Bank's Efficiency and Economic Growth: Evidence from SENA

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ABSTRACT

A non-parametric technique, data envelopment analysis (DEA) and Generalized Method of Moments (GMM) for data from 1998 to 2023 to investigate the banks' cost and profit efficiency and examine the influence of ownership, bank profile, size, and corporate structure on bank efficiency and causality between bank efficiency and economic growth for 75 commercial banks in Africa big economies, South Africa, Egypt, Nigeria and Algeria (SENA). The overall results show that commercial banks in SENA are relative more cost efficiency than profit efficiency which is consistent with other studies. Domestic banks appear to be more cost and profit efficiency than foreign banks. There are no significant differences between new and old banks in cost efficiency, while old banks found to be more profit efficiency compared with new banks. Big banks found to be more cost efficiency compared with small banks which are more profit efficiency. Unlisted banks appear to be more cost and profit efficiency than listed banks. On causality between commercial banks efficiency and economic growth, the finding show that neither cost efficiency nor profit efficiency has a Granger cause on economic growth. However, there is one-way causality between cost efficiency and profit efficiency that runs from cost to profit efficiency.

Keywords: *Africa big economies commercial banks, Causality, Cost efficiency, DEA, Economic growth, GMM, Profit efficiency.*

1. INTRODUCTION

The role of banks remains central in financing economic activities in Africa where the banking sector takes a leading position in financing the economic development of the country while other sources of funding investment and financing activities are in their emerging stage. An efficient bank in terms of cost and profit will have the ability to survive during depressing economic astonishment, and contributes to the development of financial system of the relevant country. Since banking sector is the major sector that contributes substantially to the finance of the national economy, efficiency of the banks is the one of the most interesting and crucial issues for both the government and private sector. Changes and reforms done in banking sector in Africa in recent years has the aim of improving profitability, efficiency and productivity in banking industry by reducing costs of production and maximizing profit.

Cost-effective banking sector (banking sector that is profit and cost efficient) will be better able to endure unenthusiastic economic shocks and contribute to the stability of financial system. Hence, it is significant to study cost and profit efficiency of the African banking system and their attribute to the growth of economy. Profit efficiency most strongly corresponds to the goal of value maximization as it accounts for errors on output and input sides. Thus, estimation of profit efficiency is essential feature in bank efficiency examination and considered to present more information than analysis of cost efficiency.

On the other hand, relationship between financial sector development and economic growth has been one of the most discussed areas in economics for a long time; and the direction of causality on whether financial development causes economic growth or vice versa is by no means a settled issue. Advocates of financial market deregulation stressed that it can improve competition, expanding the supply of loanable funds and lower loan rates (promoting investment in productive capital). Levine and Zervos (1998) argue that banking development and stock market liquidity, stock market capitalizations are good predictors of economic growth. The relationship between finance and economic growth also confirmed by Salahuddin, Alam, Ozturk, and Sohag (2018); Naeem

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Azmi and Akhtar (2025); Valickova, Havranek, and Horvath (2015) and Verma and Giri (2022). The role played by financial development and economic growth and the causality between the two is debatable subjects in the field of economic development where new classical view is that monetary factors do not have any effect on real variables such as GDP growth.

Reference from current studies on the relationship between bank performance and global financial development have either studies have predominantly focused on either pre- or post-financial crisis periods in examining bank profitability (Atahau & Cronje, 2022; Mateev, Sahyouni, & Al Masaeid, 2024; Vazquez & Federico, 2015). Additionally, existing studies have examined macro-variables determinants of bank profitability (Cruz-García, Forte, & Peiró-Palomino, 2020; Oanh, Van Nguyen, Le, & Duong, 2023; Pham, Nguyen, Ngo, Nguyen, & Pham, 2022).

However, existing literature has not comprehensively considered the relationship between cost and profit efficiency and other bank specific factors and macroeconomic variables. Either, the study of this nature is limited in Africa. This study highlights the need for further research to clarify these aspects and provide a more comprehensive understanding of how bank cost and profit efficiency has impact on economic performance. The study employs an appropriate econometric methodology, specifically the Generalized Method of Moments (GMM) model, to estimate dynamic panel data models and examine previously overlooked characteristics of bank performance.

2. LITERATURE REVIEW

Literature on studies in banks' cost and profit efficiency has been increased following Berger and Humphrey (1997) survey that demonstrate that majority of studies in bank efficiency are to a great extent concerned on cost efficiency and pay little attention on and profit efficiency. Ariff and Can (2008) documented that main reason for scarcity in studies on profit efficiency is the difficulty of having output price information which is required in the standard profit efficiency analysis. Maudos, Pastor, Pérez, and Quesada (2002) argue that cost efficiency corresponds to one of two most important economic objectives, cost minimization. Some of the works on cost efficiency include that of Fries and Taci (2005); Staikouras, Mamatzakis, and Koutsomanoli-Filippaki (2008); Shen and Chen (2010); Margono, Sharma, and Melvin (2010); Manlagñit (2011); Koutsomanoli-Filippaki and Mamatzakis (2011), Khalifaturofi'ah (2023), Otondi and Gitagia (2025), Ebissa and Lakew (2025) and Ridene, Jedidi, and Ben Ayed (2026).

Profit efficiency most strongly corresponds to the goal of value maximization as it accounts for errors on output and input sides. Thus, estimation of profit efficiency is essential feature in bank efficiency examination and considered to present more information than analysis of cost efficiency. Previous studies in bank efficiency have paid more attention to cost efficiency, and pay little attention to possible inefficiencies on the profit side. However, studies that have analyzed cost and profit efficiency have shown the existence of higher levels of inefficiency in profits than in costs. This result shows that a proper evaluation of efficiency should not be restricted to cost efficiency, but should also considered the profit efficiency (Maudos et al., 2002). Studies that examine cost and profit efficiency of bank include that of Berger and DeYoung (2001); Dacanay (2007); Maudos and Pastor (2001); Ariff and Can (2008); Das and Ghosh (2009); Olson and Zoubi (2011), Ngweshemi and Isiksal (2021), Siameti, Chronopoulos, and Dotsis (2025), Gržeta, Žiković, and Tomas Žiković (2023) and Sousa and Almeida (2025).

The literature has widely explored the relationship between efficiency and banking performance. Regulatory and market pressures drive many banks to increase their capital levels through enhanced efficiency (Insani, 2021). Studies on Chinese banks, for instance, have found a negative correlation between efficiency and profitability (Lei & Li, 2021; Li & Zhao, 2016) although banks can still increase profitability by improving efficiency. In recent years, study on bank efficiency incorporate other bank an industry specific such as size, ownership type, risk profile, and age of the banks to investigate their impact on cost and profit efficiency of the bank. Mamatzakis, Staikouras, and Koutsomanoli-Filippaki (2008) employed the stochastic frontier approach and estimate a common frontier to examine cost and profit efficiency in the banking systems of the ten new European Union member states over the period 1998– 2003. The results indicate a generally low level of cost and an even lower level of profit efficiency, whilst they do not observe marked differences of inefficiency scores across countries. On ownership impact of the bank, they find that foreign banks outperform both states owned and domestic private-owned banks in terms of profit efficiency, though results are less clear in the case of cost efficiency. Isik and Hassan (2002) found that

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heterogeneous characteristics of banks have significant impact on efficiency, cost and profit efficiencies of the Turkish banks and inefficiencies of the Turkish banks are due to technical inefficiency rather than allocative efficiency. Additionally, found that both small and medium banks have significant higher cost and profit efficiencies than large banks. They further evidence that the Turkish banks whose shares publicly traded in stock market dominate the banks whose shares are not traded except for scale and profit efficiency and foreign banks operate in Turkey dominate national banks, though national banks are superior in terms of allocative efficiency.

