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Article

How bank recapitalization and ownership shape agricultural finance in Ghana: A note

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Abstract: This study examines the heterogeneous effects of recapitalization and the origin of banks on agricultural finance in Ghana, using panel data from 2015–2018 (pre-recapitalization) and 2019–2022 (post-recapitalization). Fixed effects regression with robust standard errors was employed, incorporating macroeconomic indicators (interest rate, inflation) and bank-specific variables (capital adequacy ratio, non-performing loans). Results show that recapitalization improved agricultural financing. Regional banks increased lending compared to foreign banks, while indigenous banks reduced lending. Macroeconomic and bank-specific factors also influenced agricultural finance differently. Policies should incentivize domestic banks to support the agricultural sector in enhancing food security and reducing dependence on foreign aid.

Keywords: recapitalization, agricultural finance, impacts, macroeconomic indicators, Indigenous banks, foreign banks, regional banks

1. Introduction

Agricultural finance is pivotal for economic growth, rural development, and food security, especially in countries where agriculture dominates the economy (Serhiienko et al., 2023). Agricultural finance also fosters rural development by improving infrastructure, creating job opportunities, and promoting rural prosperity (Mhlanga, 2020). It ensures the inclusion of rural and marginalized populations in financial services by allowing them to save, borrow, and invest (Sagbo & Kusunose, 2021). Again, it facilitates technology adoption and thereby enhances agricultural productivity (Teye & Quarshie, 2022).

As a critical financial intermediary, the banking sector mobilizes savings and extends credit facilities (Twumasi et al., 2020). Periodic reforms and recapitalizations enhance the sector's efficiency and stability. Recapitalization ensures banks have adequate capital to support lending, absorb losses, and mitigate economic shocks (Kusi et al., 2023). It safeguards depositors' funds, boosts confidence, and attracts domestic and foreign investors (Ogbola, 2020). Also, recapitalization aligns banks with global regulatory standards, enabling cross-border transactions and strengthening the country's financial position.

Ghana's banking landscape is uniquely diverse, comprising foreign, regional, and indigenous banks, each with distinct ownership structures and financial intermediation approaches. This diversity necessitates examining how recapitalization affects these different bank categories in agricultural finance. The study focuses on how ownership structures influence lending patterns, interest rate dynamics, and financial inclusion post-recapitalization. Foreign banks often have stringent credit risk policies, potentially limiting agricultural sector financing. Conversely, regional and indigenous banks may demonstrate varied lending behaviors influenced by shareholder expectations and risk appetites.

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While studies on agricultural finance emphasize its importance for economic development, there is limited research on how recapitalization and bank ownership structures jointly impact agricultural finance in Ghana. Ghana's banking sector shows distinct heterogeneity compared to other developing countries, with foreign banks typically engaging in conservative lending due to global regulatory pressures. In contrast, indigenous banks may prioritize local development but face higher capital constraints. In countries like Kenya and Nigeria, recapitalization has led to varying impacts on agricultural credit based on bank ownership, but such comparative dynamics remain underexplored in Ghana's context.

This study bridges this gap by assessing the heterogeneous impacts of recapitalization on agricultural lending across Ghana's diverse banking institutions. By identifying the unique trends in lending behaviors and interest rate decisions post-recapitalization, this study contributes to understanding how banking reforms can be optimized to support agricultural finance. The findings are significant for policymakers aiming to enhance food security and reduce foreign aid dependence by incentivizing domestic banks to increase agricultural sector lending or credit. This study, therefore, seeks to analyze how recapitalization has influenced lending patterns among foreign, regional, and indigenous banks in Ghana's agricultural sector. Section 2 of this study contains the literature review, and Section 3 highlights the data and methods section. Section 4 details the results and discussion, and Section is the conclusion. Section 6 discusses suggestions made for further studies.

2. Literature review

2.1. Macroeconomic indicators and agricultural financing

Generally, GDP is the barometer of a nation's economic health, reflecting the total value of goods and services produced (Pandey et al., 2024). In the context of agricultural finance, GDP signifies a period of economic expansion and increased financial resources in an economy. Thus, GDP growth can often translate into heightened investment opportunities in the agricultural sector, where banks are more prone to avail or allocate funds because of the potential growth in the sector. Conversely, there is reduced financing for agricultural activities during declining GDP, as financial institutions become risk-averse towards the sector (Karangwa, 2023).

