Al-Musehel; 2018) others found inflation to be negatively related to the
profitability of banks (Tetteh-Amemei, 2014; Sufian & Chong, 2008).
The GDP growth rate determines the degree at which an economy grows and serves as the primary catalyst for the demand and supply of loans in a country. Klein and Weil (2019) found the GDP growth rate is directly associated with bank profitability in a cross-country study involving 133 countries from 1999 to 2003. Earlier findings by Naceur and Omran (2011) in four North Africa and Middle East countries and those of Obamuyi (2013) confirmed the positive relationship between GDP growth and bank profit productivity. Nevertheless, Tan and Floros (2012) of China found that GDP growth rate is negatively related to bank profitability in their study of the Chinese banking industry. This was later corroborated by Tetteh-Amemei (2014) from Ghana.

2.5 Summary
Regarding the reviewed literature, conventional wisdom has established that an announcement of an increase in minimum capital by regulatory authorities is associated with banks reducing their borrowing, especially in the risk ventures and holding on to the capital. This they do to accumulate capital to meet the deadline given them to increase their capital base. In doing this, their profit margin reduces, as they tend to minimise risk. Therefore, the risk returns hypothesis establishes that there is an inverse relationship between capitalisation and profit productivity and efficiency and this is confirmed by some empirical literature (Shehu & Nuraddeen, 2011; Ibrahim et al., 2012; Sadiq et al., 2018). However, bankruptcy cost and signalling hypothesis have an opposing view of the risk return hypothesis. It establishes that there is a direct proportionality between capital and profit productivity and bank efficiency. This has also been affirmed by empirical work by some researchers (Berger, 1995; Athanasoglou, Brissimis & Delis, 2008; Kosmidou, Tanna & Pasiouras, 2008; Sufian, 2010; Chortares, Girardone & Ventouri, 2011; Capranu & Ihnatov, 2014; Tan, 2016; Sufian, 2016).

This study also sought to determine the relationship between announcing of increase in minimum capital and performance of banks after the policy is implemented with a particular reference to the 2009 recapitalisation of the Ghanaian banking industry. Each bank in the study was considered as DMU and their efficiency, productivity and performance before and after recapitalisation evaluated.
CHAPTER THREE

METHODOLOGY

3.1 Introduction
The chapter outlines the suitable research methods to achieve the objectives of set out in this study. It discusses the research design used, source of the data, data analysis techniques, econometric model as well as the variables used.

3.2 Research Design
The design of this research deals with the approach, methods and the procedures outlined for the smooth execution of the research (Churchill & Iacobucci, 2005). The fundamental function of the design is to guarantee that the data collected addressed the research problem in using relevant term without ambiguity. It specifies the model to use for the analysis and the approach in choosing models. This study adopted a balanced panel research design as data collected for the research could enable the researcher to make an inference about the entire population (Lavrakas, 2008). A non-parametric framework called Data Envelopment Analysis (DEA) was used in this analysis. The output-oriented method of both CCR and BCC models, as well as the Malmquist Productivity Index, were employed to assess the efficiency and productivity of banks in the pre-recapitalisation and the post-recapitalisation periods. In effect, this study generalised the findings to the entire banking industry based on the CCR and BCC model of DEA using the efficiency approach and the MPI of the banks to measure productivity. The profitability approach was used because the study could find the optimal output maximisation, given a certain level of inputs used.

3.3 Data and Sampling Criterion
Secondary data on the banks operating in the country was obtained from the BOG with additional data from Ghana Banking Surveys from the year 2005 to 2015, making an 11-year annual bank-level data. Out of the population of 26 banks, 22 banks were sampled for the study. The research covered five pre-recapitalization era between 2005 and 2009, and five post-recapitalisation era between 2011 and 2015. The year 2010 was taken as the base period as it is impossible to ascertain the impact of the recapitalisation just after one year of its implementation. For the study to be able to use DEA – MPI
to assess efficiency and productivity of banks during the two periods; the data was divided into two: pre-recapitalisation (2005 to 2009) and post-recapitalisation (2011 to 2015).

3.4 Data Envelopment Analysis - Malmquist Productivity Index (DEA – MPI)

3.4.1 Brief History

Accounting ratios are the traditional procedures used in determining performance of banks and comparisons among banks. Accounting ratios like ROA, ROE, current ratio and dividend per share are some of the financial indicators used to determine best performing banks in the sector. For measurement of efficiency, Stochastic Frontier Analysis (SFA) and Data Envelopment Analysis (DEA) are used. SFA is a parametric approach that is built on the econometric framework design based on particular assumptions of its data and has an error term. Nonetheless, DEA is a non-parametric approach that has no functional form nor assumption based on its data. It also has no error, implying that there is no unobserved variable term.

The current study adopted DEA with MPI at its first stage. Edwardo Rhode first used the method in his doctoral dissertation at the Carnegie Mellon University, Pittsburgh, Pennsylvania, USA. However, as cited by Seiford (1996), the method was later modified from the work of Afrati (1972) with its algebraic operation by Charles and Cooper (1962) that allows for linear programming of inexhaustible solutions into traditional linear programming. After Charles, Cooper and Rhodes (1978) study on DEA was published, several researchers have employed DEA in their studies, most notably in the banking fraternity. The technique is employed to measure bank effectiveness as it considered each bank in the industry as a decision-making unit (DMU) and its efficiency evaluated in comparison to the best performer among the DMUs (Jiang & He, 2018). Also, DEA enables multi-input and output of a DMU that measures efficiency and performance so that there is no need for assigning any production as a model for the analysis. Causes of inefficiency are easily identified with the efficiency score and the procedures to improve on the efficiency of a DMU are also possibly determined (Repkova, 2014). Another essential benefit that DEA has over accounting ratios and SFA is that the establishment of its
The functional form is premised on empiric records instead of conceptual evidence and this has the likelihood of including other inputs and outputs at various stages (Svitakova, 2014). For productivity and efficiency estimation of DMUs, the combination of DEA and MPI models would provide a beneficial result. Also, lack of accounting indicators for determining efficiency are catered for by the use of the DEA approach (Tuskan & Stojanovic, 2016). This makes the method accessible and popular for research purposes. According to Liu, Lu, Lu and Lin (2013), there were 373 research papers in banking and finance for evaluation of efficiency and performance between 2005 and 2009, representing 20.8% more than any other fields. Some research that used DEA in banking-related research in recent years include Henriques, Sobreiro, Kimura & Mariano (2018), Jiang & He (2018), Kamarudin, Chiun, Sufian & Anwar (2017), Dauda, Ibrahim & Ganiyu (2016), Kamarudin, Sufian, Nassir & Gune (2015), Stewart, Matousek & Nguyen (2016), Wanke, Barros & Emnouznejad (2016b), Yilmaz & Gune (2015), Sufian (2011) and Mathew Zhang & Stewart, Matousek & Nguyen (2016).

3.4.2 The Concept of Technical Efficiency and Pure Technical Efficiency

Technical efficiency is the extent of the industrial-technological level that the production process of a production unit attains. It is evaluated using two approaches; input and output of the production unit, (Khrystoforova, 2017). When using input approach, technical efficiency is determined from the perspective of the minimum input achieving the maximum output, which is referred to as Output Maximisation and using the output approach, (Farrell, 1957). Thus, Technical efficiency is said to be the input minimisation, (Farrell, 1957).

On the other hand, Pure Technical Efficiency is used to determine the managerial efficiency of a product unit (Gulati, 2008). It determines the managerial underperformance using its efficiency score.

3.4.3 CCR Model with Constant Returns to Scale

Charles, Cooper and Rhodes (1978) formulated a mathematical model and methodologies to be used in DEA and named it CCR model (the initials of their names). The model has non-parametric mathematical linear programming techniques which enable various components to be used. Efficient
and inefficient DMUs are effortlessly identified while indicating the approaches to ensure inefficient
DMUs are made effective ones. Charles et al. (1978) used algebraic manipulations developed from
the work of Charles and Cooper (1962) to convert the nonlinear programming into linear
programming. The CCR model is focused on the concept of Constant Returns to Scale and assumes
that technical efficiency is a component of scale efficiency.

Supposing that technical efficiency measured as the ratio of output to the input of DMUs and therefore
we have $n$ number DMUs denoted by $DMU_j = (j = 1, 2, 3, \ldots, n)$, also each DMU has $m$ inputs
and $q$ outputs denoted by $x_s = (s = 1, 2, 3, \ldots, m)$ and $y_r = (r = 1, 2, 3, \ldots, q)$ respectively
and each input and output are weighted by

$v_s = (s = 1, 2, 3, \ldots, m)$ and $u_r = (r = 1, 2, 3, \ldots, q)$ respectively. The equations of the input-
oriented and the output-oriented model of the CCR is stated below as:

\[ v = v_1 x_1 + v_2 x_2 + v_3 x_3 + \cdots + v_m x_m \]  
\[ u = u_1 y_1 + u_2 y_2 + u_3 y_3 + \cdots + u_q y_q \]

where equation (1) and equation (2) denote weighted input and weighted output respectively.

If the bank whose ratio of output to input to be measured is denoted by $DMU$, then

\[ DMU = \frac{u_1 y_1 + u_2 y_2 + u_3 y_3 + \cdots + u_q y_q}{v_1 x_1 + v_2 x_2 + v_3 x_3 + \cdots + v_m x_m} = \frac{\sum_{r=1}^{q} u_r y_r}{\sum_{s=1}^{m} v_s x_s} \]

where $v \geq 0$ and $u \geq 0$, for $s = 1, 2, 3, \ldots, m$ and $r = 1, 2, 3, \ldots, q$.

Therefore, the model based on constant returns to scale is given as

\[ DMU = \frac{\sum_{r=1}^{q} u_r y_r}{\sum_{s=1}^{m} v_s x_s} \]
\[
\begin{align*}
\text{s.t. } & \frac{\sum_{r=1}^{q} u_r y_r j}{\sum_{i=1}^{m} v_s x_s j} \\
\text{where } v \geq 0 \text{ and } u \geq 0, \text{ for } s = 1, 2, 3, \ldots, m; \ r = 1, 2, 3, \ldots, q \text{ and } j = 1, 2, 3, \ldots, n.
\end{align*}
\]

This shows that the model is formulated to ensure efficiency evaluation of the DMU on the condition that total efficiency scores are less than 1 and therefore the weights of \( v \) and \( u \) provide more gains to the evaluated DMU. Therefore, if technology assumes to be constant in the CCR model and inputs of the DMU occurs at times \((\text{for } k > 0)\) as its initial value under the consideration of fixed technical efficiency, its output will also occur \( t \) times of its initial value as well. Both input and output measured at the DMU, with the assumption of constant returns to scale (CRS), will be \( t \) times as its initial value.

This will give a new objective function of CCR model as

\[
\max \left( \frac{\sum_{r=1}^{q} u_r y_r}{\sum_{s=1}^{m} v_s x_s} \right) = \frac{k \sum_{r=1}^{q} u_r y_r}{k \sum_{s=1}^{m} v_s x_s} = \frac{\sum_{r=1}^{q} u_r y_r}{\sum_{r=1}^{q} u_r y_r} 
\]

With the assumption that \( \sum_{s=1}^{m} v_s x_s j > 0 \), the constraint of the model in equation (4), is the same as

\[
\begin{align*}
\text{s.t. } & \sum_{s=1}^{q} u_r y_r j - \sum_{i=1}^{m} v_s x_s j \leq 0 
\end{align*}
\]

Moreover, if it is also assumed that \( k = \frac{1}{\sum_{s=1}^{m} v_s x_s} \) in order to achieve the input-oriented and output-oriented models of the CCR respectively, the objective of the nonlinear programming would be converted into linear programming as given below:

\[
\begin{align*}
\max \left( \sum_{r=1}^{q} \mu_r y_r \right) \\
\text{s.t. } & \sum_{s=1}^{q} \mu_r y_r j - \sum_{s=1}^{m} v_s x_s j \leq 0
\end{align*}
\]
\[ \sum_{s=1}^{m} v_s x_s = 1 \]

where \( v \geq 0 \) and \( u \geq 0 \), for \( s = 1, 2, 3, \ldots, m \); \( r = 1, 2, 3, \ldots, q \) and \( j = 1, 2, 3, \ldots, n \).......................... \( (7) \)

and

\[ \text{min} \left( \sum_{s=1}^{m} v_s x_s \right) \]

\[ \text{s.t.} \sum_{r=1}^{s} \mu_r y_{rj} - \sum_{s=1}^{m} v_s x_{sj} \leq 0 \]

\[ \sum_{r=1}^{q} \mu_r y_{rk} = 1 \]

where \( v \geq 0 \) and \( u \geq 0 \), for \( i = 1, 2, 3, \ldots, m \); \( r = 1, 2, 3, \ldots, q \) and \( j = 1, 2, 3, \ldots, n \).......................... \( (8) \)

3.4.4 BCC Model with Variable Returns to Scale

By conventional wisdom, DMUs may not be able to attain optimal production scale. Therefore, the CCR model has a scale efficiency in its technical efficiency. To account for this scale efficiency, Banker Charles and Cooper (1984) formulated another framework of the DEA that makes provision for estimating scale efficiency. The is called the BCC (initial of their first name) framework of DAE and on the rationale that there are variable scale returns where technical efficiency is obtainable from scale efficiency referred to as Pure Technical Efficiency. The input-oriented and the output-oriented models of the CCR are stated in equations (9) and (10) respectively,

\[ \text{min} \theta \]

\[ \text{s.t.} \sum_{j=1}^{n} \lambda_{ij} x_{ij} \leq \theta_i \]
\[ \sum_{j=1}^{n} \lambda_j y_{rj} \geq y_r \]

\[ \sum_{j=1}^{n} \lambda_j = 1 \]

\[ \lambda \geq 0 \]

\[ \text{for } i = 1, 2, 3, ..., m; \ r = 1, 2, 3, ..., q \text{ and } j = 1, 2, 3, ..., n \]

and

\[ \text{max } \emptyset \]

\[ \text{s.t. } \sum_{j=1}^{n} \lambda_j x_{ij} \leq x_i \]

\[ \sum_{j=1}^{n} \lambda_j y_{rj} \geq \emptyset y_i \]

\[ \sum_{j=1}^{n} \lambda_j = 1 \]

\[ \text{for } i = 1, 2, 3, ..., m; \ r = 1, 2, 3, ..., q; \ j = 1, 2, 3, ..., n; \ \theta = \text{input level and } \emptyset = \text{output level.} \]

3.4.5 Malmquist Productivity Index (MPI)

Malmquist Productivity Index is a distance function that defines the magnitude or length between two points. Its originality is traced to Malmquist (1953) and was fully introduced and modified for its application by Caves, Christensen and Diewert (1982). It indicates Total Factor Productivity (TFP) of DMU that has various inputs and outputs over two distinct periods (Cooper, Seiford & Tone, 2007). Thus, the Malmquist index represents a geometric average of two productivity indices that measure output distances between two periods \( k \) and \( k + 1 \), with the technology of period \( k \) as its point of reference (Caves, Christensen & Diewert, 1982).
Given that \( F(X, Y) = 0 \) is an equation of production technology with input and output vectors given as \( X = (x_1, x_2, x_3, \ldots, x_M) \); \( Y = (y_1, y_2, y_3, \ldots, y_S) \) respectively, use in defining the MPI of a production unit, (Galagedera & Edirisuriya, 2004). On the authority of Caves, Christensen and Diewert (1982), the distance function of output is defined as 
\[
D_0(X, Y) = \min_{\mu} \left[ \mu : F(X, Y \mu) = 0 \right],
\]

\( \mu \) represents the least change in equi-proportion in the output vector. To determine the output to replace \((X, Y)\) on the efficiency frontier, the output distance function that measures the enormous proportional change is used (Galagedera & Edirisuriya, 2004). The evaluated production unit is said to be efficient if \( D_o(X, Y) = 1 \), and inefficient if \( D_o(X, Y) < 1 \). Input orientation is used in computing the distance function with the reference technology in the periods \( k \) and \( k + 1 \), either for CRS or VRS preference. The output Malmquist Productivity Index which is used to assess the effectiveness of a DMU in two different periods, \( k \) and \( k + 1 \) using period \( t \) technology as established by Caves, Christensen and Diewert (1982) is

\[
M_0^k(X_{k+1}, Y_{k+1}, X_k, Y_k) = \frac{D_0^k(X_{k+1}, Y_{k+1})}{D_0^k(X_k, Y_k)}, \quad \text{.............................................. (11)}
\]

and when the production in the period \( (t + 1) \), the production function becomes

\[
M_0^{k+1}(X_{k+1}, Y_{k+1}, X_k, Y_k) = \frac{D_0^{k+1}(X_{k+1}, Y_{k+1})}{D_0^{k+1}(X_k, Y_k)}, \quad \text{.............................................. (12)}
\]

If \( M_0 > 1 \), it is an indication that productivity in period \( k \) is higher productivity in \( (k + 1) \).