Study by Tecles and Tabak (2010) in Brazilian banks suggest that large banks are most cost and profit efficiency. Moreover, the results reveal that, foreign banks have achieved a good performance through either the establishment of new affiliates or the acquisition of local banks. The results also evidence that, public banks have had improvements in cost efficiency, but are relatively profit inefficient. They final observe a positive impact of capitalization on efficiency. Cyree and Spurlin (2012) investigate the effects of big-bank presence on the performance of rural, small banks. They reveal that when competing against a big bank, rural one-county banks operate at lower levels of profit efficiency, but with higher ROA and increased levels of interest and fee income from loans.

Relationship between financial development and economic growth has become an issue of debate in recent years compared with previous time where role of financial development in the process of economic growth was given a little attention. Schumpeter (1934) was the first to argue that financial system has a major role in economic development. His arguments based on the premises of the banking operation where bankers played the role of intermediaries between those who have the production means (i.e. money) and those who wish to form new combinations (i.e. new products). Despite the growing evidence in literature that financial development contributes to the economic growth; the issue is still debatable in the field of economic development where new classical view is that monetary factors do not have any effect on real variables such as GDP growth. Levine, Loayza, and Beck (2000) confirm a significant and strong influence of financial development and growth. However, their evidence criticized by Lucchetti, Papi, and Zazzaro (2001) for two reasons. First, absolute measures of credit volumes are subject to simultaneity problems to much extent than a relative measure of bank's ability to perform its intermediation task. Second, the volume of credit is an indirect measure of the argument that better developed financial systems enjoy fewer frictions in the intermediation process and promote the rate of return through better project selection and monitoring.

The debate on the role played by financial development to economic growth brought about two schools of thought. First school is in favour of positive role of financial intermediation in promoting economic growth, who argues that financial development plays critical role in reallocating resources in most productive projects, which eventually lead to economic growth. Second school is against the first argument. This school makes argument that the financial and monetary systems have no long run role in determining growth of economy. They went further by arguing that in fact financial intermediation it follows rather than leads the growth process of the country. Hassan, Sanchez, and Yu (2011) provide evidence on the role of financial development for economic growth for the middle- and low-income countries classifies by geographical regions. They find a positive relationship between financial development and economic growth in developing countries. Moreover, their findings on short-term multivariate analysis provide mixed results: a two-way causality relationship between finance and growth for most regions and one-way causality from growth to finance for the two poorest regions. Furthermore, their findings show that other variables from the real sector such as trade and government expenditure play an important role in explaining economic growth. They make a conclusion that a well-functioning financial system is a necessary but not sufficient condition to reach steady economic growth in developing countries. Other studies that support the relationships between financial development and growth include, Anwar and Cooray (2012); Zhang, Wang, and Wang (2012); Ahmed (2013) and Bumann, Hermes, and Lensink (2013).

When it comes to bank-specific variables, prior studies present mixed findings regarding the impact of size on bank profitability across different countries. For example, Bucevska and Hadzi Misheva (2017) report that size is an insignificant determinant of profitability in the selected Balkans countries. Rakshit (2022) finds size has a negative and significant impact on bank profitability, measured by ROA and ROE in India. In contrast, Athanasoglou, Brissimis, and Delis (2008) and Isayas (2022) identify a positive relationship between size and profitability. Goddard, Molyneux, and Wilson (2004) suggest a relatively weak connection between size and profitability in the European countries, while Menicucci and Paolucci (2016) find that size and capital ratio are significant bank-

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specific determinants of profitability in Europe. In general, literatures on financial development and economic growth are rather mixed and inconclusive. There is evidence on long run relationship between financial development and economic growth (Ahmed, 2013; Bumann et al., 2013; Hassan et al., 2011; Zhang et al., 2012). However, the direction of causality is the unsolved question. While some studies provide bi-directional causality between finance and growth, there is no consensus for all measurement of financial development. Murinde (2012) termed unclear direction of causality to be similar to a "chicken and egg problem". Knowing direction of causality between financial development and growth is crucial due to two opposite streams of research to posit different points of views (Bangake & Eggoh, 2011). The supply–lead hypothesis argues that financial development is necessary pre condition for economic growth, while demand following hypothesis argues that finance is led by, rather than leads economic growth. In this case, finance plays insignificant role on growth, and in fact is by product or outcome of the economic growth.

3. DATA AND METHODOLOGY

3.1. Data Sources

This paper uses a panel dataset for commercial banks in Africa big four economies (South Africa, Egypt, Nigeria and Algeria-SENA). The primary source of data is balance sheets and income statements extracted from BankScope database produced by the Bureau van Dijk. The dataset includes annual data report on bank ownership, bank total assets, date of establishment for the bank, and corporate structure (listed or unlisted). It grouped commercial banks into ownership (foreign and domestic), new banks and old banks, big banks and small banks, and listed and unlisted banks. Previous studies in bank cost and profit efficiency either do not decompose banks into ownership, size, based on total assets owned by the bank, year of establishment and corporate structure (listed or unlisted). The paper considered the period from 1998 to 2023. The choice of the period for the study is influenced by two reasons. First, this is the periods during which many African countries changed their financial policies and embrace liberalization in their financial sectors. Second, there is enough information on the variables under study during this period. When Bankscope's does have no enough information to any variable, this paper gathers information from additional sources as used by prominent authors such as La Porta, Lopez-de-Silanes, and Shleifer (2002); Micco, Panizza, and Yañez (2007); Lin and Zhang (2009) and Cornett, Guo, Khaksari, and Tehranian (2010). These sources include Bankers' Almanac, World Bank, IMF financial statistic, Bloomberg, Central Banks of the respective countries and Banks' websites.

In sample, the study includes all commercial banks in the BankScope database for which at least five years of data are available between 1998 and 2023. The minimum requirement of five years helps to distinguish reliably between random noise and bank inefficiency in the errors of estimated cost functions (Fries & Taci, 2005). The sample includes 75 banks, 15 banks in South Africa, 27 in Egypt, 18 in the Nigeria and 15 in Algeria. Bankscope reports the data in the original currencies of the respected country, but provide an option to convert the data to any other currencies. This study uses the United State Dollar (USD) based reports in the selected sample. All banks selected in this study end their financial year at end of December for each respected year. The macro level data is collected from other secondary sources like the International Monetary Fund (IMF) reports and World Development Indicator of the World Bank.