Interest rates are essential in determining borrowers' capital cost, including those in the agricultural sector (Motaze, 2022). When interest rates change, there is the possibility of a dual effect on agricultural financing. An increase in interest rates makes borrowing expensive for lenders in the agricultural sector, potentially reducing their access to credit. Lower interest rates, however, make agricultural credit affordable, promoting agricultural investment. Banks may react differently to interest rate fluctuations, primarily based on their ownership structure (Demiralp et al., 2021). Foreign banks, for example, based on their international funding sources and global perspectives, may have the financial robustness to mitigate interest rate risks in a completely different way from regional and indigenous banks (Wanke et al., 2022). Inflation refers to the rate at which the prices of goods and services rise in an economy. In agricultural finance, high inflation erodes and diminishes the purchasing power of businesses and consumers, ultimately affecting their ability to invest in the sector (Alemu, 2022). The central bank formulates monetary policy that sometimes targets inflation through adjustment of interest rates, which directly affect agricultural credit costs (Wagan et al., 2018).

2.2. Empirical review

Using the Ordinary Least Squares regression and profits, overhead cost, and interest margin as proxies for efficiency, Azmeh (2021) examined the impact of foreign banks' entry in Lebanon on the country's financial development. Representing the size of the financial sector with liquid liabilities, private credit for institutions' monetary deposit and

extension of domestic credit to the private sector for the size of the financial sector, the researcher found that the entry of foreign banks into the Lebanese banking space had a positive impact on financial development. Hamada (2018) investigated the effects of the acquisition of indigenous banks by foreign banks on lending behavior. The study used data from ninety commercial banks in Indonesia. It concluded that foreign banks that had acquired indigenous banks reduced their financing or extension of credit to Small and Medium Enterprises (SMEs).

Tayem (2022) examined the foreign and domestic bank ownership and service type (Islamic as against conventional banking) on credit to SMEs and large businesses. Employing regression estimation and the propensity score matching in testing the hypothesis, the research analyzed data collected from Jordanian banks from 2007 to 2018. The study's findings revealed that Islamic banks that foreigners owned extended more credit facilities to large businesses compared to SMEs. Using the panel data along the framework of fixed effects regression, Schmitz (2020) studied, among others, programs to expand access to credit among SMEs and individuals in Brazil. The researcher found that foreign banks expand access to credit to small firms that are less risky. The author also found that domestic banks only increased the credit provision to large firms.

Ukaegbu & Oino (2014) investigated the impact of the penetration of foreign banks into Kenya on indigenous banking operations. The researchers used data from 19 banks from 2001 to 2009. They found that foreign banks' entry improves many firms' credit access. The researchers found that foreign banks increased lending mainly to big companies and institutions. Massand & Gopalakrishna (2018) examined the credit disbursement to various sectors in the Indian economy and further empirically investigated foreign banks' entry. The authors used the GLM estimator and the panel ARDL estimator to study the impact of foreign banks' entry in India from 1996 to 2015. They found that, even though sectoral growth attracted more credit, the growth in the agricultural sector in India for the period instead witnessed a reduction in credit disbursement in that sector. The researchers further established that the reduction in lending was also attributed to high sectoral non-performing loans. They found that foreign banks negatively impacted credit disbursement in India's services and industrial sectors.

Employing datasets on the activities of commercial banks in the MENA region from the year 2000 to 2016, El Hourani & Mondello (2021) examined how capitalization and institutional quality affect the ending activities of commercial banks. The authors further adopted the fixed effects regression. They found that bank-specific variables, macroeconomic indicators, and the Basel I and II capital regulations influence commercial banks' lending behavior. All three bank types identified in their research, foreign, domestic, and private banks, increase credit disbursement during periods of improved political stability.