Fare, Grosskopf, Norris and Zhang (1994) redefined the production function that integrates the Malmquist Productivity indices in both periods to avoid arbitrary selection of the period. The New Index is given below as,

\[
M_0(X_{k+1}, Y_{k+1}, X_k, Y_k) = \left[ \left( \frac{D_0^k(X_{k+1}, Y_{k+1})}{D_0^k(X_k, Y_k)} \right) \left( \frac{D_0^{k+1}(X_{k+1}, Y_{k+1})}{D_0^{k+1}(X_k, Y_k)} \right) \right]^{\frac{1}{2}} \quad \text{.......... (13)}
\]
This is also called the geometric means of output based on MPI regarding the two periods. From equation (13), it can be shown that,

\[ M_0(X_{k+1}, Y_{k+1}, X_k, Y_k) = \left( \frac{D_0^{k+1}(X_{k+1}, Y_{k+1})}{D_0^k(X_k, Y_k)} \right) \left[ \left( \frac{D_0^k(X_{k+1}, Y_{k+1})}{D_0^{k+1}(X_{k+1}, Y_{k+1})} \right) \left( \frac{D_0^k(X_k, Y_k)}{D_0^{k+1}(X_k, Y_k)} \right) \right]^{\frac{1}{2}} \] \quad \text{(14)}

Where \( \frac{D_0^{k+1}(X_{k+1}, Y_{k+1})}{D_0^k(X_k, Y_k)} \) measures the relative technical efficiency between the two periods, \( k \) and \( k + 1 \).

And \[ \left( \frac{D_0^k(X_t, Y_t)}{D_0^{k+1}(X_t, Y_t)} \right) \left( \frac{D_0^k(X_t, Y_t)}{D_0^{k+1}(X_t, Y_t)} \right)^{\frac{1}{2}} \] measures the technological changes between the two periods estimated at \( (X_k, Y_k) \) and \( (X_{k+1}, Y_{k+1}) \).

For each of the DMU, the study defines five indices that help apply the Malmquist Productivity Index for measuring the Total Factor Productivity for \( (k + 1) \) relative to period \( k \).

\[ \text{TFPCI} = \left( \frac{D_0^{k+1}(CRS)(X_{k+1}, Y_{k+1})}{D_0^k(CRS)(X_k, Y_k)} \right) \left[ \left( \frac{D_0^k(CRS)(X_{k+1}, Y_{k+1})}{D_0^{k+1}(CRS)(X_{k+1}, Y_{k+1})} \right) \left( \frac{D_0^k(CRS)(X_k, Y_k)}{D_0^{k+1}(CRS)(X_k, Y_k)} \right) \right]^{\frac{1}{2}} \] \quad \text{(15)}

\text{TFPCI} = \text{(Technical Efficiency Change Index) (Technological Change Index)}.

\[ \text{TCI} = \left( \frac{D_0^k(CRS)(X_{k+1}, Y_{k+1})}{D_0^{k+1}(CRS)(X_{k+1}, Y_{k+1})} \right) \left( \frac{D_0^k(CRS)(X_k, Y_k)}{D_0^{k+1}(CRS)(X_k, Y_k)} \right)^{\frac{1}{2}} \] \quad \text{(16)}

\[ \text{TECI} = \left( \frac{D_0^{k+1}(CRS)(X_{k+1}, Y_{k+1})}{D_0^k(CRS)(X_{k+1}, Y_{k+1})} \right) \] \quad \text{(17)}

\[ \text{PTECI} = \left( \frac{D_0^{k+1}(VRS)(X_{k+1}, Y_{k+1})}{D_0^k(VRS)(X_k, Y_k)} \right) \] \quad \text{(18)}

\[ \text{SECI} = \frac{\text{Technical Efficiency Change Index (TECI)}}{\text{Pure Technical Efficiency Change Index (PTECI)}} \]
\[
\text{SECI} = \left( \frac{D_0^t(X_t, Y_t)}{D_0^0(CRS)(X_t, Y_t)} \right) \left( \frac{D_0^t(X_{t+1}, Y_{t+1})}{D_0^0(VRS)(X_{t+1}, Y_{t+1})} \right)
\]

\[
\text{SECI} = \left[ \left( \frac{D_0^k(X_{k+1}, Y_{k+1})}{D_0^0(CRS)(X_{k+1}, Y_{k+1})} \right) \left( \frac{D_0^k(VRS)(X_{k+1}, Y_{k+1})}{D_0^0(VRS)(X_{k+1}, Y_{k+1})} \right) \right] \ldots \ldots \ldots (19)
\]

Where TFP\(\text{CI}\) represents Total Factor Productivity Change Index, TCI represents Technological Change Index, TCCI represents Technical Efficiency Change Index, PTECI represents Pure Technical Efficiency Change Index and SECI represents Scale Efficiency Change Index.

When the MPI is less than one, it is an indication that the production unit’s productivity has decreased, one shows that there is no change in production (productivity) and more than one suggests that the production unit’s productivity has increased from period \(k\) and to period, \((k + 1)\).

### 3.4.6 Bank Performance and DEA Based Malmquist Index

As stated above, several types of research have used DEA for analysing the efficiency of banks after it was first used by Sherman and Gold (1985) while others have used DEA based MPI to measure the profitability as well as efficiency of banks between two different time intervals. The DEA uses different approaches to measure efficiency in the banking industry (Tuskan & Stojanovic, 2016). According to Cooper, Seiford and Zhu (2011), production approach of DEA considers banks as institutions rendering services to their clients. They establish that banks use inputs such as human labour and other assets to provide services such as receiving deposits and granting credit facilities to their clients as the output they provide. Besides, the intermediation approach considers banks as agents that act on behalf and for the best interest of their customers by accepting deposits and other resources from them. They perform the functions of lending the funds collected from other customers in the form of loans, mortgages and other financial assets to those customers that need them at an agreed interest (Cooper, Seiford & Zhu, 2011). Likewise, Paradi, Rouatt and Zhu (2011) state that the profitability approach considers banks as institutions that determine their profits as the difference
between their revenue and their expenditure. They, therefore, assume expenditure as their input and revenue as their output.

The use of the radial DEA model and approach mainly is dependent on the importance of this study and the objectives it aims to achieve. Moreover, there has not been any established unison as to whether the CCR or the BCC model is the best (Henriques et al., 2018). Henriques et al., (2018) argue that using both models allows for an inefficient DMU to be determined as it will be compared to the other models. Similarly, Repkova (2014) and Yilmaz and Gunes (2015) argue that using both methods help to classify efficiency into Technical Efficiency and Pure Technical Efficiency. CCR model measures the technical efficiency while BCC model measures efficiency based on the administrative efficiency, called the Pure Technical efficiency (Yilmaz & Gunes, 2015). Based on Henriques et al.’s (2018) model (Tuskan and Stojanovic, 2016; Stewart et al., 2016; Yilmaz and Gunes, 2015; Svitakova, 2014; Seiford and Zhu, 1999), this study also adopted the CCR and the BCC model of DEA with the profitability approach to determine the efficiency and the financial performance of banks before and after 2009 recapitalisation of Ghanaian banks. The use of the output-oriented approach provided trends of efficiency and basis for ranking the banks with the best performer. In line with Tuskan and Stojanovic (2016), all expenditures will be considered as the inputs and all revenue earning variables will be used as the outputs. The study, therefore, uses Interest expenses \(x_1\), Wages and Salaries \(x_2\) and operation expenses \(x_3\) as the input variables and interest income \(y_1\), Net Operating Income \(y_2\) as the output variables (Jiang & Yifan, 2018; Henriques et al., 2018; Tuskan & Stojanovic, 2016; Dauda et al., 2016).

Interest expenses \(x_1\): It is the cost incurred by a bank as a result of using a financial resource that belongs to another bank or another financial institution. Thus, it is the interest paid on borrowed funds by a bank.

Wages and Salaries \(x_2\): It is the expenditure incurred or the investment in human capital that serves as the input in running the banks.
Operation expenses \((x_3)\): This is the main expenses incurred in the day to day running of the bank. It is mostly made up of administrative expenses.

Net Operating Income \((y_2)\): It is the profit from the operation of the banks. It is the total earning of the bank after interest and taxes are deducted.

Interest income \((y_1)\): It is the interest received by a bank on the loans granted to its customers.

Malmquist Productivity Index to measure the Total Productivity Change of banks considering the period before 2009 recapitalisation as period \(t\) and the period after recapitalisation as period \((t + 1)\) in line with Jiang & He (2018), Fadipe & Arulogun (2015), Benli & Degirmen (2013), Pandey & Singh (2015), Raphael (2013), Casu, Ferrari & Zhao (2013) and Galagedera & Edirisuriya (2004). These authors used DEA with MPI to evaluate the efficiency of banks operations. This research will, therefore, base it first stage efficiency evaluation on the DEA MPI.

3.5 Productivity Determinants

Bank specific factors and some environmental factors are actual determinants of bank productivity. These factors can predict whether productivity would decline or increase (Kale et al., 2015). The possible factors that might have impacted total productivity changes are analysed at this stage of the study. Some studies used Tobit regression (Rezitis, 2006; Hauner, 2005), Ordinary Least Squares, (Jreisat, Hassan and Shankar, 2017; Kale et al., 2015; McDonald, 2009; Banker & Natarajan, 2008; Hoff, 2007) and Generalised Method of moments (Sufian, 2015) at the second-stage.

This study went a step ahead of Jreisat et al. (2017), Kale et al. (2015), McDonald (2009), Banker and Natarajan (2008), and Hoff (2007) who suggest that ordinary least square is better referred to as Tobit regression and other regressions, by using multi-level regression, Random Effects Model, with its Maximum Likelihood estimates. The study referred to the random-effects model as OLS as it best fits the data as per the results of the Hausman test conducted which supported the hypothesis that the random effects is appropriate for the data. In addition, the study used other diagnostic tests such as the Breusch and Pagan Lagrangian multiplier test for random effects to determine if indeed the random
effects are appropriate for the data and that the null hypothesis that variance across entities is zero is rejected which also supported the use of the random-effects model. The model also has the ability to capture the within-entity error and the between-entity error separately in its model. The individual-specific effect in the random effect model is a random variable which is uncorrelated to the explanatory variables (Green, 2008). It also assumes that an individual-specific effect is an uncorrelated random variable with the explanatory variables of all the individual's past, current and future time periods (Del Fava, Shkedy, Aregay & Molenberghs, 2014). In addition, the selection of the random-effects model is in line with Gaganis, Liadaki, Doumpos and Zopounidis (2009) and Danquah, Barimah & Ohemeng (2013) who considered possible challenges of observed and unobserved heterogeneity not catered for by the ordinary least squares regression model.

The choice of independent variables is based on the empirical literature reviewed on banking sector efficiency evaluations by Jreisat, Hassan and Shankar (2017), Vu and Turnell (2011), Hermes and Nhung (2010) and Pasiouras (2009). This allowed the productivity estimates to be regressed on a set of independents variables with two different sets of regression equations representing the pre-capitalization and post-capitalisation periods respectively. These two equations are labelled as equation (20) and (21) respectively;

\[ \Delta{MPI}_{it} = \beta_0 + \beta_1{LTA}_{it} + \beta_2{LTD}_{it} + \beta_3{ROE}_{it} + \beta_4{NIM}_{it} + \beta_5{NIETA}_{it} + \beta_6{GDPGR}_t + \beta_7{INFLA}_t + \beta_8{OWN}_{it} + \tau_t + \epsilon_{it} \ldots \ldots \ldots \ldots \ldots (20). \]

\[ \Delta{MPI}_{it} = \alpha_0 + \alpha_1{LTA}_{it} + \alpha_2{LTD}_{it} + \alpha_3{ROE}_{it} + \alpha_4{NIM}_{it} + \alpha_5{NIETA}_{it} + \alpha_6{GDPGR}_t + \alpha_7{INFLA}_t + \alpha_8{OWN}_{it} + \epsilon_t + \mu_{it} \ldots \ldots \ldots \ldots \ldots (21). \]

\( \Delta{MPI}_{it} \) is the dependent variable of the model that measures the change in the MPI of an \( i^{th} \) Bank at any time \( t \). The variables \( \beta_0 \) and \( \alpha_0 \) are the intercepts (constants) of the two regression equations and \( \alpha_i \) and \( \beta_i \) (\( i = 1, 2, 3, \ldots, 8 \)) are the constants terms of the independent variables in the two regression equations, \( \epsilon_{it} \) and \( \mu_{it} \) are errors terms before and after the 2009 recapitalisation respectively.
and $\tau_t$ and $\epsilon_t$ are the unobserved time-invariant individual effect before and after the 2009 recapitalisation respectively.

LTA represents the logarithm of total assets of each bank. This is used to denote the growth of banks in the industry. Its value is expected to be directly proportionate to productivity, hence positive. Productivity is expected to decline if a bank becomes very big in size and management are ineffective to run the banking operation efficiently (Jreisat et al., 2017).

LTD denotes the value of the loans in proportionate of deposits measured by total loans divided by total deposit at any given time $t$. It is the primary indicator for liquidity creation of banks. A higher ratio means that banks give more loans from the deposits taken which means that they are executing their intermediation role to their customers well and in turns they will get more interest. However, they will find it challenging to provide deposits on-demand to their customer. Similarly, a low ratio also shows that banks are not being able to loan out the deposit they have mobilised to earn interest (Jreisat et al., 2017).

ROE represents Return on equity which means the financial performance of the banks by expressing the net income of the banks over the shareholders’ equity. Improved value of ROE is an indication that the bank is performing well (Jreisat et al., 2017).

NIETA means non-interest expenditure as a proportion of total assets that measure the administrative expenditure incurred by banks. In the presence of prudent management, this expenditure is expected to be low, leading to increased productivity. Therefore, for improved productivity, it is expected that the ratio of non-interest expenses to total assets is low, meaning the banks are being cost-effective (Jreisat et al., 2017).