3.2. Analysis- Cost and Profit Efficiency Estimation

3.2.1. Data Envelopment Analysis (DEA)

Data Envelopment Analysis (DEA) has become a very popular linear programming technique used as an invaluable benchmarking tool in examining efficiency in banking industry. It is a deterministic methodology for determining the relatively efficient production frontier based on the empirical data on chosen inputs and outputs of a number of entities called Decision Making Units (DMUs). Since the original study by Charnes, Cooper, and Rhodes (1978) considerable amounts of published research-using DEA have appeared. Leibenstein and Maital (1992) argue that DEA is the superior method for measuring overall technical inefficiency. Emrouznejad, Parker, and Tavares (2008) evaluates research in efficiency and productivity for 30 years using DEA and documented that there are 1621 papers published in 20 journals that that have published the greatest number of DEA papers. They further evidence that the number are increased from time to time where from 1995-2003 the number of publications was 226 per year and increased to reach 360 per year from 2004-2006.

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Suppose that there are *n* DMUs, each with *m* inputs and *s* outputs, relative efficiency score of a given DMU_0 is obtained by solving the following linear programming model.

$$\max h_0(u,v) = \frac{\sum_{r=1}^{s} v_r y_{r0}}{\sum_{i=1}^{m} u_i x_{i0}} \quad (1)$$

subject to

$$\frac{\sum_{r=1}^{s} v_r y_{rj}}{\sum_{i=1}^{m} u_i x_{ij}} \le 1 ; j = 1,2,.....,n$$

$$u_i \ge 0 ; i = 1,2,.....,m$$

$$v_r \ge 0 ; r = 1,2,.....,s$$

where

x ij = the amount of input *i* utilized by the *j*th DMU

y rj = the amount of output *r* produced by the *j*th DMU

u i = weight given to input *i*

v = weight given to output *r*

Following the Charnes and Cooper (1962) one can select a representative solution (*u, v*) for which

$$\sum_{i=1}^{m} u_i x_{i0} = 1 \quad (2)$$

Hence, the denominator in the efficiency score h_0 shown above is set equal to one, the transformed linear programming model for DMU_0 can be written as follow.

$$\max z_0 = \sum_{r=1}^{s} v_r y_{r0} \quad (3)$$

subject to

$$\sum_{r=1}^{s} v_r y_{rj} - \sum_{i=1}^{m} u_i x_{ij} \le 0 ; j = 1,2,.....,n$$

$$\sum_{i=1}^{m} u_i x_{i0} = 1$$

$$u_i \ge 0 ; i = 1,2,.....,m$$

$$v_r \ge 0 ; r = 1,2,.....,s$$

The linear programming model shown above will be run *n* times in identifying the relative efficiency scores of all the DMUs. Each DMU selects input and output weights that maximize its efficiency score. Generally, a DMU is considered efficient if it obtains a score of 1.00, implying 100% efficiency; whereas a score of less than 1.00 implies that it is inefficient. Maximizing the fraction from Equation 2 can be accomplished by minimizing the denominator of the fraction and normalizing the denominator to one (Lehmann, Warning, & Weigand, 2004).

$$Min \sum_{r=1}^{m} u_{i,} x \quad (4)$$

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Subject to: $\sum_{r=1}^{s} v_r y_r = 1$

$$-\sum_{r=1}^{s} v_r y_{r\,j} + \sum_{r=1}^{m} u_{i,} x \geq 0, \qquad j = 1, 2\ldots n$$

$v_r \geq 0 \qquad r = 1,2,\ldots.s$

$u_i \geq 0 \qquad i = 1,2, \ldots m$

The duality theory from linear programming suggests that there is a dual program for each original linear program and the solution are always equal (Gale, Kuhn, & Tucker, 1951).

3.2.2. DEA for Profit Maximization

The profit-maximization of a multiple outputs, multiple inputs firm facing inputs and outputs prices *w* and *p*, respectively, can be formulated as the following DEA problem:

$$\text{Max} \sum_{r=1}^{m} p_r y_r - \sum_{i=1}^{n} w_i x_i \qquad (5)$$

Subject to $\sum_{j=1}^{N} \lambda_j y_{rj} \geq y_r (r = 1,2,\ldots.,m);$

$$\sum_{j=1}^{N} \lambda_j x_{ij} \leq x_i (i = 1,2,\ldots.,n);$$

$$\sum_{j=1}^{N} \lambda_j = 1;$$

$$\lambda_j \geq 0; (j = 1,2,\ldots.,N).$$

The profit maximizing input and output quantities $x_i^*(i = 1,2,\ldots,n)$ and $y_r^*(r=1,2,\ldots,m)$ are obtained along with the other decision variables λ_j^* *(j =1,2,..., N)* at the optimal solution of this equation. A point to be noted in this context is that, the optimal value of the objective function $\Pi^* = p' y^* - w' x^*$ is the maximum profit that the firm can earn.

3.3. Analyses of Causality Between Bank Cost and Profit Efficiency and Economic Growth

The second stage of this paper investigated the causality relationship between bank efficiency and economic growth measured by the real GDP per capita. To accomplish this task, the following approaches adopted. First, unit-root tests performed on cost and profit efficiency and economic growth in order to determine the existence of non-stationarity. Second, tests for panel co integration implemented to test the existence of long run relationship between variables. Third, Granger causality test performed. In performing causality, testing, bivariate regressions implemented.

3.3.1. Unit Rot Tests

Traditional test used for testing the order of integration is Augmented Dickey-Fuller (ADF). Problem of low power in rejecting null hypothesis of stationary especially for short period data and not take into account of possible autocorrelation in the error term for ADF causes researchers to suggest alternative panel unit root tests. These include Levin, Lin, and Chu (2002), Im, Pesaran, and Shin (2003) and Maddala and Wu (1999) among others. From among different methods developed in the literature, LLC and IPS are the most popular. IPS begins by specifying a separate ADF regression for each cross section.

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$$\Delta y_{i,t} = \alpha_i + \beta_i y_{i,t-1} + \sum_{j=1}^{p_i} \rho_{i,j} \Delta y_{i,t-j} + \varepsilon_{i,t} \quad (6)$$

where $y_{i,t}$ (i=1, 2,.....,N; t=1,2,.....,T) is the series for panel member *i* over period *t*, p_i is the number of lags in the ADF regression, and the error terms $\varepsilon_{i,t}$ are assumed to be independently and normally distributed random variables for all *i*'s and *t*'s with zero means and finite heterogeneous variances σ_i^2. Both β_i and the lag order ρ in Equation 6 are allowed to vary across sections. Consequently, the null hypothesis to be tested is:

$$H_0 : \beta_i = 0, \ \forall i$$

Against the alternative hypothesis:

$$H_1 : \begin{cases} \beta_i = 0 & \text{for some } i\text{'s.} \\ \beta_i \prec 0 & \text{for at least one } i. \end{cases}$$

The t-bar statistics is calculated using the average t-statistics for β_i from the separate ADF regressions in the following fashion:

$$\tilde{t-bar}_{NT} = \frac{\sum_{i=1}^{N} t_{i,T}(p_i)}{N} \quad (7)$$

Where $t_{i,T}$ is the calculated ADF statistics from individual panel component.

This paper pursues the following steps to test for stationary and convert a non-stationary variable into a stationary one. First, it applies Augmented Dickey-Fuller (ADF), Phillips-Perron (PP), Levin, Lin and Chu (LLC), Im, Pesaran and Shin (IPS). Second, it tests for a unit root in the level, first difference, and second difference of the series where necessary. When a test fails to reject the null hypothesis at levels, then proceed to test at first differences. If it can reject null hypothesis, then the series is said to contains one-unit root and it is said to be integrated at order one I (1). If the test fails to reject the test in levels and first differences but rejects the test in second differences, then the series contains two-unit roots and is integrated of order two I (2).