Cybo-Ottone & Savorelli (2016) also investigated the effects of recapitalization on the risk preferences of banks based on their categorization and associated increase in credit disbursement across sectors and industries. In their analysis, the researchers underscore recapitalization's important role in credit allocation across sectors and its effects on economic growth. Brei et al. (2020), in their paper on using separation tools of impaired loans and recapitalization, which can result in recovery of banks' lending and NPLs, employed a dataset of 135 banks from the period between 2000 and 2016. The researcher, however, found a statistically insignificant relationship between recapitalization of banks and loan disbursement or lending. Hryckiewicz et al. (2023), in their paper Towards a New Era of Restructuring, investigated banks' resolution techniques. The authors employed 22 granular datasets at the bank level from 22 advanced economies from 1992 to 1997. The authors also adopted the financial stability model and found that without strategies to address NPLs and delinquent facilities, recapitalization will not necessarily improve banks' performance and lending activities.

In his research on an econometric approach to agricultural credit and agricultural productivity in Bangladesh, Islam (2020) employed the autoregressive distributed lag model (ARDL) and other control variables. Using time series data from 2000 to 2019 from the Bureau of Statistics, Bangladesh, Bangladesh Bank, and the Ministry of Finance, Bangladesh, the researcher found that high interest rates, among other variables, limit access to agricultural finance.

3. Data and Methods

This section describes the methodology employed in conducting the research.

3.1. Study Design and Rationale for Fixed-Effects Model

This study employs a quantitative approach that utilizes panel data analysis to examine the heterogeneous impacts of foreign, regional, and indigenous banks on agricultural finance in Ghana. Panel data is appropriate for analyzing agricultural loan disbursements, bank-specific financial metrics, and macroeconomic variables over eight years (2015-2022) for 23 banks (as detailed in Table 1). The choice of a fixed-effects model over a random-effects model is based on the assumption that the unobserved heterogeneity across banks (such as the inherent risk preferences, management styles) is correlated with the independent variables. This assumption is critical because if these unobserved factors are correlated, a random-effects model would produce biased estimates (Wooldridge, 2010). The fixed-effects model also controls for these time-invariant, bank-specific characteristics by including bank-specific intercepts, eliminating the potential for bias due to these factors.

Table 1. Banks Categorization

Bank	Origin	Categorization	Year of Commencement		Branches in Ghana
			World	Ghana	
Absa Bank Ghana Ltd	South Africa	Regional	1991	2020	95
Access Bank Ghana Ltd	Nigeria	Regional	1989	2009	53
ADB Bank Ltd	Ghana	Indigenous	1965	1965	82
Bank of Africa Ghana Ltd	Morocco	Regional	1997	1982	26
Cal Bank PLC	Ghana	Indigenous	1990	1990	32
Consolidated Bank Ghana Ltd	Ghana	Indigenous	2018	2018	113
Ecobank Ghana Ltd	ECOWAS	Regional	1985	1990	67
FBN Bank Ghana Ltd	Nigeria	Regional	1894	1996	21
Fidelity Bank Ghana Ltd	Ghana	Indigenous	2006	2006	73
First Atlantic Bank Ghana Ltd	Ghana	Indigenous	1996	1996	35
First National Bank Ghana Ltd	South Africa	Regional	1838	2015	11
GCB Bank Ltd	Ghana	Indigenous	1953	1953	196
Guaranty Trust Bank Ghana Ltd	Nigeria	Regional	1990	2004	34
National Inv. Bank Ltd	Ghana	Indigenous	1963	1963	51
OmniBSIC Bank Ghana Ltd	Ghana	Indigenous	2019	2019	42
Prudential Bank Ltd	Ghana	Indigenous	1993	1993	44
Republic Bank (Ghana) PLC	Trinidad & Tobago	Foreign	1837	2019	42
Société Générale Ghana Ltd	France	Foreign	1864	1975	49
Stanbic Bank Ghana Ltd	South Africa	Regional	1992	1999	40
Standard Chartered Bank (Ghana) Ltd	United Kingdom	Foreign	1862	1896	23
United Bank for Africa (Ghana) Ltd	Nigeria	Regional	1949	2005	30
Universal Merchant Bank Ltd	Ghana	Indigenous	1972	1972	37
Zenith Bank (Ghana) Ltd	Nigeria	Regional	1990	2005	40

Source: Bank of Ghana.

Furthermore, a Hausman test was conducted to assess the fixed-effects model's appropriateness formally. The results of the Hausman test supported the use of the fixed effects model.

3.2. Data sources and variable selection

The study relies on secondary data obtained from various sources. Bank-specific data on agricultural loan disbursements, recapitalization levels, capital adequacy ratios (CAR), and agricultural sector non-performing loans (NPLs) were collected directly from each bank and the Bank of Ghana. Macroeconomic indicators, including inflation and interest rates, were obtained from the Ghana Statistical Service.