NIM signifies the net interest margin of a bank. It is the difference between the interest income earns and interest expenditure pays out expressed on the total earning assets. If interest income is higher
than interest expenses, then it is an indication of excellent performance as it is positively related to productivity (Jreisat et al., 2017).

GDPGR is the growth rate of the gross domestic products of the country where the banking transactions are carried out during the period of the study. It is expected to be positive or negative by empirical findings (Klien & Weill, 2019; Tetteh-Amenei, 2014; Obamuyi, 2013; Naceur & Omran, 2011).

The inflation rate is the other macroeconomic environment indicator used in the linear regression model. It is stated that an increase in inflation leads to an increase in banks’ profitability as an increase in inflation enables banks to adjust their interest rate of loans upwards. However, this is expected to be positively or negatively associated with banks’ performance and profitability according to well-documented literature and empirical findings (Bayramli & Al-Musehel, 2018; Tetteh-Amemi, 2014).

The model used a dummy variable to indicate whether a bank is a local bank or a foreign bank. It takes a value of 1 if a bank is a foreign-owned and 0 otherwise.

3.6 Data Analyzes Procedure
The study employed MaxDEA 7 software for the first stage analysis. This software enabled the study to carry out both the CCR and the BCC model of DEA. It enabled the researcher to compute the scale efficiency of each DMU besides the Technical efficiency and the Pure Technical Efficiency computed using the CCR and the BCC models. It also has the Malmquist Productivity Index option. Therefore, estimating the total factor productivity change for pre-capitalization and post-capitalisation was dealt with efficiently. In the second stage, Stata Edition 14 was used for the linear regression. It enabled the study to conduct some diagnostic test to determine the reliability and fitness of the linear regression model employed.

3.7 Ethical Consideration
Plagiarism is the ethical problems most academic studies generally face. With that in mind, this research guarantees that any such problems are prevented as much as possible. Any content used from

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other publications are recognized and acknowledged. It is of priority that no information and data collected could be tampered within order to manipulate the outcome of the findings with data for the analysis of the results. Per the method that the study seeks to employ, information about all the banks used have been stated explicitly. However, the study did not consider this as an ethical issue as these pieces of information are always available upon request for anyone who may wish to use them. Therefore, stating the actual names of the banks would not in any way damage the reputation of the banks used for this research.
CHAPTER FOUR
RESULTS AND DATA ANALYSIS

4.1 Introduction
The chapter starts with the descriptive statistics of the input and output variables of Banks in Ghana from 2005 to 2015. The descriptive statistics is split in two, representing before capitalization era and after capitalisation era. Also, all the variables used are outlined here. Besides the results are displayed consistently to outline the objectives of the study. What is more, discussions are made to corroborate existing empirical and theoretical arguments.

4.2 Description of the Variables
The measures of central tendencies and associations such as means, medians, minimal, maximal and standard deviations of the variables used in the first-stage are presented in Table 4.1 below. The input and output variables for pre-capitalization and post-capitalisation are exhibit in Table 4.2 and Table 4.3 respectively. The data of the 22 banks, (12 foreign and 10 local) were sourced from the various banks’ published financial statements and the GBA from the period of 2005 to 2015 and this was cross-validated from the research unit of the Bank of Ghana. The input variables are interest expenses ($x_1$), Wages and Salaries ($x_2$), and Other operating expenses ($x_3$) while interest income ($y_1$) and other operating income ($y_2$) are the output variables used by the study.

From the Table 4.1, the period from 2005 to 2015 banks on average got GH₵81,610,910.00 as the net interest income from their operations, calculated from the average interest expenses of GH₵44,435,960.00 as against the interest income of GH₵122,680,880.00 for the period under consideration. The banks spent an average of GH₵41,525,580.00 on wages and salaries, and GH₵69,857,100.00 on other operating expenses. The average income generated from operating activities was GH₵126,046,870.00. The maximum amount paid out by a bank as interest expenses was GH₵495,948,000.00 while a bank received GH₵ 867,285,000.00 as interest income.
Table 4.1: Descriptive Statistics of input and output variables from 2005 to 2015.

<table>
<thead>
<tr>
<th></th>
<th>Interest expenses (GH₵000)</th>
<th>Wages and Salaries (GH₵000)</th>
<th>Other Operating Expenses (GH₵000)</th>
<th>Interest Income (GH₵000)</th>
<th>Other Operating Income (GH₵000)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean</td>
<td>44,435.96</td>
<td>41,525.58</td>
<td>69,857.10</td>
<td>122,680.88</td>
<td>126,046.87</td>
</tr>
<tr>
<td>Standard Error</td>
<td>3,935.58</td>
<td>9,490.32</td>
<td>6,785.60</td>
<td>9,509.98</td>
<td>10,190.05</td>
</tr>
<tr>
<td>Median</td>
<td>26,626.50</td>
<td>16,697.00</td>
<td>38,993.00</td>
<td>66,017.22</td>
<td>60,454.50</td>
</tr>
<tr>
<td>Standard Deviation</td>
<td>61,223.30</td>
<td>147,329.41</td>
<td>105,559.20</td>
<td>147,940.60</td>
<td>158,519.92</td>
</tr>
<tr>
<td>Minimum</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Maximum</td>
<td>495,948.00</td>
<td>2,230,940.00</td>
<td>998,837.00</td>
<td>839,007.00</td>
<td>867,285.00</td>
</tr>
<tr>
<td>Number of observations</td>
<td>242</td>
<td>242</td>
<td>242</td>
<td>242</td>
<td>242</td>
</tr>
</tbody>
</table>

Author’s computation.

Personnel compensation by a bank was as high as GH₵2,230,940,000.00 while the maximum amount spent on operations amounted to GH₵998,837,000.00 and GH₵867,285,000.00 was the highest amount generated from other operating expenses. The interest income and interest expenses had a close measure of association as their mean and standard deviations were close to each other. However, for the wages and salaries, other operating expenses and income, the standard deviation and the mean spread out from each other.

The pre-capitalization period saw banks on average paying GH₵16,056,430.00 as interest expense and received GH₵41,929,300.00 as interest income. The banks spent on average GH₵12,575,060.00 and GH₵26,381,420.00 on wages and salaries as well as other operating expenses for the period respectively and received GH₵41,964,260.00 as income from their other business operations between the period of 2005 and 2009.
Table 4.2: Descriptive Statistics of input and output variables of Banks from 2005 to 2009 (Pre-Capitalization period).

<table>
<thead>
<tr>
<th></th>
<th>Interest expenses (GHC'000)</th>
<th>Wages and Salaries (GHC'000)</th>
<th>Other Operating Expenses (GHC'000)</th>
<th>Interest Income (GHC'000)</th>
<th>Other Operating Income (GHC'000)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Mean</strong></td>
<td>16,056.43</td>
<td>12,575.06</td>
<td>26,381.42</td>
<td>41,929.30</td>
<td>41,964.26</td>
</tr>
<tr>
<td><strong>Standard Error</strong></td>
<td>1,733.16</td>
<td>1,483.51</td>
<td>2,742.48</td>
<td>4,384.47</td>
<td>4,379.31</td>
</tr>
<tr>
<td><strong>Median</strong></td>
<td>10,889.07</td>
<td>6,570.50</td>
<td>17,197.50</td>
<td>26,935.00</td>
<td>25,569.00</td>
</tr>
<tr>
<td><strong>Standard Deviation</strong></td>
<td>18,177.53</td>
<td>15,559.14</td>
<td>28,763.41</td>
<td>45,984.68</td>
<td>45,930.62</td>
</tr>
<tr>
<td><strong>Minimum</strong></td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td><strong>Maximum</strong></td>
<td>134,312.00</td>
<td>84,989.00</td>
<td>141,584.00</td>
<td>266,019.00</td>
<td>202,224.00</td>
</tr>
<tr>
<td><strong>Count</strong></td>
<td>110</td>
<td>110</td>
<td>110</td>
<td>110</td>
<td>110</td>
</tr>
</tbody>
</table>

*Author’s computation*

Maximum expenditure for the banks stood at GHC134,312,000.00, GHC84,989,000.00 and GHC141,584,000.00 for interest expenses, wages and salaries and other operating expenditure, respectively. There was no figure for minimum values as Bank of Baroda was incorporated in 2006 and had no figure for their business operations in 2005. The measures of the association from that of the central tendencies for all the five variables indicate the spread out of the values from the mean values. It is an indication of the infancy of some banks in the industry banks from 2005 to 2009.

From the post-capitalisation analysis, banks on average got more revenue than what they got during the pre-capitalization period and the entire period. At the same time, they spent more on expenditure. Average interest income and interest expenses were GHC209,526,720.00 and GHC75,150,610.00 respectively. They spent on average GHC72,994,050.00 on compensation for human capital in their operation and GHC117,071,640.00 on the day to day running of the banking activities. In turns, the banking sector generated on average a total of GHC218,440,980.00 for the other business operation. The minimum amount paid as interest income after recapitalisation stood at GHC102,000.00 while the
interest income received was GH₵5,343,620.00. Employees were compensated as low as GH₵295,000.00 by a bank while the minimum other operating income of a bank was GH₵5,148,000.00 after the recapitalisation period.

Table 4.3: Descriptive Statistics of inputs and output variables of Banks from 2011 to 2015 (Post-Capitalization period).

<table>
<thead>
<tr>
<th></th>
<th>Interest expenses (GH₵000)</th>
<th>Wages and Salaries (GH₵000)</th>
<th>Other Operating Expenses (GH₵000)</th>
<th>Interest Income (GH₵000)</th>
<th>Other Operating Income (GH₵000)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean</td>
<td>75,150.61</td>
<td>72,994.05</td>
<td>117,071.64</td>
<td>209,526.72</td>
<td>218,440.98</td>
</tr>
<tr>
<td>Standard Error</td>
<td>7,504.16</td>
<td>20,531.92</td>
<td>13,341.38</td>
<td>16,851.29</td>
<td>18,299.77</td>
</tr>
<tr>
<td>Median</td>
<td>50,232.00</td>
<td>36,659.00</td>
<td>76,576.00</td>
<td>174,320.00</td>
<td>155,646.00</td>
</tr>
<tr>
<td>Standard Deviation</td>
<td>78,345.72</td>
<td>214,359.53</td>
<td>139,288.05</td>
<td>175,932.66</td>
<td>191,055.17</td>
</tr>
<tr>
<td>Minimum</td>
<td>102.00</td>
<td>295.00</td>
<td>1,282.00</td>
<td>5,343.62</td>
<td>5,148.00</td>
</tr>
<tr>
<td>Maximum</td>
<td>495,948.00</td>
<td>2,230,940.00</td>
<td>998,837.00</td>
<td>839,007.00</td>
<td>867,285.00</td>
</tr>
<tr>
<td>Number of observations</td>
<td>110</td>
<td>110</td>
<td>110</td>
<td>110</td>
<td>110</td>
</tr>
</tbody>
</table>

*Author’s computation.*

4.3 Validity of the Efficiency Evaluation Model

This study employs a non-parametric test in its first stage which requires that the isotonicity test is carried out to confirm the validity of the model. This property states that an increment in inputs should be associated with a corresponding increment in outputs. It suggests that a positive correlation should be found between the input and output variables (Hawng, Park & Kim, 2018; Adusei, 2016; Cooper et al., 2011; Avkiran, 2006). Furthermore, the magnitude of the correlation coefficients is not necessarily an issue despite the fact that a low coefficient correlation is acceptable (Dyson et al., 2001). The tables below show the correlation coefficients between the input and output variables with the p-values in the parenthesis under the hypothesis of no correlation between the variables. The study revealed a positive correlation between the variables at 1% level of significance for the entire duration. The tables 4.4, 4.5
and 4.6 below show the correlation coefficients. It demonstrates that the model’s specification is appropriate for the analysis.

**Table 4.4: Correlation Coefficients of the Input and Output variables used in the DEA Analysis**

(For the duration of the study, 2005 to 2015).

<table>
<thead>
<tr>
<th></th>
<th>Interest expenses</th>
<th>Wages and Salaries</th>
<th>Other Operating Expenses</th>
<th>Interest Income</th>
<th>Other Operating Income</th>
</tr>
</thead>
<tbody>
<tr>
<td>Interest expenses</td>
<td>1.00</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wages and Salaries</td>
<td>0.21 (0.0000***</td>
<td>1.00</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Other Operating Expenses</td>
<td>0.48 (0.0000***</td>
<td>0.75 (0.0000***</td>
<td>1.00</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Interest Income</td>
<td>0.77 (0.0000***</td>
<td>0.36 (0.0000***</td>
<td>0.72 (0.0000***</td>
<td>1.00</td>
<td></td>
</tr>
<tr>
<td>Other Operating Income</td>
<td>0.55 (0.0000***</td>
<td>0.50 (0.0000***</td>
<td>0.82 (0.0000***</td>
<td>0.90 (0.0000***</td>
<td>1.00</td>
</tr>
</tbody>
</table>

*Author’s computation. *** Is an indicator of 1% significance level.*

**Table 4.5: Correlation Coefficients of the Input and Output variables used in the DEA Analysis**

(Post-capitalization period, 2005 to 2009).

<table>
<thead>
<tr>
<th></th>
<th>Interest expenses</th>
<th>Wages and Salaries</th>
<th>Other Operating Expenses</th>
<th>Interest Income</th>
<th>Other Operating Income</th>
</tr>
</thead>
<tbody>
<tr>
<td>Interest expenses</td>
<td>1.00</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wages and Salaries</td>
<td>0.74 (0.0000***</td>
<td>1.00</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Other Operating Expenses</td>
<td>0.69 (0.0000***</td>
<td>0.88</td>
<td>1.00</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Interest Income</td>
<td>0.88 (0.0000***</td>
<td>0.91</td>
<td>0.88</td>
<td>1.00</td>
<td></td>
</tr>
<tr>
<td>Other Operating Income</td>
<td>0.72 (0.0000***</td>
<td>0.90</td>
<td>0.90</td>
<td>0.93 (0.0000***</td>
<td>1.00</td>
</tr>
</tbody>
</table>

*Author’s computation. *** Is an indicator of 1% significance level.*
Table 4.6: Correlation Coefficients of the Input and Output variables used in the DEA Analysis (Post-capitalization period, 2011 to 2015).

<table>
<thead>
<tr>
<th></th>
<th>Interest expenses</th>
<th>Wages and Salaries and Operating Expenses</th>
<th>Interest Income</th>
<th>Other Operating Income</th>
</tr>
</thead>
<tbody>
<tr>
<td>Interest expenses</td>
<td>1.00</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wages and Salaries</td>
<td>0.12</td>
<td>1.00</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Other Operating Expenses</td>
<td>0.33 (0.0000***), 0.75 (0.0000***), 1.00 (0.0000***), 0.63 (0.0000***), 0.84 (0.0000***), 1.00 (0.0000***),</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Interest Income</td>
<td>0.68 (0.0000***), 0.30 (0.0000***), 0.63 (0.0000***), 0.84 (0.0000***), 1.00 (0.0000***), 0.38 (0.0000***), 0.47 (0.0000***), 0.78 (0.0000***), 0.84 (0.0000***), 1.00 (0.0000***),</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Other Operating Income</td>
<td>0.38 (0.0000***), 0.47 (0.0000***), 0.78 (0.0000***), 0.84 (0.0000***), 1.00 (0.0000***),</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Author’s computation. *** Is an indicator of 1% significance level.