3.3.2. Cointegration Tests

Granger (1980) first introduced the concept of cointegration into the literature. Cointegration entails the existence of a long-run relationship between economic variables. The quintessence of testing for cointegration is to examine whether there is significant deviation from a certain relationship between variables. Literature suggests that, if variables are co integrated, it implies that they move together over time so that short-term disturbances will be corrected in the long-term. This means that if, in the long-run, two or more series move closely together, the difference between them is constant. Otherwise, if two series are not co integrated, they may ramble arbitrarily far away from each other (Dickey, Jansen, & Thornton, 1991).

This paper therefore, utilized the two types of the heterogeneous panel cointegration test developed by Pedroni (1999) which, overcoming the problem of small samples, as the case for this paper. This approach also allows different individual cross-section effects by sanctioning heterogeneity in the intercepts and slopes of the co integrating equation. Pedroni's method takes in a number of different statistics for the test of the null hypothesis of no cointegration in heterogeneous panels[1]. The first group of tests is termed "within dimension" that includes the panel-v, panel rho(r), which is similar to the Phillips and Perron (1988) test, panel non-parametric (PP) and panel parametric (ADF) statistics. The panel non-parametric statistic and the panel parametric statistic are

[1] For details and mathematical representations of the tests, one may refer to Pedroni (2004).

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analogous to the single-equation ADF-test. The other group of tests is called "between dimensions" which is comparable to the group mean panel tests of Im et al. (2003). The "between dimensions" tests include four tests: group-rho, group-PP, and group-ADF statistics. The seven Pedroni's tests are based on the estimated residuals from the following long run model:

$$y_{it} = \alpha_i + \sum_{j=1}^{m} \beta_{ji} x_{jit} + \varepsilon_{it} \quad (8)$$

Where $\varepsilon_{it} = \rho_i \varepsilon_{i(t-1)} + w_{it}$ are the estimated residuals from the panel regression?

The null hypothesis tested is whether ρ_i is unity or not. The seven statistics are normally distributed and compared to appropriate critical values. If critical values exceeded that of seven statistics, the null hypothesis of no-cointegration is rejected implying that there exists no long run relationship between the variables.

3.3.3. Granger Causality

Pedroni's heterogeneous panel cointegration method tests for the existence of long run relationships only. The tests indicate the presence or absence of long run links between the variables, but do not indicate the direction of causality when the variables are co integrated. Traditionally causality is tested by the standard two-step EG causality procedure. Therefore, this paper follows this traditional way in testing the causality relationship between cost and profit efficiency and economic growth.

The most widely used method in the literature for testing panel causality is that proposed by Holtz-Eakin, Newey, and Rosen (1988). Their time-stationary VAR model is of the form:

$$Y_{it} = \alpha_0 + \sum_{j=1}^{m} \alpha_j Y_{it-j} + \sum_{j=1}^{m} \delta_j X_{it-j} + f_{yi} + u_{it}$$
$$X_{it} = \beta_0 + \sum_{j=1}^{m} \beta_j Y_{it-j} + \sum_{j=1}^{m} \gamma_j X_{it-j} + f_{xi} + v_{it} \quad (9)$$

where Y_{it} and X_{it} are the two co-integrated variables, *i*=1,.....,N represents cross-sectional panel members, u_{it} and v_{it} are error terms. This model differs from the standard causality model in that it adds two terms, f_{xi} and f_{yi} which are individual fixed effects for the panel member *i*.

The lagged dependent variables of the above equations correlated with the error terms, including the fixed effects. Thus, an OLS estimate of the above model is biased. The remedy is to remove the fixed effects by differencing. The resulting model is:

$$\Delta Y_{it} = \sum_{j=1}^{m} \alpha_j \Delta Y_{it-j} + \sum_{j=1}^{m} \delta_j \Delta X_{it-j} + \Delta u_{it}$$
$$\Delta X_{it} = \sum_{j=1}^{m} \beta_j \Delta Y_{it-j} + \sum_{j=1}^{m} \gamma_j \Delta X_{it-j} + \Delta v_{it} \quad (10)$$

To test for the causality, the joint hypotheses $\delta_j = 0 \quad for\ j = 1,.....,m$ and $\beta_j = 0 \quad for\ j = 1,.....,m$ is simply tested. Chi-squared distribution with (*k-m*) degrees of freedom followed in testing statistics. The variable *X* is said not to Granger-cause the variable *Y* if all the coefficients of lagged X in Equation 10 are not significantly different from zero, for the reason that it implies that the history of *X* does not improve the prediction of *Y*.

4. EMPIRICAL RESULTS

4.1. Average Efficiency for the SENA Countries.

Table 1 summarizes the average cost and profit efficiencies based on ownership, type, size, and corporate structure. It indicates that on average commercial banks in SENA are relatively more cost efficiency than profit efficiency. Mean score of the profit efficiency is 0.8684 compared with cost efficiency which has a mean score of

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0.8869. The results suggest that for the commercial banks in SENA to operate at the maximum efficiency they need further reduce their costs by 11.31 percent. This result could also interpret that in overall, SENA commercial banks wastes around 11.31 percent of its costs relative to the best practice banks for the same level of output.
The findings for commercial banks in SENA are consistent with the findings of previous studies, for example, Maudos et al. (2002); [2]Ariff and Can (2008)[3]; Das and Ghosh (2009); Kirkpatrick, Murinde, and Tefula (2008)[4] and Okeahalam (2006) among others who reported profit efficient level of the banks are well below those of cost efficiency

Table 1. Descriptive Statistics for cost and profit efficiency (1998 -2011): Big Four Economies.

Africa Big Four Economies	Cost Efficiency		Profit Efficiency	
	Mean	Std. Dev.	Mean	Std. Dev.
Panel A: All banks	0.8869	0.0575	0.8684	0.1023
Panel B: Local banks	0.9028	0.0566	0.8802	0.0986
Panel C: Foreign banks	0.8843	0.0787	0.8706	0.1848
Panel D: Old banks	0.8945	0.0534	0.8618	0.1881
Panel E: New banks	0.8915	0.0597	0.8464	0.1218
Panel F: Big banks	0.9244	0.0335	0.8473	0.1359
Panel G: Small banks	0.8660	0.0905	0.8798	0.1163
Panel H: Listed banks	0.8760	0.1030	0.8874	0.1253
Panel I: Unlisted banks	0.8871	0.0512	0.8490	0.1553