4.4 Evaluation of Efficiency and Productivity of the Banking Sector

In line with the first objective of the study to evaluate the efficiency and productivity of the banking industry before and after the 2009 recapitalisation, the study used efficiency evaluation to achieve the objects of the study since the efficiency evaluation used profit productivity determinants of each bank. The efficiency calculation based on a geometric mean, as was parallel in the literature, was used for all the banks for the pre-capitalisation period of 2005 to 2009 and the post-capitalisation period of 2011 to 2015 (Kale et al., 2015; Pasiouras & Sifodaskalakis, 2010; Tanna, 2009; Ramathan 2007; Jaffry, Ghulam, Pascoe & Cox, 2005; Casu & Girardone, 2005; Dogan & Fauten, 2003). Thus, the study used the profit productivity approach of the DEA. The radial model of DEA which has to deal with a proportional reduction in input given outputs or proportional augmentation in output given inputs (Cook & Zhu, 2005; Fried et al., 2008; Cooper et al., 2011).

Thus, both the CCR and BCC models were utilized, which enabled the study to make use of the CCR model’s technical efficiency as a result of its constant scale returns with the variable scale returns of the BCC model, which determined the pure technical efficiency and helped calculate scale efficiency of each bank. The table labelled Table 4.7 below shows the output from the DEA computation.

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efficiencies based on the technical, pure technical and scale efficiency scores were evaluated as shown in Table 4.7. On average, the overall technical efficiency based on the CCR model for the pre-capitalization period was 75% which was decomposed into a mutually exclusive and collectively exhaustible component of the pure technical efficiency and scale technical efficiency as 82% and 91% respective. These averages represent the geometric means of the 22 banks from 2005 to 2009. The period saw Universal Merchant Bank achieving the maximum technical efficiency of 95.7% while Guaranteed Trust Bank achieved the least of 39.6%.

Considering the post recapitalisation period of 2011 – 2015 the overall efficiency was 45.7%. However, Bank of Baroda was the most effective as it obtained an efficiency score of 100%. Universal Merchant Bank was the least efficient bank with an efficient score of 20.5% from 2011 to 2015, considering that it obtained an excellent efficiency of 95.75% during the pre-capitalization era. Given that the standard deviation for the CCR model is the highest, it shows that the efficiency score is widespread among the banks during the post-recapitalisation era. The efficiencies as measured by the technical efficiency, pure technical efficiency and scale efficiency are shown in Figure 4.1 and 4.2, respectively.

Of all the twenty-two (22) banks that were analysed, the pre-capitalization period of 2005 to 2009, saw twenty (20) banks having overall efficiencies above 50%. Only UMB and GTB had an efficiency of 0.498 and 0.396, respectively. The overall efficiencies dropped drastically for most of the banks with only 10 banks having efficiency scores above 50% after the recapitalisation was fully implemented. The period between 2011 and 2015 only saw BCC, Ecobank, FNB Bank, GTB and GCB Bank with the overall efficiency of 0.87, 0.559, 0.584, 0.522 and 0.659, respectively. The rest were SG-SSB, SCB, UBA, Zenith Bank and Bank of Baroda, with their respective efficiency scores of 0.611, 0.528, 0.506, 0.621 and 1 respectively as illustrated in Figure 4.3 below.
Figure 4. 1: Technical, Pure Technical and Scale Efficiencies of Banks during Pre-Capitalisation (2005 – 2009).

Figure 4. 2: Technical, Pure Technical and Scale Efficiencies of Banks during Post-Capitalisation (2011 – 2015).
Figure 4.3 reveals that more banks performed efficiently before recapitalisation than they did after recapitalisation, judging from their technical efficiency scores that measure the production capabilities of each of the banks and the diagram in Figure 4.3 that illustrates the technical efficiency for both periods.

Technical Efficiency was decomposed into mutually exclusive and collectively exhaustible components of the pure technical efficiency and scale of technical efficiency. The scale efficiency determines the optimal operation scale of a bank. From Table 4.7, the geometric average scale efficiency is 91% between the period of 2005 and 2009. It, however, dropped drastically to 60.5% for the post-capitalisation period, even though the maximum scale efficiency for both periods is at 100%. The minimum for both periods is 74% and 45.9% representing the pre-capitalization and post-capitalisation era respectively. The pictorial analysis of this is in Figure 4.4 below.
From the diagram, apart from Bank of Baroda which maintain it 100% efficiency level for both periods, only Barclays Bank improved it efficiency after recapitalisation from 89% to 93% on its scale efficiency which is an indicator of optimal production.

According to VRS approach, which uses BCC model to measure the efficiency scores of the banks based on pure technical efficiency that determines the administrative and the managerial abilities of the banks and their real operating economic environment the pure technical efficiency on average is greater for the pre-capitalization era as against the post-capitalisation era with a score of 82% relative to 75.6%. Three banks: Barclays Bank Ghana Ltd, GCB Bank Ltd and Standard Chartered Bank achieved an efficiency score of 100% before recapitalisation. However, only the Bank of Baroda achieved an
efficiency of 100% in terms of its pure technical efficiency that measures the managerial and the administrative capacity of the banks. Universal Merchant Bank was the least efficient bank again with its pure technical efficiency score of 41.3%. This is illustrated in Figure 4.5 below.

From the diagram in Figure 4.5, it can be seen that in the pre-capitalization period thirteen (13) of the twenty-two (22) banks performed better than in the post-capitalization period. Taking into account the pure technical efficiency of the nine (9) banks left, 3 achieved a 1% rise in their pure technical effectiveness following recapitalization. Given that all these banks are small banks relative to the other thirteen banks, conclusion can be drawn that on average, the pure technical efficiency in the pre-capitalization era is higher than the post-capitalisation era.

With the analysis using the figures above and the computation in the table, the study deduced that the banking sector witnessed a decrease in efficiency and productivity which are the leading indicators of their profit productivity after recapitalisation relative to their efficiency and performance before recapitalisation.
Table 4. 7: Technical Efficiency, Pure Technical Efficiency and Scale Technical Efficiency of Banks during the Pre-capitalization and Post-Capitalization Period.

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>TE</td>
<td>PTE</td>
</tr>
<tr>
<td>ADB</td>
<td>0.696</td>
<td>0.779</td>
</tr>
<tr>
<td>BANK OF AFRICA</td>
<td>0.597</td>
<td>0.660</td>
</tr>
<tr>
<td>BBG</td>
<td>0.891</td>
<td>1.000</td>
</tr>
<tr>
<td>CAL BANK</td>
<td>0.855</td>
<td>0.868</td>
</tr>
<tr>
<td>ECOBANK</td>
<td>0.813</td>
<td>0.944</td>
</tr>
<tr>
<td>FBL</td>
<td>0.758</td>
<td>0.681</td>
</tr>
<tr>
<td>FAB</td>
<td>0.932</td>
<td>0.934</td>
</tr>
<tr>
<td>FNB BANK</td>
<td>0.689</td>
<td>0.757</td>
</tr>
<tr>
<td>GCB BANK</td>
<td>0.740</td>
<td>1.000</td>
</tr>
<tr>
<td>GTB</td>
<td>0.396</td>
<td>0.467</td>
</tr>
<tr>
<td>HFC BANK</td>
<td>0.920</td>
<td>0.935</td>
</tr>
<tr>
<td>NIB</td>
<td>0.656</td>
<td>0.722</td>
</tr>
<tr>
<td>PBL</td>
<td>0.898</td>
<td>0.921</td>
</tr>
<tr>
<td>SG-SSB</td>
<td>0.789</td>
<td>0.919</td>
</tr>
<tr>
<td>STANBIC</td>
<td>0.825</td>
<td>0.892</td>
</tr>
<tr>
<td>SCB</td>
<td>0.899</td>
<td>1.000</td>
</tr>
<tr>
<td>UBA</td>
<td>0.498</td>
<td>0.589</td>
</tr>
<tr>
<td>UMB</td>
<td>0.957</td>
<td>0.976</td>
</tr>
<tr>
<td>ZENITH BANK</td>
<td>0.871</td>
<td>0.923</td>
</tr>
<tr>
<td>BORODA</td>
<td>0.871</td>
<td>0.871</td>
</tr>
<tr>
<td>UNIBANK</td>
<td>0.658</td>
<td>0.768</td>
</tr>
<tr>
<td>UT BANK</td>
<td>0.665</td>
<td>0.714</td>
</tr>
<tr>
<td>Geomean</td>
<td>0.750</td>
<td>0.820</td>
</tr>
<tr>
<td>Standard Deviation</td>
<td>0.148</td>
<td>0.147</td>
</tr>
<tr>
<td>Minimum</td>
<td>0.396</td>
<td>0.467</td>
</tr>
<tr>
<td>Maximum</td>
<td>0.957</td>
<td>1.000</td>
</tr>
</tbody>
</table>

Source: Author’s computation; TE(Technical Efficiency); PTE(Pure Technical Efficiency) and SES(Scale Efficiency)

These findings concur with other findings in the literature (Francisco & Sonia, 2014; Ibrahim et al., 2012; Shehu & Nuraddeen, 2011; Sadiq et al., 2018; Tetteh-Ametei, 2014). It, however, contradicts those findings by Bakare, (2011), Naceur and Omran (2010), Ernovianti and Ahmad (2017), Kale et al. (2015), Akomea and Adusei (2013), Kukurah et. al. (2014), Naceur and Kandil (2009) and Dauda et al.
In dealing with the second objective of the study, the study considered the local banks and the foreign banks as two separate DMUs and assessed the performance of one relative to the other.

Table 4.8: Technical Efficiency, Pure Technical Efficiency and Scale Technical Efficiency of Banks from the year 2005 to 2015.

<table>
<thead>
<tr>
<th>YEAR</th>
<th>DOMESTIC BANKS</th>
<th>FOREIGN BANKS</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>TE</td>
<td>PTE</td>
</tr>
<tr>
<td>2005</td>
<td>0.804</td>
<td>0.760</td>
</tr>
<tr>
<td>2006</td>
<td>0.800</td>
<td>0.847</td>
</tr>
<tr>
<td>2007</td>
<td>0.811</td>
<td>0.906</td>
</tr>
<tr>
<td>2008</td>
<td>0.750</td>
<td>0.830</td>
</tr>
<tr>
<td>2009</td>
<td>0.704</td>
<td>0.807</td>
</tr>
<tr>
<td>2010</td>
<td>0.650</td>
<td>0.820</td>
</tr>
<tr>
<td>2011</td>
<td>0.434</td>
<td>0.845</td>
</tr>
<tr>
<td>2012</td>
<td>0.492</td>
<td>0.792</td>
</tr>
<tr>
<td>2013</td>
<td>0.226</td>
<td>0.691</td>
</tr>
<tr>
<td>2014</td>
<td>0.353</td>
<td>0.725</td>
</tr>
<tr>
<td>2015</td>
<td>0.347</td>
<td>0.463</td>
</tr>
<tr>
<td>GEOMEAN</td>
<td>0.536</td>
<td>0.761</td>
</tr>
</tbody>
</table>

Source: Author’s computation; TE(Technical Efficiency); PTE(Pure Technical Efficiency) and SC(Scale Efficiency)

Table 4.9: Technical Efficiency, Pure Technical Efficiency and Scale Technical Efficiency of Banks from the year 2005 to 2009 (Pre-Capitalisation Period)

<table>
<thead>
<tr>
<th>FOREIGN BANKS</th>
<th>DOMESTIC BANKS</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>TE</td>
</tr>
<tr>
<td>BORODA</td>
<td>0.87</td>
</tr>
<tr>
<td>BBG</td>
<td>0.89</td>
</tr>
<tr>
<td>SG-SSB</td>
<td>0.79</td>
</tr>
<tr>
<td>FNB BANK</td>
<td>0.69</td>
</tr>
<tr>
<td>ZENITH BANK</td>
<td>0.87</td>
</tr>
<tr>
<td>ECOBANK</td>
<td>0.81</td>
</tr>
<tr>
<td>STANBIC</td>
<td>0.82</td>
</tr>
<tr>
<td>UBA</td>
<td>0.50</td>
</tr>
<tr>
<td>GTB</td>
<td>0.40</td>
</tr>
<tr>
<td>SCB</td>
<td>0.90</td>
</tr>
<tr>
<td>FAB</td>
<td>0.93</td>
</tr>
<tr>
<td>BA</td>
<td>0.60</td>
</tr>
<tr>
<td>GEOMEAN</td>
<td>0.73</td>
</tr>
</tbody>
</table>

Source: Author’s computation; TE(Technical Efficiency); PTE(Pure Technical Efficiency) and SC(Scale Efficiency)
The research computed the overall efficiency as measured by the technical efficiency, disintegrated into the pure technical efficiency and the scale efficiency for the domestic and the foreign banks from the period of 2005 to 2015. It aided the study to ascertain the efficiency as well as performance and helped to determine the profit productivity throughout the study. Table 4.8 above highlights the banks’ efficiency scores.

**Table 4.10: Technical Efficiency, Pure Technical Efficiency and Scale Technical Efficiency of Banks from the year 2011 to 2015 (Post-Capitalisation Period).**

<table>
<thead>
<tr>
<th>FOREIGN BANKS</th>
<th>TE</th>
<th>PTE</th>
<th>SES</th>
<th>DOMESTIC BANKS</th>
<th>TE</th>
<th>PTE</th>
<th>SES</th>
</tr>
</thead>
<tbody>
<tr>
<td>BORODA</td>
<td>1.00</td>
<td>1.00</td>
<td>1.00</td>
<td>GCB BANK</td>
<td>0.66</td>
<td>0.94</td>
<td>0.70</td>
</tr>
<tr>
<td>BBG</td>
<td>0.87</td>
<td>0.93</td>
<td>0.93</td>
<td>CAL BANK</td>
<td>0.47</td>
<td>0.82</td>
<td>0.58</td>
</tr>
<tr>
<td>SG-SSB</td>
<td>0.61</td>
<td>0.84</td>
<td>0.73</td>
<td>NIB</td>
<td>0.40</td>
<td>0.73</td>
<td>0.55</td>
</tr>
<tr>
<td>FNB BANK</td>
<td>0.58</td>
<td>0.82</td>
<td>0.72</td>
<td>ADB</td>
<td>0.32</td>
<td>0.61</td>
<td>0.53</td>
</tr>
<tr>
<td>ZENITH BANK</td>
<td>0.62</td>
<td>0.91</td>
<td>0.69</td>
<td>HFC</td>
<td>0.31</td>
<td>0.62</td>
<td>0.51</td>
</tr>
<tr>
<td>ECOBANK</td>
<td>0.56</td>
<td>0.84</td>
<td>0.66</td>
<td>UMB</td>
<td>0.21</td>
<td>0.41</td>
<td>0.50</td>
</tr>
<tr>
<td>STANBIC</td>
<td>0.48</td>
<td>0.76</td>
<td>0.64</td>
<td>UNIBANK</td>
<td>0.43</td>
<td>0.87</td>
<td>0.49</td>
</tr>
<tr>
<td>UBA</td>
<td>0.51</td>
<td>0.78</td>
<td>0.64</td>
<td>FBL</td>
<td>0.35</td>
<td>0.75</td>
<td>0.47</td>
</tr>
<tr>
<td>GTB</td>
<td>0.52</td>
<td>0.86</td>
<td>0.61</td>
<td>UT BANK</td>
<td>0.33</td>
<td>0.72</td>
<td>0.46</td>
</tr>
<tr>
<td>SCB</td>
<td>0.53</td>
<td>0.88</td>
<td>0.60</td>
<td>PBL</td>
<td>0.27</td>
<td>0.59</td>
<td>0.46</td>
</tr>
<tr>
<td>FAB</td>
<td>0.36</td>
<td>0.61</td>
<td>0.59</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>BA</td>
<td>0.36</td>
<td>0.67</td>
<td>0.54</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>GEOMEAN</strong></td>
<td><strong>0.56</strong></td>
<td><strong>0.82</strong></td>
<td><strong>0.69</strong></td>
<td><strong>GEOMEAN</strong></td>
<td><strong>0.36</strong></td>
<td><strong>0.69</strong></td>
<td><strong>0.52</strong></td>
</tr>
</tbody>
</table>

*Source: Author’s computation; TE(Technical Efficiency); PTE(Pure Technical Efficiency) and SC(Scale Efficiency).*

On average, the technical efficiency, pure technical efficiency and the scale efficiency of the foreign banks outweighed those of their domestic counterparts. It suggests that the foreign banks perform better than the domestic banks during the period under consideration. For the overall efficiency of both units, the domestic banks recorded better efficiency scores than foreign banks in the following three consecutive years: 2005, 2006 and 2007. For the remaining eight years period, the foreign banks performed better than the domestic ones, as evident in Figure 4.6 below. However, the pre-capitalisation period indicated that the domestic banks performed better than the foreign banks. But after
recapitalisation, the foreign banks improved their performance steadily and recorded better performance than the domestic banks as shown in Table 4.9 and 4.10, respectively.