Similarly, the mean score of profit efficiency is 0.8684 suggest that an average bank in SENA earn around 86.84 of the profits that the best profit practice banks could realize under the same conditions. The result also suggests that for the SENA banks to reach the level of the best profit practice banks they need further improve their profits by 13.16 percent.
Cost efficiency score compared with profit efficiency found to be relatively higher with the exception of 2002 where profit efficiency reaches at peak. The results also indicate that cost and profit efficiency move in the same direction with little variation between the two. A comparison of the domestic and foreign banks reveals that domestic banks are relatively more cost efficient compared with foreign banks. The mean score of cost efficiency is 0.9028 for domestic banks compared with 0.8843 for the foreign banks put forward that domestic bank well utilizes their resources compared with foreign banks. The results suggest that domestic banks waste around 9.72 percent of the resources while foreign banks waste around 11.57 of their resources for the same level of output. In other words, domestic banks can be explained, as they are much closer to the cost-efficient frontier than foreign banks. In a case of profit efficiency, domestic banks found to use well their ability to generate profits compared with foreign banks. The findings on cost efficiency between domestic and foreign banks confirm the findings of previous studies (For example, (Edward Chang, Hasan, & Hunter, 1998; Frimpong, 2010; Hasan & Hunter, 1996; Mahajan, Rangan, & Zardkoohi, 1996; Mamatzakis et al., 2008; Tecles & Tabak, 2010)).
The explanation could be that foreign banks at the outset incur higher costs of establishing due to transfer of technology to the local financial market, the adoption of technology in their operations and establishment under the new operating environment. Berger, DeYoung, Genay, and Udell (2000) suggest that domestic efficiency superiority over foreign banks could due to home field advantage. The superiority of domestic banks may also be explained by highly regulated banking system, domestic banks may likely to have advantages to the field such as introducing new products, as they are familiar with the environment they operate and getting better treatment from regulators and government. Domestic banks also have an advantage of superior access to local information, and greater commitment to local prosperity. On the other hand, foreign banks entering into developing countries appears more willing to focus on asset quality rather than generating new loans (Kim & Lee, 2004). The profit

[2] Maudos analyses the cost and profit efficiency of sample of 14 countries of the European Union, as well as Japan and the USA and found inequalities of profitability between countries.
[3] Ariff and Can used non parametric technique for data from 1995 to 2004 to investigate cost and profit efficiency of 28China commercial banks.
[4] Kirkpatrick et al. (2008) uses the translog stochastic cost and profit frontier approach to measure the degree of x-inefficiencies in a panel of 89 commercial banks drawn from 9 Sub Saharan countries. However, Kirkpatrick results should be taken with care as the sample dominated with banks from two countries (Nigeria 35 and Kenya 22).

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mean score is 0.8802 for the domestic banks compared with 0.8706 for the foreign banks suggest that domestic banks are much closer to the most profit efficient banks compared with foreign banks. These results imply that for the foreign banks to match with the most profit efficient banks they need further improve their profits by 12.94 percent while for the domestic banks to match with most profit efficient banks they need further improve their profits by 11.98 percent. Analyses of new and old banks indicate that, there are no significant differences between old and new banks in cost efficiency scores. The mean score for old banks is 0.8945 while that of new banks is 0.8915 suggesting that overall old and new banks almost waste the same number of resources for the same level of output. To contest with the most cost-efficient banks, old banks required further trim down their costs by 10.55 percent whilst the new banks further oblige to cut down their costs by 10.85 percent. In contrary old banks seems to relatively more profit efficient compared with new banks with the mean score of 0.8618 whilst new banks have a mean score of 0.8464 suggesting that old banks are making profits by 13.82 percent of what best profit practice banks make and new banks make a profit by 15.36 of what best profit practice banks make. Findings on big banks and small banks disclose that big banks are relatively more cost efficient than small banks. On average big banks have a mean score of 0.9244 compared with small banks, which have mean score of 0.8660 that recommend that, typical big banks waste a little number of resources compared with small banks for the same level of output. These results indicate that while big banks waste 7.56 of their resources for the same level of output that could otherwise use to realize maximum efficiency, small banks waste 13.4 percent of the resources for the same level of output. Unlike cost efficiency score, profit efficiency estimates show that small banks are relatively more profit efficient than big banks. The mean score for the big banks is 0.8473 signify that big banks should further improve their profits by 15.27 percent to match with most profit efficient banks. A mean score for small banks is 0.8798 signify that small banks require to further perk up their profits by 12.02 percent in order to earn profits that the best profit practice banks earn.

Another interesting part of analysis is that of banks whose shares listed at stock market and those whose shares not listed at stock market. The findings of this study reveal that unlisted banks are relatively more cost and profit efficient than listed banks. Nevertheless, their differences are very little that make no significant meaning. A mean cost efficiency score for listed banks is 0.8760 while that of unlisted is 0.8871. On profit efficiency, a mean score for listed banks is 0.8874 and that of unlisted is 0.8490 signifying that listed and unlisted banks have inefficiencies of 0.124 and 0.1129 for cost efficiencies and 0.1126 and 0.151 for profit efficiencies respectively. Thus, there is opportunity for listed banks to further improve their efficiencies by cutting down their costs by 12.4 percent and improving their profits by 11.26. For unlisted banks, they need further reduce their costs by 11.29 percent and get better to their profits by 15.1 percent.

4.2. Results on Causality between Cost and Profit Efficiency and Economic Growth

4.2.1. Unit Root Test- Africa Big Four Economies Sample

The primary step at this section is to test the integration order of the variables to ensure that all variables integrated at the same order before testing for cointegration. The assumption of the test is that the variables should be stationary at level or first differences or at level and first differences. If any variable, found to be integrated at I (2) or beyond, then test provides biased results that make long run relationship if present to be inappropriate and unreliable. The study has applied difference test for unit root as shown in Table 2. The results reported in Table 2 shows that the variable per capita GDP have unit root problem at their level form and found to be integrated at first difference I (1). The variables cost and profit efficiencies indicated that there is no unit root at level.

Table 2. Unit root test statistics.

	Variable	LLC	IPS	ADF	PP
Level	LogPGDP	1.01039	10.9876	25.4073	17.2404
1st Difference	LogPGDP	-5.06368***	-4.52401***	213.866***	293.538***
Level	CE	-4.44448***	-1.51088*	166.849*	172.217**
1st Difference	CE	23.2822***	-16.0735***	468.457***	541.277***
Level	PE	-4.33950***	-2.58801***	161.281***	154.119**

Note: ***, **, and * denotes significant at 1%, 5%, and 10% respectively. Probabilities for Fisher tests computed using an asymptotic Chi-squared distribution. All other tests assume asymptotic normality.

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This result indicates that variables used become stationary at level and first differences. The stationarity of the variables provide room to apply Pedron testing approach for cointegration test.

4.2.2. Cointegration Test

Table 3 indicates that there is no cointegration between variables. Null hypothesis that no cointegration exists cannot rejected at any level of significant. This result suggests that cost and profit efficiencies of the commercial banks cannot affect economic growth in the long run.

Table 3. Panel cointegration test statistics.

	Panel Statistics	Group Statistics
V	-4.446975	-
Rho	5.480379	8.974433
PP	6.235412	8.540782
ADF	5.910289	7.847873

4.2.3. Granger Causality Test

Causality test is conducted using pairwise Granger Causality tests with lag two. The results from Granger causality models shown on Table 4 reveal that there is no causality between cost efficiency and economic growth. Thus, neither cost efficiency nor economic growth has influence to each other. This result implies that reduction of costs for commercial banks provide no improvement in economy of the countries. The results from profit efficiency and economic growth show that there is no causality between variables. Thus, neither commercial bank profit efficiency has an influence on economic growth, nor economic growth has an influence on commercial bank profit efficiency. The implication of the results is that; improvement of commercial banks profit efficiency has no any impact in improving economy of the SENA countries. This result is not surprise taking into account that countries under this group are relatively developed in other financial sectors compared with other African countries and therefore their economy might rely more on other financial sectors rather than banking sectors.