Figure 4.6: Technical Efficiency of Domestic and Foreign Banks from 2005 to 2015.

From the graph, the highest efficiency score was 86.1% in 2008 recorded by the foreign banks and the lowest 22.6% in 2013 recorded by domestic banks. Therefore it is indicative that foreign banks performed better on the overall efficiency score than domestic banks.

Contrarily, the pure technical efficiency of both units shows no different findings. Again, the first four years show that the domestic banks did well except for 2006. However, performance fell from 2009 till 2015. On that account, the managerial and administrative abilities of the foreign banks are better than those of domestic banks. The accompanying graph justifies this analysis.

The graph above illustrates that domestic banks did marginally better than foreign banks in 2005; they outperformed them in 2008 and 2009. Nonetheless, the remaining years were not favourable as the foreign banks did better than their domestic counterparts. Efficiency score for both units declined.
between 2014 and 2015 though. The scale efficiency of each of the units on average purported that foreign banks did better than domestic banks. This is exhibited in the graph tagged Figure 4.7.

**Figure 4.7: Pure Technical Efficiency of Domestic and Foreign Banks from 2005 to 2015.**

From the graph, it can only be seen that the only significant period that the domestic banks did better than the foreign banks was 2008.

The three measures of efficiency tell the story that foreign banks performance was better than the domestic banks performance during the period of the study. This is affirmed in the literature by Jasiniak and Pastusiak (2014) in Poland, Tetteh (2014) as well as Saka, Aboagye and Gemegah (2012) in Ghana.
It, however, contradicts findings of Claessens and van Horen (2011) in 70 developed economies.

![Graph showing scale efficiency of domestic and foreign banks from 2005 to 2015.](image)

**Figure 4. 8: Scale Efficiency of Domestic and Foreign Banks from 2005 to 2015.**

### 4.5 Malmquist Productivity Index of the Banks Between the year 2005 and 2015

The Malmquist Productivity Index is a tool that is used to compare the relative performance between two periods and two economies by using statistical data. It measures the productivity change of the one period to another period. This productivity measuring tool is used for measuring bank efficiency before recapitalisation and after recapitalisation. The DEA based Malmquist Productivity Index adopted by this research is the Adjacent Malmquist Productivity Index by Fare et al. (1994). The research chose this against others as it is commonly used in many academic studies and is not applicable for the next periods. The table below exhibit the Malmquist Productivity Change from period $k$ and period $(k + 1)$, representing pre-capitalization and post-capitalisation, respectively. The MPI measures the total productivity change of all the banks using the three inputs and the two output when determining the efficiency scores. The MPI's capacity to process these multiple inputs and outputs with minimal assumptions and without input and output price data makes it appropriate for this research. The MPI
for the period is the geometric means of the productivity over the five years for each bank for the pre and post-capitalisation periods. The total productivity change of each bank was further decomposed into efficiency change, also referred to as catch-up effect and the technological change called the frontier shift effect (Fare et al., 1992; 1994). The catch-up effect measures the extent to which a bank progresses or deteriorates its efficiency and is related to the bank itself (i.e. how a bank is catching up with the best performing bank). This includes the technological change, innovations, regulatory environment and competition.

Table 4.11: Malmquist Productivity Change of the Banking sector Between Pre-Capitalisation (period $k$) and Post-Capitalisation; period $(k + 1)$.

<table>
<thead>
<tr>
<th>BANKS</th>
<th>Pre-Capitalization Period ($k$)</th>
<th>Post-Capitalization Period ($k+1$)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>MPI($k$)</td>
<td>EC($k$)</td>
</tr>
<tr>
<td>ADB</td>
<td>1.424</td>
<td>1.346</td>
</tr>
<tr>
<td>BOA</td>
<td>1.251</td>
<td>1.136</td>
</tr>
<tr>
<td>BBG</td>
<td>1.051</td>
<td>1.000</td>
</tr>
<tr>
<td>CAL</td>
<td>0.975</td>
<td>1.000</td>
</tr>
<tr>
<td>ECOBANK</td>
<td>0.939</td>
<td>0.899</td>
</tr>
<tr>
<td>FBL</td>
<td>1.070</td>
<td>0.975</td>
</tr>
<tr>
<td>FAB</td>
<td>0.978</td>
<td>0.885</td>
</tr>
<tr>
<td>FNB</td>
<td>0.923</td>
<td>0.825</td>
</tr>
<tr>
<td>GCB</td>
<td>1.010</td>
<td>1.018</td>
</tr>
<tr>
<td>GTB</td>
<td>1.055</td>
<td>1.000</td>
</tr>
<tr>
<td>HFC</td>
<td>1.578</td>
<td>1.442</td>
</tr>
<tr>
<td>NIB</td>
<td>0.948</td>
<td>0.841</td>
</tr>
<tr>
<td>PBL</td>
<td>1.048</td>
<td>0.943</td>
</tr>
<tr>
<td>SG-SSB</td>
<td>0.523</td>
<td>0.405</td>
</tr>
<tr>
<td>STANBIC</td>
<td>1.028</td>
<td>1.000</td>
</tr>
<tr>
<td>SCB</td>
<td>0.928</td>
<td>0.895</td>
</tr>
<tr>
<td>UBA</td>
<td>1.104</td>
<td>1.000</td>
</tr>
<tr>
<td>UMB</td>
<td>0.896</td>
<td>0.837</td>
</tr>
<tr>
<td>ZENITH</td>
<td>1.045</td>
<td>0.979</td>
</tr>
<tr>
<td>BORODA</td>
<td>0.977</td>
<td>1.000</td>
</tr>
<tr>
<td>UNIBANK</td>
<td>1.259</td>
<td>1.151</td>
</tr>
<tr>
<td>UT BANK</td>
<td>1.324</td>
<td>1.166</td>
</tr>
<tr>
<td>GEOMEAN</td>
<td><strong>1.039</strong></td>
<td><strong>0.965</strong></td>
</tr>
</tbody>
</table>

*Source: Author’s Computation.*
In contrast, the frontier-shift determines the efficient change in frontiers and it is related to technological progress or regress that affect all banks in the sector (Bogetoft, 2013). An efficiency score of one indicates no change in productivity; greater than one is an indication of progress and a score less than one shows regress in productivity change.

From the computation in the table, the entire banking sector recorded a total productivity change of 1.039 before recapitalisation and 0.988 after recapitalisation. This is an indication of productivity progress of 3.9% for the sector between the period of 2005 and 2009 and a reduction in total productivity from the year 2011 to 2015 by 1.2%. The total productivity of the sector was decomposed into efficiency change and technological change. On average, the industry had a score of 0.965 for the pre-capitalization period against 0.868 for the post-capitalisation for the catch-up effect which determines the technical efficiency change. Both periods show regress in the technical efficiency with the after recapitalisation having more inefficiency period. However, for the technological change, both periods indicate progress, with the post-recapitalisation period showing more progress than the pre-capitalization period. The productivity change for the entire period is shown in the diagram below.

From the graph, total productivity change from 2006 to 2010 has a pattern that flows steadily, but from 2011 to 2015, total productivity change has an unstable pattern. Growth decreased to the lowest for the entire banking sector in 2011 and rose to its highest in 2012. The same could be said of the Efficiency change and the Technological change, as it can be deduced from the graph that the performance of the sector had a regular pattern before recapitalisation relative to the period after recapitalisation. The fluctuations in the total productivity change from 2011 to 2015 might be the main reason that accounted for the better performance in the pre-capitalization period as compared to the post-capitalisation period.

The study looked at the total productivity change of each of the 22 banks during the period of the research. It was to enable the study ascertain how technical efficiency change and technological change of the banks impacted the total productivity change of each bank over the period. During the period, HFC Bank recorded the highest progress in total productivity change while SG-SSB Bank had the
lowest total productivity change of 0.523 which indicates production regress over the period. The total productivity change for each of the 22 banks was mainly influenced by the level of change in their technical efficiency rather than technological change. This can be seen from the fact that the line of the technical efficiency change lies below the total productivity line in the graph for all the banks. This was evident from the fact that even though SG-SSB has the highest technological change index, it recorded the lowest total productivity change because the index for the technical efficiency change was shallower than that of the gain and the technological change was eroded by change in technical efficiency of the bank.

In all, 13 banks saw progress in their total productivity from 2005 to 2009. Eight out of the nine banks that had their total productivity declined recorded an MPI in the ranges of 0.99 to 0.90; only one bank had 0.523 as its MPI. Nineteen banks had technological progress while sixteen progressed in their technical efficiency over the period.

Figure 4.9: Malmquist Productivity Change for the Banking Sector from 2006 to 2015.
MPI (Malmquist Productivity Change), EC (Efficiency Change) and TC (Technological Change)
The pattern witnessed in the decomposition of total productivity change into technical efficiency change and technological change witnessed in the pre-capitalization period was not the same as in the post-recapitalisation period as displayed in the graph labelled Figure 4.9 above.

![Yearly MPI for the Banking from 2006 to 2015.](http://ugspace.ug.edu.gh)

**Figure 4. 10: Malmquist Productivity Change for the Banking Sector from 2006 to 2015.**

*MPI (Malmquist Productivity Change), EC (Efficiency Change) and TC (Technological Change).*

In the pre-capitalization period, the total productivity change and the technical efficiency change followed the same pattern for all the banks. However, the post-recapitalisation period displayed different patterns as shown in the figures 4.10 and 4.11 respectively. Overall, twelve banks recorded production progress after recapitalisation while ten banks saw a decline in their total productivity. No bank showed constant productivity for the period. It's worth noting that all the banks achieved progress over the period in areas of innovation, technological change and competition as the measure of their frontier-shift effect (technological change) is greater than 1.
Figure 4. 11: Malmquist Productivity Change of Banks in the Pre-Capitalisation Period. (2005 – 2009). MPI (Malmquist Productivity Change), EC (Efficiency Change) and TC (Technological Change).

Figure 4. 12: Malmquist Productivity Change of Banks in the Post-Capitalisation Period. (2011 – 2015). MPI (Malmquist Productivity Change), EC (Efficiency Change) and TC (Technological Change).
In the pre-capitalization period, the total productivity change and the technical efficiency change followed the same pattern for all the banks. However, the post-capitalisation displayed different patterns as shown in the graph below. Overall, twelve banks recorded production progress after recapitalisation while ten banks saw a decline in their total productivity. No bank showed constant productivity for the period. It is interesting to note that all the banks achieved progress over the period in areas of innovations, technological change and competition as the measure of their frontier-shift effect (technological change) is greater than 1. However, the only bank that recorded decline was GT Bank with technological change index of 0.996, with a 0.42% decline in total productivity change over the period. Only 3 out of the 22 banks had their technical change index above one, which indicates progress, the ability of the banks to increase their efficiency in order to compete with the best performer in the sector. These banks are GT Bank, UT Bank and Fidelity Bank. It, therefore, suggests that the increase in the total productivity of the banks over the period is mainly attributable to progress in the area of technological change.

![Figure 4.13: Total Productivity Change of Domestic and Foreign Banks from 2006 to 2015.](http://ugspace.ug.edu.gh)
4.6 Descriptive Statistics of Second-Stage Variables

In the following table, the variables used in the regression model are calculated and summarised. The principal descriptive elements are the mean, the standard deviation, the minimum, the maximum and number of the observations. This measure gives a balanced view for the researcher to screen for any suspicious elements in the data set. The analytical data is divided into two, as was the case in the study in the first stage. The first set of data represents the pre-recapitalisation period of 2005 to 2009 and the second set for the post-recapitalisation period of 2011 to 2015.

Table 4.12: Pre-Capitalisation Period of 2005 to 2009.

<table>
<thead>
<tr>
<th>Variable</th>
<th>No. of Obs.</th>
<th>Mean</th>
<th>Standard Deviation</th>
<th>Minimum</th>
<th>Maximum</th>
</tr>
</thead>
<tbody>
<tr>
<td>ΔMPI</td>
<td>110</td>
<td>1.12</td>
<td>0.46</td>
<td>0.19</td>
<td>3.22</td>
</tr>
<tr>
<td>LOG(ASSETS)</td>
<td>110</td>
<td>238,217,363.84</td>
<td>374,305,956.85</td>
<td>178</td>
<td>1,645,796,995.00</td>
</tr>
<tr>
<td>ROE</td>
<td>110</td>
<td>0.8497</td>
<td>5.3194</td>
<td>-2.6123</td>
<td>44.9821</td>
</tr>
<tr>
<td>LTD</td>
<td>110</td>
<td>0.9670</td>
<td>0.0605</td>
<td>0.7075</td>
<td>1.1958</td>
</tr>
<tr>
<td>NIETA</td>
<td>110</td>
<td>0.4038</td>
<td>0.1288</td>
<td>0.1706</td>
<td>1.0301</td>
</tr>
<tr>
<td>NIM</td>
<td>110</td>
<td>0.7974</td>
<td>0.7974</td>
<td>0.4274</td>
<td>1.9907</td>
</tr>
<tr>
<td>INFLATION</td>
<td>110</td>
<td>14.51</td>
<td>3.32</td>
<td>10.70</td>
<td>19.30</td>
</tr>
<tr>
<td>GDPGR</td>
<td>110</td>
<td>6.24</td>
<td>1.42</td>
<td>3.99</td>
<td>8.43</td>
</tr>
<tr>
<td>OWNERSHIP</td>
<td>110</td>
<td>0.55</td>
<td>0.50</td>
<td>0.00</td>
<td>1.00</td>
</tr>
</tbody>
</table>

Source: Author’s computation

Table 4.13: Post-Capitalization Period of 2011 to 2015.

<table>
<thead>
<tr>
<th>Variable</th>
<th>No. of Obs.</th>
<th>Mean</th>
<th>Standard Deviation</th>
<th>Minimum</th>
<th>Maximum</th>
</tr>
</thead>
<tbody>
<tr>
<td>ΔMPI</td>
<td>110</td>
<td>1.05</td>
<td>0.33</td>
<td>0.18</td>
<td>1.93</td>
</tr>
<tr>
<td>LOG(ASSETS)</td>
<td>110</td>
<td>712,155,356.57</td>
<td>928,904,534.91</td>
<td>2,707.54</td>
<td>4,624,405,000.00</td>
</tr>
<tr>
<td>ROE</td>
<td>110</td>
<td>0.2078</td>
<td>0.2080</td>
<td>-0.5478</td>
<td>1.6483</td>
</tr>
<tr>
<td>LTD</td>
<td>110</td>
<td>0.9508</td>
<td>0.0256</td>
<td>0.8992</td>
<td>1.0821</td>
</tr>
<tr>
<td>NIETA</td>
<td>110</td>
<td>0.3920</td>
<td>0.0954</td>
<td>0.2862</td>
<td>0.9137</td>
</tr>
<tr>
<td>NIM</td>
<td>110</td>
<td>0.8359</td>
<td>0.0637</td>
<td>0.3650</td>
<td>0.9646</td>
</tr>
<tr>
<td>INFLATION</td>
<td>110</td>
<td>12.37</td>
<td>3.40</td>
<td>8.70</td>
<td>17.15</td>
</tr>
<tr>
<td>GDPGR</td>
<td>110</td>
<td>6.90</td>
<td>4.05</td>
<td>3.84</td>
<td>14.39</td>
</tr>
<tr>
<td>OWNERSHIP</td>
<td>110</td>
<td>0.55</td>
<td>0.50</td>
<td>0</td>
<td>1</td>
</tr>
</tbody>
</table>

Source: Author’s computation

The maximum change in total productivity (ΔMPI) is about 322% with a minimum of 19%. Banks, on the average, recorded increase in overall productivity change with 112%. On average, 84.97% of profit
after tax went to total equity, maximum profit after tax to total equity was 449.821% while 261.23% was the loss to the total equity holders. Nevertheless, the post-capitalisation period revealed that the maximum change in total productivity ($\Delta MPI$), is about 193%, the minimum was 18% with the average total productivity change at 105%. The profit after tax to total equity was on average of 20.80%, the maximum for the period was 164.83% with the decline at the percentage of 54.78%.

On the financial intermediation function of banks, the risk-loving banks were using about 120% of their deposits from client to grant loans to other clients before recapitalisation while after recapitalisation, banks were only ready to go to the extent of nearly 109% of the deposits for granting loans. The most risk-averse bank was just prepared to use 70.75% of their deposits to give loans to their customers before recapitalization, and the after recapitalisation even witnessed little aggressiveness, as the most risk-averse bank used about 89.92% of their deposits as loans. On average, before capitalization and after capitalization periods, banks committed 96.70% and 97.08% of their total deposits to grant loans to their clients. The Non-Interest Expenditure to total assets stood at the average of 40.38% and 39.20% for both periods with the amount spent on administrative expenditure as a ratio of total assets at 17.06% and 28.62% respectively for pre and post-recapitalisation. However, 91.37% was the highest administrative expenses incurred by a bank as a ratio of total assets after recapitalisation. The pre-capitalization period was 1.0301. This suggests that banks, on average spent more on their administrative expenditure in the pre-capitalization period than they did after recapitalising. The Net Interest Margin of the banks were on average of 79.74% and 83.59%. This means that banks made more gains from their net interest income after recapitalisation relative to the pre-capitalization period. The least benefit from the net interest income as a ratio of total earning assets was 42.74% and 36.50% while the most significant increase was 199.07% and 96.46% respectively for the pre and post-recapitalisation.

Inflation was at its highest at 19.3% before recapitalisation, and at its lowest at 8.7% after the recapitalisation. Given that inflation is usually seen to be strongly linked to bank output, it is anticipated
to be strongly linked to profit productivity and that banks could perform better in the year that inflation is expected to be higher than periods in which it is lower as lending rates are adjusted higher in an anticipation of higher inflations. The lowest and highest GDP growth rates were recorded in the post-capitalisation period. Given that it was expected to be positively associated with banks’ performance, it is not clear if the values recorded could impact the post-capitalisation more than the pre-capitalisation period.

4.7 Panel Data Modelling
The study conducted an analysis of the data using both random and fixed effects model. The p-value ($p$-value = 0.0000) of the two tests for both periods (pre-capitalisation and post-capitalisation) was very low at 1% level of significance, which suggests the rejection of the null hypothesis. The researcher further used the Hausman Test to measure the random and fixed effects model to determine the appropriate model for the study. The null hypothesis of random-effects modeling is appropriate is tested against the alternative hypothesis of the fixed-effects modeling is appropriate. This is done to determine which of the model could be appropriate for the study.

$H_0$: Random-effects model is appropriate.

$H_A$: Fixed-effects model is appropriate.

The p-value of the Hausman test for both periods are significantly high; ($p$-value = 0.6649) and ($p$-value = 0.9786). There is no evidence against the rejection of the null hypothesis. The study, therefore, adopted the random-effects model for the analysis of the data. The choice of the random-effects model was cross-validated by the Breusch and Pagan Lagrangian multiplier test for random effects to check the appropriateness of the model selection. The null hypothesis that there is zero variance across entities was tested against the alternative hypothesis that there is a significant difference in the variance across the entities (there is a panel effect).

$H_0$: There is zero variance across the entities. (No panel effect).

$H_A$: There is a significant difference in the variance across the entities. (There is a panel effect).
Table 4.14: Test of the Presence of Panel Effect

<table>
<thead>
<tr>
<th>BPLM Test</th>
<th>Pre-capitalisation</th>
<th>Post-capitalisation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chi(1)</td>
<td>8.67</td>
<td>8.82</td>
</tr>
<tr>
<td>P-value</td>
<td>0.0016</td>
<td>0.0079</td>
</tr>
</tbody>
</table>

*Source: Author's computation*

From the results, the null hypothesis is rejected as the p-values are too small to suggest the rejection of the null hypothesis. This signifies that the random-effects model is appropriate for the data used by this study.

4.8 Regression Model Diagnostics

This part determines how well the data satisfies the assumptions of the Regression model and provides a better fit for the model used for the study or objectives of the Research.

(a) Test of Normality (*Shapiro-Wilk W test for Normal Data*). The study used the Shapiro-Wilk W test to test for the normality of the data set. The study examined the null hypothesis that the population is normally distributed against the alternate hypothesis that the population is not normally distributed at 0.05 level of significance.

\[ H_0 : \text{Population is normally distributed.} \]
\[ H_A : \text{Population is not normally distributed.} \]

Table 4.15: Test of Normality

<table>
<thead>
<tr>
<th>Variable</th>
<th>Pre-Capitalization</th>
<th>Post-Capitalization</th>
</tr>
</thead>
<tbody>
<tr>
<td>W</td>
<td>0.98215</td>
<td>0.98211</td>
</tr>
<tr>
<td>V</td>
<td>1.597</td>
<td>1.600</td>
</tr>
<tr>
<td>z-Stat</td>
<td>1.043</td>
<td>1.048</td>
</tr>
<tr>
<td>P-Value</td>
<td>0.14839</td>
<td>0.14736</td>
</tr>
<tr>
<td>No. of Obs.</td>
<td>110</td>
<td>110</td>
</tr>
</tbody>
</table>

*Author’s computation.*

From the table, it can be deduced that the p-value for both periods is significantly higher than the alpha value of 0.05. We, therefore, failed to reject the null hypothesis and concluded that there is no evidence that the data tested is not normally distributed.
(b) **Wooldridge test for autocorrelation in panel data**: The study employed this test to determine the presence of serial correlation in the panel data used for both periods of the analysis under the null hypothesis of no serial autocorrelation against the alternative hypothesis that there is autocorrelation.

\[ H_0: \text{No first-order autocorrelation} \]
\[ H_A: \text{There is the first-order autocorrelation.} \]

**Table 4.16: Test of the first-order autocorrelation**

<table>
<thead>
<tr>
<th></th>
<th>Pre-Capitalisation</th>
<th>Post-Capitalisation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wooldridge test stat</td>
<td>( F(1,21) = 0.4787 )</td>
<td>( F(1,21) = 0.357 )</td>
</tr>
<tr>
<td>( P)-Value</td>
<td>0.520</td>
<td>0.5568</td>
</tr>
</tbody>
</table>

*Author's computation.*

From the Wooldridge test statistics and their respective p-values that are significantly higher, there is no evidence against the null hypothesis. It is therefore concluded that there is no serial autocorrelation in the data set used.

(c) **Pesaran’s (2004) CD Test (Cross-section independent test)**. This test is conducted to determine whether or not the residuals are correlated across entities. Cross-sectional dependence can lead to bias in test results. This is referred to as the contemporaneous correlation. The test is conducted under the null hypothesis that residuals are not correlated against the alternative hypothesis that the residuals are correlated. The study corroborated Pesaran’s (2004) CD test with Frees’ (1995) and Friedman’s (1937) test to confirm the first test of the existence of cross-sectional independence.

\[ H_0: \text{Residuals are not correlated. (Cross-sectional independence).} \]
\[ H_A: \text{Residuals are not correlated. (Cross-sectional dependence).} \]

From the results of the Pesaran’s (2004) CD test, the Friedman’s (1995) test and the Frees’ (1937) test, the \( p\)-values are significantly high. There is no evidence against the rejection of the null hypothesis. The study therefore concluded that there is cross-sectional independence among the entities under Random Effects modelling. Otherwise, the residuals are not correlated.
(d) Test of Stationarity (Unit roots test)

The test determines the stationarity of a panel data set. It is done to identify any possible unit roots in the data used for the analysis of the impact of recapitalisation on the performance of banks in Ghana.

The null hypothesis that the panels contains unit root is tested against the alternative hypothesis of stationarity of the panels data sets.

Table 4.17: Test of cross-sectional independence

<table>
<thead>
<tr>
<th>Variables</th>
<th>Pre-Capitalisation</th>
<th></th>
<th></th>
<th>Post-Capitalisation</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Test-value</td>
<td>P-value</td>
<td>Average</td>
<td>Test-value</td>
<td>P-value</td>
<td>Average</td>
</tr>
<tr>
<td>Pesaran's CD Test</td>
<td>-1.27</td>
<td>1.7956</td>
<td>0.437</td>
<td>-0.802</td>
<td>1.5776</td>
<td>0.489</td>
</tr>
<tr>
<td>Friedman's Test</td>
<td>3.345</td>
<td>1.0000</td>
<td>3.636</td>
<td>3.636</td>
<td>1.0000</td>
<td>1.0000</td>
</tr>
<tr>
<td>Frees' Test</td>
<td>0.226</td>
<td></td>
<td></td>
<td>1.159</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(α = 0.10) = 0.4892</td>
<td></td>
<td></td>
<td>(α = 0.10) = 0.4892</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(α = 0.05) = 0.6860</td>
<td></td>
<td></td>
<td>(α = 0.05) = 0.6860</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(α = 0.01) = 1.1046</td>
<td></td>
<td></td>
<td>(α = 0.01) = 1.1046</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Author’s computation.

There are several tests that could be applied to identify the stationarity. However, the study employed three tests in order to confirm the results with the other tests. The Levin-Lin-Chu (2002), the Harris-Tzavalis (1999) and the Im-Pesaran-Shin (2003) unit roots test were applied in this study to test for stationarity of the data set.

Ho: Panels contain unit-roots. (Panels are non-stationary)

H_A: Some panels are stationary.

Table 4.18: Test of stationarity (unit-roots)

<table>
<thead>
<tr>
<th>Test</th>
<th>Pre-Capitalisation</th>
<th>Post-Capitalisation</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>t-stat</td>
<td>P-Value</td>
</tr>
<tr>
<td>Levin-Lin-Chu</td>
<td>-5.9820</td>
<td>0.0000</td>
</tr>
<tr>
<td>Harris-Tzavalis</td>
<td>-20.5011</td>
<td>0.0000</td>
</tr>
<tr>
<td>Im-Pesaran-Shin</td>
<td>-7.8173</td>
<td>0.0000</td>
</tr>
</tbody>
</table>

Author’s computation,
From the results of the three test conducted which are displayed in Table 4.15, the test statistics are very high and the p-values are significantly low. This is an indication of the rejection of the null hypothesis that the panels contain unit-roots.

**Table 4.19: Pre-Capitalization Period**

<table>
<thead>
<tr>
<th></th>
<th>(1)</th>
<th>(2)</th>
<th>(3)</th>
<th>(4)</th>
<th>(5)</th>
<th>(6)</th>
<th>(7)</th>
<th>(8)</th>
<th>(9)</th>
</tr>
</thead>
<tbody>
<tr>
<td>MPI(1)</td>
<td>1.00</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>LTA(2)</td>
<td>-0.11</td>
<td>1.00</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ROE(3)</td>
<td>0.08</td>
<td>-0.03</td>
<td>1.00</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>LTD(4)</td>
<td>0.24</td>
<td>-0.13</td>
<td>0.02</td>
<td>1.00</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>NIETA(5)</td>
<td>0.09</td>
<td>-0.74</td>
<td>0.11</td>
<td>0.28</td>
<td>1.00</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>NIM(6)</td>
<td>0.04</td>
<td>-0.37</td>
<td>-0.32</td>
<td>0.16</td>
<td>0.01</td>
<td>1.00</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>GDPGR(7)</td>
<td>0.04</td>
<td>-0.16</td>
<td>0.01</td>
<td>-0.03</td>
<td>0.13</td>
<td>0.02</td>
<td>1.00</td>
<td></td>
<td></td>
</tr>
<tr>
<td>INFLATION(8)</td>
<td>0.04</td>
<td>0.32</td>
<td>-0.11</td>
<td>-0.09</td>
<td>-0.29</td>
<td>0.01</td>
<td>-0.44</td>
<td>1.00</td>
<td></td>
</tr>
<tr>
<td>OWNERSHIP(9)</td>
<td>0.30</td>
<td>-0.02</td>
<td>0.06</td>
<td>0.14</td>
<td>0.00</td>
<td>-0.02</td>
<td>0.00</td>
<td>0.00</td>
<td>1.00</td>
</tr>
</tbody>
</table>