Table 4. Granger causality test.

Null Hypothesis:	F-Statistic	Prob.
CE does not Granger Cause LPGDP	0.79833	0.4504
LPGDP does not Granger Cause CE	0.57210	0.5645
PE does not Granger Cause LPGDP	0.00864	0.9914
LPGDP does not Granger Cause PE	0.11576	0.8907
PE does not Granger Cause CE	0.28561	0.7516
CE does not Granger Cause PE	14.4820***	6.E-07

Note: *** denotes significant at 1% respectively.

The test on causality between cost and profit efficiencies indicate that there is one-way causality runs from cost efficiency to profit efficiency. This implies that banks, which are more cost efficient, could be also be more profit efficient.

5. CONCLUSIONS

Most studies on bank efficiency focuses on cost and neglect the profit efficiency. These studies face criticism for pay no attention to potential inefficiencies on the profit side. Existing empirical evidence hints out that higher level of inefficiencies be present in profits than in cost. This paper presents evidence on commercial banks cost and profit efficiencies, and its impact to the economic growth of the Africa big four economies countries. The sample consists of a panel dataset covering the period 1998-2023. The study employed data envelopment analysis (DEA) for estimation of cost and profit efficiency scores. The DEA findings indicate high levels of cost efficiency for commercial banks in SENA. This finding is consistent with previous evidence in the existing literature that profit efficiency levels of the banks are below cost efficiency.

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Second stage of this paper analyzed the causality relationship between bank efficiency and economic growth. The findings evidenced that there is no long run relationship between bank efficiency and economic growth. However, there exist a unidirectional relationship between cost efficiency and profit efficiency where cost efficiency Granger causes profit efficiency. Thus, although literature posits that most cost-efficient banks not necessarily be more profit efficient, the evidence form this paper suggest that cost efficient bank might also be profit efficient.

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REFERENCES

Ahmed, A. D. (2013). Effects of financial liberalization on financial market development and economic performance of the SSA region: An empirical assessment. *Economic Modelling, 30*, 261-273. https://doi.org/10.1016/j.econmod.2012.09.019

Anwar, S., & Cooray, A. (2012). Financial development, political rights, civil liberties and economic growth: Evidence from South Asia. *Economic Modelling, 29*(3), 974-981. https://doi.org/10.1016/j.econmod.2012.02.009

Ariff, M., & Can, V. L. (2008). Cost and profit efficiency of Chinese banks: A non-parametric analysis. *China Economic Review, 19*(2), 260-273. https://doi.org/10.1016/j.chieco.2007.04.001

Atahau, A. D. R., & Cronje, T. (2022). What drives the performance of different bank-ownership types in Indonesia? The pre- and post-GFC analysis. *International Journal of Productivity and Performance Management, 71*(8), 3309-3330. https://doi.org/10.1108/IJPPM-03-2020-0096

Athanasoglou, P. P., Brissimis, S. N., & Delis, M. D. (2008). Bank-specific, industry-specific and macroeconomic determinants of bank profitability. *Journal of International Financial Markets, Institutions and Money, 18*(2), 121-136. https://doi.org/10.1016/j.intfin.2006.07.001

Bangake, C., & Eggoh, J. C. (2011). Further evidence on finance-growth causality: A panel data analysis. *Economic Systems, 35*(2), 176-188. https://doi.org/10.1016/j.ecosys.2010.07.001

Berger, A. N., & DeYoung, R. (2001). The effects of geographic expansion on bank efficiency. *Journal of Financial Services Research, 19*(2), 163-184. https://doi.org/10.1023/A:1011159405433

Berger, A. N., DeYoung, R., Genay, H., & Udell, G. F. (2000). Globalization of financial institutions: Evidence from cross-border banking performance. *Brookings-Wharton Papers on Financial Services, 2000*(1), 23-120. https://doi.org/10.1353/pfs.2000.0001

Berger, A. N., & Humphrey, D. B. (1997). Efficiency of financial institutions: International survey and directions for future research. *European Journal of Operational Research, 98*(2), 175-212. https://doi.org/10.1016/S0377-2217(96)00342-6

Bucevska, V., & Hadzi Misheva, B. (2017). The determinants of profitability in the banking industry: Empirical research on selected Balkan countries. *Eastern European Economics, 55*(2), 146-167. https://doi.org/10.1080/00128775.2016.1260473

Bumann, S., Hermes, N., & Lensink, R. (2013). Financial liberalization and economic growth: A meta-analysis. *Journal of International Money and Finance, 33*, 255-281. https://doi.org/10.1016/j.jimonfin.2012.11.013

Charnes, A., & Cooper, W. W. (1962). Programming with linear fractional functionals. *Naval Research Logistics Quarterly, 9*(3-4), 181-186. https://doi.org/10.1002/nav.3800090303

Charnes, A., Cooper, W. W., & Rhodes, E. (1978). Measuring the efficiency of decision making units. *European Journal of Operational Research, 2*(6), 429-444. https://doi.org/10.1016/0377-2217(78)90138-8

Cornett, M. M., Guo, L., Khaksari, S., & Tehranian, H. (2010). The impact of state ownership on performance differences in privately-owned versus state-owned banks: An international comparison. *Journal of Financial Intermediation, 19*(1), 74-94. https://doi.org/10.1016/j.jfi.2008.09.005

Cruz-García, P., Forte, A., & Peiró-Palomino, J. (2020). On the drivers of profitability in the banking industry in restructuring times: A Bayesian perspective. *Applied Economic Analysis, 28*(83), 111-131. https://doi.org/10.1108/AEA-01-2020-0003

Cyree, K. B., & Spurlin, W. P. (2012). The effects of big-bank presence on the profit efficiency of small banks in rural markets. *Journal of Banking & Finance, 36*(9), 2593-2603. https://doi.org/10.1016/j.jbankfin.2012.05.015

Dacanay, S. J. O. (2007). Profit and cost efficiency of Philippine commercial banks under periods of liberalization, crisis and consolidation. *The Business Review, 7*(2), 315-322.

Das, A., & Ghosh, S. (2009). Financial deregulation and profit efficiency: A nonparametric analysis of Indian banks. *Journal of Economics and Business, 61*(6), 509-528. https://doi.org/10.1016/j.jeconbus.2009.07.003

Dickey, D. A., Jansen, D. W., & Thornton, D. L. (1991). A primer on cointegration with an application to money and income. *Federal Reserve Bank of St. Louis Review, 73*(2), 58–78.

Ebissa, T. T., & Lakew, D. M. (2025). Cost efficiency of commercial banks in Ethiopia: Does financial technology matter? *PLoS One, 20*(1), e0317226. https://doi.org/10.1371/journal.pone.0317226

Edward Chang, C., Hasan, I., & Hunter, W. C. (1998). Efficiency of multinational banks: an empirical investigation. *Applied Financial Economics, 8*(6), 689-696. https://doi.org/10.1080/096031098332727

Emrouznejad, A., Parker, B. R., & Tavares, G. (2008). Evaluation of research in efficiency and productivity: A survey and analysis of the first 30 years of scholarly literature in DEA. *Socio-Economic Planning Sciences, 42*(3), 151-157. https://doi.org/10.1016/j.seps.2007.07.002

Fries, S., & Taci, A. (2005). Cost efficiency of banks in transition: Evidence from 289 banks in 15 post-communist countries. *Journal of Banking & Finance, 29*(1), 55-81. https://doi.org/10.1016/j.jbankfin.2004.06.016

Frimpong, J. M. (2010). Investigating efficiency of Ghana banks: A non-parametric approach. *American Journal of Scientific Research 7*(4), 64-76.