*Source: Author’s computation*

**Table 4.20: Post-Capitalization Period**

<table>
<thead>
<tr>
<th></th>
<th>(1)</th>
<th>(2)</th>
<th>(3)</th>
<th>(4)</th>
<th>(5)</th>
<th>(6)</th>
<th>(7)</th>
<th>(8)</th>
<th>(9)</th>
</tr>
</thead>
<tbody>
<tr>
<td>MPI(1)</td>
<td>1.00</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>LTA(2)</td>
<td>-0.38</td>
<td>1.00</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ROE(3)</td>
<td>-0.10</td>
<td>-0.08</td>
<td>1.00</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>LTD(4)</td>
<td>0.04</td>
<td>0.05</td>
<td>-0.05</td>
<td>1.00</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>NIETA(5)</td>
<td>0.22</td>
<td>-0.87</td>
<td>0.24</td>
<td>-0.06</td>
<td>1.00</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>NIM(6)</td>
<td>0.22</td>
<td>-0.14</td>
<td>0.42</td>
<td>0.04</td>
<td>0.15</td>
<td>1.00</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>GDPGR(7)</td>
<td>0.19</td>
<td>0.12</td>
<td>-0.03</td>
<td>-0.19</td>
<td>-0.12</td>
<td>0.38</td>
<td>1.00</td>
<td></td>
<td></td>
</tr>
<tr>
<td>INFLATION(8)</td>
<td>0.44</td>
<td>-0.79</td>
<td>0.20</td>
<td>-0.12</td>
<td>0.63</td>
<td>0.01</td>
<td>-0.41</td>
<td>1.00</td>
<td></td>
</tr>
<tr>
<td>OWNERSHIP(9)</td>
<td>0.33</td>
<td>0.05</td>
<td>-0.10</td>
<td>0.12</td>
<td>-0.16</td>
<td>-0.02</td>
<td>-0.03</td>
<td>0.00</td>
<td>1.00</td>
</tr>
</tbody>
</table>

*Source: Author’s computation*
<table>
<thead>
<tr>
<th>Variable</th>
<th>VIF</th>
<th>1/VIF</th>
<th>Variables</th>
<th>VIF</th>
<th>1/VIF</th>
</tr>
</thead>
<tbody>
<tr>
<td>LTA</td>
<td>6.02</td>
<td>0.166083</td>
<td>LTA</td>
<td>9.45</td>
<td>0.105806</td>
</tr>
<tr>
<td>NIETA</td>
<td>3.28</td>
<td>0.305162</td>
<td>NIETA</td>
<td>5.58</td>
<td>0.179282</td>
</tr>
<tr>
<td>GDPGR</td>
<td>3.17</td>
<td>0.315896</td>
<td>INFLATION</td>
<td>4.40</td>
<td>0.227092</td>
</tr>
<tr>
<td>NIM</td>
<td>1.85</td>
<td>0.541229</td>
<td>GDPGR</td>
<td>1.96</td>
<td>0.509550</td>
</tr>
<tr>
<td>INFLATION</td>
<td>1.37</td>
<td>0.730978</td>
<td>NIM</td>
<td>1.60</td>
<td>0.624459</td>
</tr>
<tr>
<td>ROE</td>
<td>1.31</td>
<td>0.764120</td>
<td>ROE</td>
<td>1.47</td>
<td>0.680678</td>
</tr>
<tr>
<td>LTD</td>
<td>1.31</td>
<td>0.764059</td>
<td>LTD</td>
<td>1.20</td>
<td>0.830590</td>
</tr>
<tr>
<td>OWNERSHIP</td>
<td>1.02</td>
<td>0.978672</td>
<td>OWNERSHIP</td>
<td>1.11</td>
<td>0.830590</td>
</tr>
<tr>
<td>Mean VIF</td>
<td>2.41</td>
<td></td>
<td>Mean VIF</td>
<td>3.35</td>
<td></td>
</tr>
</tbody>
</table>

4.9 Regression Results and Analysis

The results of the linear regression of the change in total factor productivity and independent variables for the pre and post capitalisation period are presented in Tables 4.22 and 4.23 respectively. The model consists of five bank-specific explanatory variables that vary across banks for the period of the study. These are the logarithms of Total Assets (LTA), Return on Assets (ROE), the ratio of Loans to Deposits (LTD), the ratio of Non-Interest Expenditure to Total Assets (NIETA) and Net Interest Margin (NIM). Two variables that account for the macroeconomic environment in which banks are operating are Gross Domestic Product Growth Rate (GDPGR) and Inflation. A dummy variable is used that represents the ownership of banks, whether local or foreign banks. The random-effects model was employed and the regression results are displayed in tables 4.22 and 4.23 below for both before and after recapitalisation period. The coefficients of the independent variable log of total assets (LTA) were statistically significant at 5% level of significance. While it was positive before recapitalisation, it had a negative coefficient after recapitalisation. This means that before recapitalisation if all other independent variables were to be held constant, a unit increase LTA was expected to increase total factor productivity by 0.0443 while after recapitalisation, a unit increase in LTA was expected to decrease total factor productivity by 0.0415. This implies that on average, the growth of the banking industry was accompanied by an increase in the total productivity of banks before recapitalisation but the post-capitalisation indicated otherwise. This result corroborates that of Isık, Aydın, Unal and Unal (2017) in Nigeria; Jreisat et al. (2017) in Egypt.
The ROE before and after recapitalisation were positive and statistically significant with the change in total factor productivity of banks. For a one-unit increase in ROE, the total factor productivity of banks was expected to increase by 0.2398 before recapitalisation and 0.2061 after recapitalisation, holding the...
remaining independent variables constant. This suggests that an increase in productivity improves equity holders’ fund, but it increases more in pre-recapitalisation than it did after recapitalisation. It, therefore, implies that the recapitalisation made shareholders worse off.

Table 4.23: Post-Capitalisation (Random Effect Model Estimates)

<table>
<thead>
<tr>
<th></th>
<th>Robust Option Estimates</th>
<th></th>
<th>Maximum Likelihood Estimates</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Coef.</td>
<td>z-stat</td>
<td>P-Value</td>
<td>Coef.</td>
</tr>
<tr>
<td>LTA</td>
<td>-0.0415**</td>
<td>-2.13</td>
<td>0.0330</td>
<td>-0.0404**</td>
</tr>
<tr>
<td></td>
<td>(0.0194)</td>
<td></td>
<td></td>
<td>(0.0179)</td>
</tr>
<tr>
<td>ROE</td>
<td>0.2061***</td>
<td>3.32</td>
<td>0.0010</td>
<td>0.2181**</td>
</tr>
<tr>
<td></td>
<td>(0.0622)</td>
<td></td>
<td></td>
<td>(0.1544)</td>
</tr>
<tr>
<td>LTD</td>
<td>1.5061***</td>
<td>2.93</td>
<td>0.0030</td>
<td>1.5295**</td>
</tr>
<tr>
<td></td>
<td>(0.0619)</td>
<td></td>
<td></td>
<td>(0.0640)</td>
</tr>
<tr>
<td>NIETA</td>
<td>0.1814***</td>
<td>2.76</td>
<td>0.0060</td>
<td>0.1791***</td>
</tr>
<tr>
<td></td>
<td>(0.1781)</td>
<td></td>
<td></td>
<td>(0.2371)</td>
</tr>
<tr>
<td>NIM</td>
<td>0.4909**</td>
<td>2.27</td>
<td>0.0230</td>
<td>0.5008**</td>
</tr>
<tr>
<td></td>
<td>(0.6621)</td>
<td></td>
<td></td>
<td>(0.7709)</td>
</tr>
<tr>
<td>GDPGR</td>
<td>0.9876***</td>
<td>4.70</td>
<td>0.0000</td>
<td>0.9789***</td>
</tr>
<tr>
<td></td>
<td>(0.2101)</td>
<td></td>
<td></td>
<td>(0.1777)</td>
</tr>
<tr>
<td>INFLATION</td>
<td>0.0983</td>
<td>0.51</td>
<td>0.6120</td>
<td>0.1057</td>
</tr>
<tr>
<td></td>
<td>(0.1935)</td>
<td></td>
<td></td>
<td>(0.1672)</td>
</tr>
<tr>
<td>OWNERSHIP</td>
<td>0.1511***</td>
<td>4.02</td>
<td>0.0000</td>
<td>0.1508***</td>
</tr>
<tr>
<td></td>
<td>(0.0392)</td>
<td></td>
<td></td>
<td>(0.0376)</td>
</tr>
<tr>
<td>Constant</td>
<td>-4.0436***</td>
<td>-2.87</td>
<td>0.0040</td>
<td>-4.14867**</td>
</tr>
<tr>
<td></td>
<td>1.4081</td>
<td></td>
<td></td>
<td>(1.7256)</td>
</tr>
<tr>
<td>Wald Test/LR Chi(11)</td>
<td>3904.42</td>
<td></td>
<td></td>
<td>107.55</td>
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<tr>
<td>Hausman Test</td>
<td>0.9786</td>
<td></td>
<td></td>
<td>0.9786</td>
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<tr>
<td>P-Value</td>
<td>0.0000</td>
<td></td>
<td></td>
<td>0.0000</td>
</tr>
<tr>
<td>R-Squared</td>
<td>61.01%</td>
<td></td>
<td></td>
<td>61.10%</td>
</tr>
<tr>
<td>Adjusted R-Squared</td>
<td>56.17%</td>
<td></td>
<td></td>
<td>57.25%</td>
</tr>
<tr>
<td>No. of Obs.</td>
<td>110</td>
<td></td>
<td></td>
<td>110</td>
</tr>
<tr>
<td>Log-Likelihood</td>
<td></td>
<td></td>
<td></td>
<td>61.31</td>
</tr>
</tbody>
</table>

Source: Author's computation: *** Significant at 1%, ** Significant at 5%, * Significant at 10%.
(robust standard error in parenthesis).

The intermediation indicators of banks for both periods was positively related to total productivity growth of banks in Ghana and significant at 1% and 5% level of significance respectively, before and after recapitalisation. Holding other independent variables constant, a unit increase in the loan to deposit ratios (LTD) was expected to increase total factor productivity of banks by 0.2060 and 1.5061 in the pre-capitalisation and the post-capitalisation period, respectively. This indicates that the growth of banks was stimulated by loan to deposit ratios (LTD) for both periods. However, it impacted growth significantly in the post-capitalisation than pre-capitalization. The finding agreed with that of Yüksel, Mukhtarov, Mammadov and Özsarı (2018) in 13 post-Soviet countries; Kingu, Macha and Gwahula (2018) in Tanzania, Ifechi and Akani (2015) in Nigeria and Tetteh-Amemi (2014) in Ghana.

The Net Interest Margin (NIM) for both periods was positively associated with the change of total productivity of banks and statistically significant at 5% level of significance for both periods. This means that whenever NIM increases by 10 units, the total factor productivity of banks could increase by 1.932 during the pre-capitalisation regime and by 4.909 after the policy was implemented. This suggests that banks have invested their funds efficiently for both periods which has impacted the productivity and performance of the banks. The magnitude for this variable is greater after recapitalisation than before, which implies that on average, banks were more effective in getting a substantial return on their investments after recapitalisation. It, however, contradicts the findings of Jreisat et al. (2017) in Egypt but supported those of Kukurah et al. (2014) in Ghana and Eze (2014) as well as Tunde (2015) in Nigeria.
Should there be a 10-unit increase in the ratio of Non-Interest Expenditure to Total Assets (NIETA), total factor productivity of banks would be expected to increase by 2.380 and 1.814 between the periods of 2005 and 2009 and 2011 and 2015. The coefficient of this independent variable is significant as the p-value is very small enough for both periods. This contradicts the findings of Serpil and Ozer (2016) in Turkey who established a decrease in the first period but an increase in the second period of the study.

The GDPGR for both periods is positive and significant at 1% level of significance with a change in total productivity which measures the profit productivity of banks. A ten percent increase in gross domestic products growth rate was expected to increase total factor production of banks in Ghana by 9.876 before recapitalisation and by 4.238 after recapitalisation. This underpins the theory that as economic activities increase (as measured by GDP growth), banks experience improves in profit productivity. Recent findings by Klien and Weill (2019) across 133 countries between 1999 and 2013 corroborates those of this study. They are also in line with Naceur and Omran (2011) in four North African and Middle East countries and Obamuyi (2013) of Nigeria. They have, however, not agreed with findings of Tetteh-Amemei (2014) of Ghana and of Tan and Floros (2012) of China.

The average yearly increase in the Ghanaian consumer price index was positive and statistically significant before recapitalisation but insignificant after the policy was implemented. This illustrates that an increase in inflation is positively connected with the growth in total productivity change hence the performance of banks before recapitalisation but has no influence on total factor productivity after recapitalisation. This follows a logical conclusion that banks may always want to adjust their interest rates upwards as inflation is expected to rise and increase in interest which may trigger an increase in the profit productivity of banks. This confirms findings of Oleka et al. (2014) in Nigeria as well as those of Hasanov et al. (2018) in Saudi Arabia. Nevertheless, they stand against the findings of Tetteh-Amemi (2014).
The dummy variable that denotes whether a bank is a domestic bank or foreign bank has a positive relationship with bank productivity and statistically significant at the conventional 1% level of significance. This alludes to the fact that foreign banks are more profitable than local banks and supported by empirical studies by Pawłowska (2016) in Pakistan, Alnaa et al. (2016) in Ghana and Cull, Martinez Peria and Verrier (2017) in developing countries in which their study was conducted.

4.9 Discussion of Findings
This research had its ultimate objective of determining the impact of the 2009 recapitalisation on the performance and profitability of banks in the Ghanaian banking sector. This led the study to formulate a research question to determine if there is any significant difference between the performance and efficiency of banks before and after the 2009 recapitalisation of the Ghanaian banking sector. The results from the analyses indicate the effect of the implementation of the minimum capitalisation of the banking industry on performance and profitability of banks in the country. The first stage results of both CCR and BCC models stipulate that banks performed better from 2005 to 2009 than they did from 2011 to 2015. Their technical efficiency was 75.0% against 45.7%; pure technical efficiency was 82.0% compared to 75.6% and the scale efficiency score for pre-capitalisation was 91.0% compared to 60.5% for post-capitalisation. The pre-capitalisation witnessed an increase in productivity as the MPI for the period is higher than one while post-capitalisation witnessed a decline in productivity. The geometric mean of the MPI for the pre-capitalisation period was 1.039 while it was 0.988 for the post-capitalisation period. To confirm the findings based on the efficiency scores of DEA, the study tested the hypothesis of profitability indicators as in Adegbaju and Olokoyo (2008), Mohammed and Gani (2012), Sani and Alani (2013) and Ibrahim et al.’s (2012) studies of recapitalisation in Nigeria. The Return on Equity (ROE), Net Interest Margin (NIM) and the ratio of Loan to Deposit (LTD) were used to determine the profitability and the performance of the banks. These three variables were positively and statistically significant. Both LTD and NIM were statistically significant at 1% and 5% respectively for the two periods. The main determinant of the financial performance of banks was statistically significant at 10% and 1% level of significance respectively before and after recapitalisation. With this,
the test provides a decisive evidence that the null hypothesis is wrong. The research rejects the first null hypothesis and concludes that there is a significant difference between profitability and performance in the two periods. The main indicator of financial performance, ROE, was higher in pre-capitalisation era than in post-capitalisation (the coefficient for pre-capitalisation 0.2398 against the post-capitalisation coefficient of 0.2061), suggesting that profitability and performance were better between 2005 and 2009 as compared to the period between 2011 and 2015. This agreed with the findings of Price Water House Coopers in the Ghana Banking Surveys between 2011 and 2015. Their findings indicate that the returns on equity (ROE) for the industry was 17.8% in 2011, 23.8% in 2012, 27.5% in 2013, 29.3% in 2014 and dropped significantly in 2015 to 20.7%. The decline in the ROE was attributable to a significant impairment losses from 2014 to 2015 which eroded potential earnings in 2015. The capital injections, therefore, failed to produce the anticipated outcomes. This decline suggests that on average, shareholders received less between 2011 and 2015 as compared to 2005 to 2009, and this is parallel with Francisco and Sonia (2014), Ibrahim et al. (2012), Shehu and Nuraddeen (2011), Sadiq et al. (2018) and Tetteh-Ametei (2014).