Gale, D., Kuhn, H. W., & Tucker, A. W. (1951). Linear programming and the theory of games. In T. C. Koopmans (Ed.), *Activity analysis of production and allocation*. In (pp. 317–329). New York, NY: John Wiley & Sons.

Goddard, J., Molyneux, P., & Wilson, J. O. S. (2004). The profitability of European banks: A cross-sectional and dynamic panel analysis. *The Manchester School, 72*(3), 363-381. https://doi.org/10.1111/j.1467-9957.2004.00397.x

Granger, C. W. (1980). Long memory relationships and the aggregation of dynamic models. *Journal of Econometrics, 14*(2), 227-238. https://doi.org/10.1016/0304-4076(80)90092-5

Gržeta, I., Žiković, S., & Tomas Žiković, I. (2023). Size matters: Analyzing bank profitability and efficiency under the Basel III framework. *Financial Innovation, 9*(1), 43. https://doi.org/10.1186/s40854-022-00412-y

Hasan, I., & Hunter, W. C. (1996). Efficiency of Japanese multinational banks in the United States. In A. H. Chen (Ed.), *Research in finance*. In (Vol. 14, pp. 157–173). Greenwich, CT: JAI Press.

Hassan, M. K., Sanchez, B., & Yu, J.-S. (2011). Financial development and economic growth: New evidence from panel data. *The Quarterly Review of Economics and Finance, 51*(1), 88-104. https://doi.org/10.1016/j.qref.2010.09.001

Holtz-Eakin, D., Newey, W., & Rosen, H. S. (1988). Estimating vector autoregressions with panel data. *Econometrica, 56*(6), 1371-1395. https://doi.org/10.2307/1913103

Im, K. S., Pesaran, M. H., & Shin, Y. (2003). Testing for unit roots in heterogeneous panels. *Journal of Econometrics, 115*(1), 53-74. https://doi.org/10.1016/S0304-4076(03)00092-7

Insani, D. S. (2021). *How liquidity, bank efficiency, and NPF ratio impact on Islamic commercial bank performance during the COVID-19 pandemic?* Paper presented at the Proceedings of the 2nd International Seminar of Science and Applied Technology (ISSAT 2021). Atlantis Press.

Isayas, Y. N. (2022). Determinants of banks' profitability: Empirical evidence from banks in Ethiopia. *Cogent Economics & Finance, 10*(1), 2031433. https://doi.org/10.1080/23322039.2022.2031433

Isik, I., & Hassan, M. K. (2002). Technical, scale and allocative efficiencies of Turkish banking industry. *Journal of Banking & Finance, 26*(4), 719-766. https://doi.org/10.1016/S0378-4266(01)00167-4

Khalifaturofi'ah, S. O. (2023). Cost efficiency, innovation and financial performance of banks in Indonesia. *Journal of Economic and Administrative Sciences, 39*(1), 100-116. https://doi.org/10.1108/JEAS-07-2020-0124

Kim, H. E., & Lee, B.-Y. (2004). *The effects of foreign bank entry on the performance of private domestic banks in Korea*. Basel, Switzerland: Bank for International Settlements.

Kirkpatrick, C., Murinde, V., & Tefula, M. (2008). The measurement and determinants of x-inefficiency in commercial banks in Sub-Saharan Africa. *The European Journal of Finance, 14*(7), 625-639. https://doi.org/10.1080/13518470701705769

Koutsomanoli-Filippaki, A. I., & Mamatzakis, E. C. (2011). Efficiency under quantile regression: What is the relationship with risk in the EU banking industry? *Review of Financial Economics, 20*(2), 84-95. https://doi.org/10.1016/j.rfe.2011.04.001

La Porta, R., Lopez-de-Silanes, F., & Shleifer, A. (2002). Government ownership of banks. *The Journal of Finance, 57*(1), 265-301. https://doi.org/10.1111/1540-6261.00422

Lehmann, E., Warning, S., & Weigand, J. (2004). Governance structures, multidimensional efficiency and firm profitability. *Journal of Management and Governance, 8*(3), 279-304. https://doi.org/10.1007/s10997-004-1116-z

Lei, J., & Li, Y. (2021). The influence of digital finance development on the operating performance of China's commercial banks. *International Journal of Frontiers in Engineering Technology, 3*(8), 20–24. https://doi.org/10.25236/IJFET.2021.030804

Leibenstein, H., & Maital, S. (1992). Empirical estimation and partitioning of X-inefficiency: a data-envelopment approach. *The American Economic Review, 82*(2), 428-433.

Levin, A., Lin, C.-F., & Chu, C.-S. J. (2002). Unit root tests in panel data: Asymptotic and finite-sample properties. *Journal of Econometrics, 108*(1), 1-24. https://doi.org/10.1016/S0304-4076(01)00098-7

Levine, R., Loayza, N., & Beck, T. (2000). Financial intermediation and growth: Causality and causes. *Journal of Monetary Economics, 46*(1), 31-77. https://doi.org/10.1016/S0304-3932(00)00017-9

Levine, R., & Zervos, S. (1998). Stock markets, banks, and economic growth. *American economic review, 88*(3), 537-558.

Li, M.-G., & Zhao, J.-J. (2016). Measuring the efficiency of Chinese commercial banks: An analytical model and empirical validation. *Journal of Interdisciplinary Mathematics, 19*(5-6), 1057-1076. https://doi.org/10.1080/09720502.2016.1251709

Lin, X., & Zhang, Y. (2009). Bank ownership reform and bank performance in China. *Journal of Banking & Finance, 33*(1), 20-29. https://doi.org/10.1016/j.jbankfin.2006.11.022

Lucchetti, R., Papi, L., & Zazzaro, A. (2001). Banks' inefficiency and economic growth: A micro-macro approach. *Scottish Journal of Political Economy, 48*(4), 400-424. https://doi.org/10.1111/1467-9485.00206

Maddala, G. S., & Wu, S. (1999). A comparative study of unit root tests with panel data and a new simple test. *Oxford Bulletin of Economics and Statistics, 61*(S1), 631-652. https://doi.org/10.1111/1468-0084.0610s1631

Mahajan, A., Rangan, N., & Zardkoohi, A. (1996). Cost structures in multinational and domestic banking. *Journal of Banking & Finance, 20*(2), 283-306. https://doi.org/10.1016/0378-4266(94)00129-4

Mamatzakis, E., Staikouras, C., & Koutsomanoli-Filippaki, A. (2008). Bank efficiency in the new European Union member states: Is there convergence? *International Review of Financial Analysis, 17*(5), 1156-1172. https://doi.org/10.1016/j.irfa.2007.11.001

Manlagñit, M. C. V. (2011). The economic effects of foreign bank presence: Evidence from the Philippines. *Journal of International Money and Finance, 30*(6), 1180-1194. https://doi.org/10.1016/j.jimonfin.2011.06.015