The second objective analysed the performance of the local banks and their foreign counterparts between 2005 and 2015. This was done to determine whether the foreign banks performed better than the domestic banks. In the first stage, the study based its analyses on the efficiency scores. The banks were classified into domestic banks and foreign banks and the geometric mean of the two groupings from 2005 to 2015 used to determine their performance over the period. Based on the technical efficiency, foreign banks recorded 64.6% compared to 53.6% for the domestic banks. The pure technical efficiency was 81.9% for foreign banks while their domestic counterpart recorded 76.1%. Foreign banks had 79.1% as their scale efficiency score against 69.8 % for domestic banks during the period under review.

On the other hand, the difference in means of foreign and the domestic banks, considering their technical efficiency, pure technical efficiency and scale efficiency were 0.11, 0.058 and 0.093 respectively. This indicates that on average, foreign banks performed better than local banks.
Furthermore, the study in the second stage used a dummy variable for the local and foreign banks. This was captured in the regression model and its output as the ownership variable. The coefficient of this independent variable is positive for both periods. It implies that the foreign banks performed better than the local banks before and after recapitalisation. The coefficient before recapitalisation was 0.1304 while it was 0.1511 after recapitalisation. This suggests that on average, the performance was better after recapitalisation than before recapitalisation for the foreign banks. This can be attributed to the fact that the foreign banks recapitalised on time before the local banks and this impacted their operation faster than their domestic counterparts. The p-value of this independent variable; ownership was small enough, at a 1% level of significance which provides decisive evidence that the second null hypothesis is wrong. The study on these grounds rejects the assertion that there is no significant difference between the performance, profitability and efficiency of foreign and local banks before and after the 2009 recapitalisation. This finding is consistent with Chen and Liao (2011) in 70 countries, Jasiniak and Pastusiak (2014) in Poland, Tetteh (2014) as well as Saka, Aboagye and Gemegah (2012) in Ghana. It, however, contradicts findings of Claessens and van Horen (2011) in 70 developed economies.

The third and the last objective determined the impact of macroeconomic factors on the performance, total productivity change and profitability of the banking sector of Ghana. The GDP growth rate and the rate of Inflation were used as proxies’ variables that account for macroeconomic indicators. The coefficients of both indicators were positive and statistically significant at 1% level of significance before recapitalisation while GDP growth rate was significant at 1% of significance after recapitalisation. This implies that inflation rate and growth of GDP impacted the profit and the performance of banks positively before the recapitalisation but the rate of GDP growth influenced the performance of banks positively. The coefficients revealed that the influence of GDP growth rate on productivity of banks during the pre-capitalisation was less than during post-capitalisation period. The coefficient of this independent variable before recapitalisation was 0.4238 against the post-capitalisation era of 0.9876. This can be attributed to the fact that the post-capitalisation period recorded
an average growth in GDP of 6.90% as compared to 6.40% and witnessed the highest growth rate of 14.39% in 2011.

Besides, the effects of inflation on profitability was higher in pre-capitalisation period than in post-capitalisation period. From the descriptive statistics, the average inflation of 14.51% during the period of 2005 to 2009 was higher than 12.37% for the period of 2011 to 2015. Also, the highest inflation rate was recorded in 2009. The higher coefficient for inflation before recapitalisation can, therefore, be attributed to these factors. However, inflation has no influence on productivity, performance and profitability of banks after recapitalisation as the p-value of this coefficient is large enough. These findings of the macroeconomic indicators led to the study to reject the third null hypothesis that the macroeconomic indicators have no significant influence on the performance of banks before and after the 2009 recapitalisation. This confirmed other findings by Kosmidou et al. (2005) in the UK, Naceur & Omran (2011) in the Middle East and North African countries, Hasanov et al. (2018) in Azerbaijan and Oleka, Adanma and Onyeze (2014) in Nigeria. It, however, contradicts those of Tetteh-Amemei (2014) in Ghana and Sufian and Chong (2008) in China.

The coefficients of the independent variable LTD before and after recapitalisation was 0.2060 and 1.5061 respectively. It implies that the banks created credits or liquidity creation was about five times better after recapitalisation. This was confirmed by the coefficients of the independent variable NIM which had a coefficient of 0.1932 before recapitalisation as compared to 0.4909 after recapitalisation. It could be deduced that banks earned about two half times on their investment as they did before recapitalisation. The difference can be attributed to the high rate of non-performing loans recorded between 2011 and 2015 as compared to the period from 2005 to 2009. Between 2008 and 2015, the lowest rate of the non-performing loan was 7.68% in the year 2008 while the highest was recorded in 2015, at a rate of 14.67% (World Bank, n.d.). It, therefore, suggests that the non-performing loans eroded much of the gains from the prudent liquidity creation.

The independent variable that measures the growth of the banking industry was positively associated with an increase in total factor productivity of banks before the recapitalisation but negatively related
with total factor productivity after recapitalisation. The coefficient of this variable before recapitalisation was 0.0443 as against -0.0415. It means that before recapitalisation, whenever the logarithm of total assets (LTA) increased by 100 units, change in total productivity increased by 4.43 units but after recapitalisation, whenever, the logarithm of total assets (LTA) increased by 100 units, change in total productivity decreased by 4.15 units. It could be deduced from this that the growth in the industry affected the total factor productivity of banks negatively as evident in the reports of the Ghana Banking Surveys (2015; 2016). The banking industry saw a steady increase in total assets from 2012 to 2015. In the year 2012, total assets grew by 28% and 42% in 2013 and 41% in 2014 during which the sector started experiencing difficulties. In 2015, when the sector suffered significant impairment losses and ROE dropped from the previous year’s value, total assets increased by 13%, (GBS, 2016). This affirms that the growth of the industry affected the productivity of the sector.
CHAPTER FIVE

SUMMARY, CONCLUSION AND RECOMMENDATIONS

5.1 Introduction
This section provides an overview of the results, conclusion and recommendation for further research on the application of the minimum capital legislation in the Ghanaian banking industry. The summary details the ultimate facts and focal point of the study. The deductions made based on the empirical evidence from the research are listed in the conclusion. The study further proposed recommendations based on the conclusion of this research. These recommendations are pertinent for academic research and policy regulation, industrial practice for managers and for customers in the banking sector.

5.2 Summary of the Main Findings
The financial sector of every country is essential for economic development and growth. A well-developed and serene financial industry propels a country’s industrialisation and growth as a result of improved intermediation role of the financial institutions. The competitive nature of the players in the sector further ensures that the industry players are up to the task and render quality and timely services to their customers. Banks, therefore, are geared towards the competitive atmosphere in the banking industry. For banks in a country to be in an excellent position to invest in “bigger ticket deals” and have the potential to resist economic shock and turmoil as well as maintain financial stability in their operation, they must operate with sizeable capital. The 2009 recapitalisation came to ensure banks have adequate capital to guarantee them enough capital-base to undertake the bigger ticket deals. This study appraises the benefit of the 2009 minimum capitalisation of Ghanaian banks from the perspective of their profit and performance since profit is the ultimate indicator of the survival of a business enterprise. The study examined three fundamental facts of the regulatory recapitalization: its impact on the performance of the banks, how the local and domestic banks performed during the period under consideration and the effects of the macroeconomic variables on banks’ profitability. With the impact of the policy on the performance, efficiency and profitability of banks, the study employed DEA-based MPI to determine the efficiency and the performance of the banks. The study used profitability
indicators as the input variables and the output variables as in the literature (Kale, Hasan and Selimler, 2015; Tuskan and Stojanovic, 2016). The variables that represent total revenue (income interest and other operating income) were used as the output variables while those that represent total expenditure (wages and salaries, interest expenditure and other operating expenses) were used as the input variables in the first stage of the analysis that employed DEA-based MPI. The study computed the technical efficiency, pure technical efficiency and scale technical efficiency for all the 22 banks investigated. This revealed the best performing banks and the worst-performing banks for both the pre and post-capitalisation periods. The study calculated the geometric means of the technical efficiency, pure technical efficiency and the scale efficiency of the banks for the pre and post-capitalisation based on the same approach employed by Kale et al. (2015), Pasiouras & Sifodaskalakis (2010), Tanna (2009), Ramathan (2007), Pascoe & Cox (2005) and Dogan & Fauten, (2003). This was followed by the calculation of total productivity change by the use of MPI. The total productivity change was decomposed to Technological Change and Pure Technical Efficiency Change. The research employed the same approach to the local and domestic banks by grouping all the foreign banks as one DMU and all the domestic banks as one DMU. The results of the study specified that between 2005 and 2009 (the period classified as the pre-capitalisation regime) recorded 75%, 82.0% and 91.0% efficiencies of their operation in the areas of the technical efficiency, pure technical efficiency and the scale efficiency respectively. Based on the overall efficiency of the banks, UMB Bank recorded the highest efficiency score of 95.7% while GT Bank recorded the least efficiency of 39.6%. The total productivity change for the period between 2005 to 2009 recorded 103.9%, indicating that productivity grew by 3.9%.

On the other hand, from 2011 to 2015 (the period classified as the post-capitalisation regime) recorded 45.7%, 75.6% and 60.5% efficiencies of their operation in areas of the technical efficiency, pure technical efficiency and scale efficiency respectively. Based on the overall efficiency of the banks, Bank of Baroda recorded the highest efficiency score of 100% while UMB Bank recorded the least
efficiency of 20.5%. The total productivity change for the period from 2011 to 2015 recorded 98.8%, indicating that productivity declined by 1.2%.

In the second stage, the study considered LTA, ROE, LTD, NIETA and NIM as the indicators of performance and profitability of the banks with the main focus on ROE in line with Jreisat et al. (2017). Before the recapitalisation and after the implementation of the policy, these independent variables were positively associated with the total productivity change and statistically significant at the conventional 1%, 5% and 10% levels of significance in the random effects regression model the study adopted.

In determining the performance, efficiency and the profitability of the domestic and foreign banks, the study employed the DEA-based MPI. The efficiency scores as measured by the CCR and the BCC models of DEA in the order of technical efficiency, pure technical efficiency and scale efficiency for the domestic banks are 53.6%, 76.1% and 69.8% respectively, while the foreign counterparts recorded 64.6%, 81.9% and 79.1% respectively. The second stage used a dummy variable to present local and foreign banks. The regression output indicate that there was a positive and significant relationship at 1% level of significance between bank ownership and change total factor productivity of the banks, indicating that on average, foreign banks performed better than the domestic banks between the periods of 2005 to 2015.

On the last point of assessing the impact of GDP growth and inflation on the profitability of the banks, for both pre and post-capitalisation periods the independent variable GDPGR was positive and statistically significant at 1% level of significance with the change in total factor productivity which was proxy for profitability in the regression model in the study. The rate of inflation was significant at 1% level of significance before recapitalisation but its p-value was significantly higher after recapitalisation, denoting that it has no influence on the change in total factor productivity of banks.
5.3 Conclusion
From the findings from the first stage analysis using DEA-based MPI, the study found the overall efficiency of banks as measured by the technical efficiency, pure technical efficiency, scale efficiency and the change in total factor productivity to be better during the pre-capitalisation period than during the post-capitalisation era. The study also found that on average, the overall efficiency of the banking sector was 0.750 before recapitalisation while after recapitalisation it recorded 0.457; total factor productivity was growth between 2005 and 2009 with an accumulated growth of about 3.9% while the period from 2011 to 2015 saw an accumulated decline in total factor productivity of about 1.2%.

The second stage regression analysis, which used the effect of ROE (the main indicator of the financial performance of banks) on change in total factor productivity to measure banks’ performance, the coefficients of pre-capitalisation were higher than it was for post-capitalisation. The ROE for the former was 0.2389 while it was 0.2061 for the latter. This confirmed the first stage findings that performance was better in the pre-capitalisation era than in the post-capitalisation period. This finding agreed with earlier studies by Francisco and Sonia (2014), Ibrahim et al. (2012), Shehu and Nuraddeen (2011), Sadiq et al. (2018) and Tetteh-Amteei (2014).

The study further assessed the banks based on their ownership structure. From the first-stage analysis, foreign banks achieved technical efficiency of 64.6% while domestic banks achieved technical efficiency of 53.6%. In the regression model, the dummy variable that was proxy for the ownership structure of the banks, where foreign banks take a value of one (1) and zero (0) otherwise was positively related with change in total factor productivity change. Foreign banks were therefore considered to have performed better than the local banks for the period under consideration. This could be attributed to the fact that most foreign banks recapitalised on time before the domestic banks. By the end of December 2010, all foreign banks had met the required minimum capital while it took some of the domestic banks up to 2012 before fully raising the required capital. This finding is consistent with Chen and Liao (2011), Jasiniak and Pastusiak (2014), Tetteh (2014) as well as Saka et al. (2012). It, however, contradicts findings of Claessens and van Horen (2011).
The research also evaluated the impact of macroeconomic indicators such as GDP growth and the rate of inflation on profitability of banks. The study found that these two indicators are statistically significant in the model and impacted profitability positively before recapitalisation but the rate of growth of GPD was the only variable that impacted change in the total factor productivity of banks. This confirms similar findings by Kosmidou et al. (2005), Naceur and Omran (2011), Hasanov et al. (2018) and Oleka, Adanma and Onyeze (2014).

5.4 Recommendations
From all the analysis, it is evident that the increase in the capital of the banks did not impact the profitability of the banking industry in general. However, some banks increased their overall efficiency scores while few got closer to their previous best scores. As demonstrated, most of the indicators of profits appeared to be better when the capital-base was less as compared to the period that saw banks increase their long-term capital in order to achieve the minimum capital set by the Bank of Ghana. The study has identified a constant increase in the compensation of labour as one proponent of expenditure that keeps rising. This was seen in the pure technical efficiency of the banks in the first stage. All the sampled banks achieved higher pure technical efficiency than their technical efficiency, with the exception of Bank of Baroda. This shows that they are achieving better administrative capacity than their production capacity. For a business organisation to be more profitable, its production capacity must be greater than the administrative capacity. The banks must, therefore, increase their production to be proportionate with administrative capacity or reduce their administrative capacity to commensurate with their production capacity in order to maximise their profit margin.

It also appeared that banks credited much liquidity between 2011 and 2015. Given that the non-performing loans were high during this period, due diligence must be taken in granting loans to customer. Besides, efforts must be made to reduce the level of non-performing loans and lending to the productive sector must be prioritised. It is advisable that banks diversify their investment portfolio.
to have a significant proportion of their investment in long term financial assets to improve their long term profitability.

Besides, it would be appropriate if the Bank of Ghana can divide the universal banks into two tiers to specify different minimum capital requirements for each tier based on their risk profile and the investment and financing they can undertake. Banks will, therefore, have to know the type of business transaction they can undertake based on their risk level as it is in some jurisdictions like Nigeria, the USA and the UK. The government of the country should also put in mechanisms that will aim at improving macroeconomic indicators such as inflation rate, the policy rate, exchange rate and growth of the economy that have direct effects on the profitability of banks. In this regard, government policies should be geared towards growth in GDP and maintaining the level of inflation that could be appropriate for banks to make higher profits.

This thesis being the first of its kind that looks at bank recapitalisation in Ghana using a combinatorial approach, it is recommended that a further study that could replicate this examine the 2018 recapitalisation of the banking industry.
REFERENCES


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