Margono, H., Sharma, S. C., & Melvin, P. D. I. (2010). Cost efficiency, economies of scale, technological progress and productivity in Indonesian banks. *Journal of Asian Economics, 21*(1), 53-65. https://doi.org/10.1016/j.asieco.2009.06.001

Mateev, M., Sahyouni, A., & Al Masaeid, T. (2024). Bank performance before and during the COVID-19 crisis: Does efficiency play a role? *Review of Managerial Science, 18*(1), 29-82. https://doi.org/10.1007/s11846-022-00611-y

Maudos, J., & Pastor, J. M. (2001). Cost and profit efficiency in banking: An international comparison of Europe, Japan and the USA. *Applied Economics Letters, 8*(6), 383-387. https://doi.org/10.1080/135048501750237829

Maudos, J., Pastor, J. M., Pérez, F., & Quesada, J. (2002). Cost and profit efficiency in European banks. *Journal of International Financial Markets, Institutions and Money, 12*(1), 33-58. https://doi.org/10.1016/S1042-4431(01)00051-8

Menicucci, E., & Paolucci, G. (2016). The determinants of bank profitability: Empirical evidence from European banking sector. *Journal of Financial Reporting and Accounting, 14*(1), 86-115. https://doi.org/10.1108/JFRA-05-2015-0060

Micco, A., Panizza, U., & Yañez, M. (2007). Bank ownership and performance. Does politics matter? *Journal of Banking & Finance, 31*(1), 219-241. https://doi.org/10.1016/j.jbankfin.2006.02.007

Murinde, V. (2012). Financial development and economic growth: Global and African evidence. *Journal of African Economies, 21*(Suppl. 1), i10-i56. https://doi.org/10.1093/jae/ejr042

Naeem Azmi, S., & Akhtar, S. (2025). Does financial development and economic growth matter for services export? Cross-country evidence from OECD countries. *The Journal of International Trade & Economic Development, 34*(5), 1048-1069. https://doi.org/10.1080/09638199.2024.2361658

Ngweshemi, L. E., & Isiksal, A. Z. (2021). Analysis of the factors affecting bank profitability: Evidence of Tanzania commercial banks. *Studies of Applied Economics, 39*(8). https://doi.org/10.25115/eea.v39i8.4768

Oanh, T. T. K., Van Nguyen, D., Le, H. V., & Duong, K. D. (2023). How capital structure and bank liquidity affect bank performance: Evidence from the Bayesian approach. *Cogent Economics & Finance, 11*(2), 2260243. https://doi.org/10.1080/23322039.2023.2260243

Okeahalam, C. C. (2006). Production efficiency in the South African banking sector: A stochastic analysis. *International Review of Applied Economics, 20*(1), 103-123. https://doi.org/10.1080/02692170500362819

Olson, D., & Zoubi, T. A. (2011). Efficiency and bank profitability in MENA countries. *Emerging Markets Review, 12*(2), 94-110. https://doi.org/10.1016/j.ememar.2011.02.003

Otondi, F. M., & Gitagia, F. K. (2025). Financial innovations and cost efficiency of commercial banks in Kenya. *International Academic Journal of Economics and Finance, 5*(1), 470-484.

Pedroni, P. (1999). Critical values for cointegration tests in heterogeneous panels with multiple regressors. *Oxford Bulletin of Economics and Statistics, 61*(S1), 653-670. https://doi.org/10.1111/1468-0084.0610s1653

Pedroni, P. (2004). Panel cointegration: Asymptotic and finite sample properties of pooled time series tests with an application to the PPP hypothesis. *Econometric Theory, 20*(3), 597-625. https://doi.org/10.1017/S0266466604203073

Pham, H. N., Nguyen, N. T., Ngo, V. T., Nguyen, M. N., & Pham, T. H. N. (2022). Does internal control affect bank profitability in Vietnam? A Bayesian approach. In N. T. Nguyen, V. Kreinovich, T. H. Doan, & D. T. Nguyen (Eds.), *Financial econometrics: Bayesian analysis, quantum uncertainty, and related topics*. In (pp. 219–238). Cham, Switzerland: Springer.

Phillips, P. C. B., & Perron, P. (1988). Testing for a unit root in time series regression. *Biometrika, 75*(2), 335-346. https://doi.org/10.1093/biomet/75.2.335

Rakshit, B. (2022). Does bank competition necessarily contribute to higher profits? The case of Indian banking. *Asian Economics Letters, 3*(3), 1–7. https://doi.org/10.46557/001c.35526

Ridene, S., Jedidi, L., & Ben Ayed, W. (2026). Assessing the impact of FinTech on bank efficiency: Insights from the MENA region. *Fintech and Digital Accounting Review, 2*(1), 1-17. https://doi.org/10.1108/FDAR-08-2025-0023

Salahuddin, M., Alam, K., Ozturk, I., & Sohag, K. (2018). The effects of electricity consumption, economic growth, financial development and foreign direct investment on CO_2 emissions in Kuwait. *Renewable and Sustainable Energy Reviews, 81*, 2002-2010. https://doi.org/10.1016/j.rser.2017.06.009

Schumpeter, J. A. (1934). *The theory of economic development: An inquiry into profits, capital, credit, interest, and the business cycle (R. Opie, Trans.)*. Cambridge, MA: Harvard University Press.

Shen, C.-H., & Chen, T.-H. (2010). Estimating banking cost efficiency with the consideration of cost management. *The Quarterly Review of Economics and Finance, 50*(4), 424-435. https://doi.org/10.1016/j.qref.2010.08.002

Siameti, P., Chronopoulos, D. K., & Dotsis, G. (2025). Negative rates and bank profit and cost efficiency: Evidence for Eurozone. *The European Journal of Finance, 31*(1), 14-30. https://doi.org/10.1080/1351847X.2024.2366367

Sousa, F., & Almeida, L. (2025). Banking profitability: Evolution and research trends. *International Journal of Financial Studies, 13*(3), 139. https://doi.org/10.3390/ijfs13030139

Staikouras, C., Mamatzakis, E., & Koutsomanoli-Filippaki, A. (2008). An empirical investigation of operating performance in the new European banking landscape. *Global Finance Journal, 19*(1), 32-45. https://doi.org/10.1016/j.gfj.2008.01.001

Tecles, P. L., & Tabak, B. M. (2010). Determinants of bank efficiency: The case of Brazil. *European Journal of Operational Research, 207*(3), 1587-1598. https://doi.org/10.1016/j.ejor.2010.06.007

Valickova, P., Havranek, T., & Horvath, R. (2015). Financial development and economic growth: A meta-analysis. *Journal of Economic Surveys, 29*(3), 506-526. https://doi.org/10.1111/joes.12068

Vazquez, F., & Federico, P. (2015). Bank funding structures and risk: Evidence from the global financial crisis. *Journal of Banking & Finance, 61*, 1-14. https://doi.org/10.1016/j.jbankfin.2015.08.023

Verma, A., & Giri, A. K. (2022). ICT diffusion, financial development, and economic growth: Panel evidence from SAARC countries. *Journal of Public Affairs, 22*(3), e2557. https://doi.org/10.1002/pa.2557

Zhang, J., Wang, L., & Wang, S. (2012). Financial development and economic growth: Recent evidence from China. *Journal of Comparative Economics, 40*(3), 393-412. https://doi.org/10.1016/j.jce.2012.01.001

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