3.3. Recapitalization and bank origin as key variables

Recapitalization as a variable in this study is crucial as it represents a significant regulatory intervention to strengthen the banking sector. Its inclusion allows us to assess how changes in bank capital influence lending behavior, particularly towards the agricultural sector. Recapitalization levels directly influence a bank's lending capacity and risk appetite. Bank origin (either foreign, regional, or indigenous) as a variable is essential for capturing the heterogeneous impacts of recapitalization and other factors on agricultural finance. Different bank ownership structures will likely exhibit varying responses due to differences in strategic focus, risk management practices, and resource access. This variable allows the isolation of the impact of bank origin on agricultural lending.

3.4. Model specification and addressing potential biases

The following fixed-effects regression model estimates the impact of recapitalization and bank origin on agricultural finance.

$$lnAF_{it} = \beta_0 + \beta_1 RECAP_{it} + \beta_2 CAR_{it} + \beta_3 lnNPLA_{it} + \beta_4 INTEREST_{it} + \beta_5 INFLATION_{it} + \beta_6 COVID_{it} + \beta_7 IndigenousBank_{it} + \beta_8 RegionalBanks_{it} + \alpha_i + \varepsilon_{it}, \quad (1)$$

where:

- $lnAF_{it}$ refers to the natural logarithm of agricultural finance for bank i at time t.
- $RECAP_{it}$ represents the recapitalization variable for bank i at time t.
- CAR_{it} is the Capital Adequacy Ratio of bank i at time t.
- $lnNPLA_{it}$ denotes the natural logarithm of non-performing loans in the agricultural sector for bank i at time t.
- $INTEREST_{it}$ is the interest rate for bank i at time t.
- $INFLATION_{it}$ captures the inflation rate at time t.
- $IndigenousBank_{it}$ and $RegionalBanks_{it}$ are dummy variables indicating whether bank i is classified as an indigenous or regional, respectively, at time t.
- α_i represents bank-specific fixed effects.
- ε_{it} is the error term.

To mitigate potential survivorship bias, the study included banks that were operational throughout the study period, even those that underwent mergers or restructuring. Using the consolidated bank ensures that the data from the consolidated banks is not lost.

To address endogeneity concerns further, an instrumental variables (IV) technique was employed. The potential endogeneity of the recapitalization variable (RECAP) was tested, given its possible correlation with the error term due to reverse causality or omitted variable bias. The Capital Adequacy Ratio (CAR) and inflation rate (INF) were used as instruments, as they are theoretically correlated with recapitalization but not directly with the error term in the agricultural finance equation.

The first-stage regression confirmed the relevance of the instruments, with statistically significant coefficients. The Sargan-Hansen test for over-identifying

restrictions yielded a p-value greater than 0.05, indicating that the instruments were valid and uncorrelated with the error term. Also, the Durbin-Wu-Hausman test for endogeneity resulted in a p-value greater than 0.05, suggesting the absence of endogeneity in the model. Therefore, the fixed-effects model without additional IV corrections remains appropriate for the analysis, as illustrated in Table 2.

Table 2. Endogeneity Test

Test	Test Statistic	p-value	Conclusion
First-Stage F-Test	18.72	0	Instruments are relevant
Sargan-Hansen Test	2.45	0.117	Instruments are valid
Durbin-Wu-Hausman Test	1.36	0.243	No endogeneity detected

Source: Authors' Analysis from Stata 17. Note: A *p*-value greater than 0.05 for the Sargan-Hansen and Durbin-Wu-Hausman tests indicates that the instruments are valid and there is no evidence of endogeneity.

3.5. Robustness checks

To ensure the reliability of the results, robustness checks were performed. These checks involved conducting regressions with alternative model specifications and variable definitions. The tests' results are presented in Table 3.

Table 3. Robustness checks

Robustness Test	Model Specification	Key Findings	Conclusion
Alternative Dependent Variable	ln(AF) replaced with AF growth	Coefficients retained magnitude and significance	Results are robust
Random Effects Model	Random effects instead of FE	Hausman test p-value = 0.003 (FE preferred)	FE model confirmed
Lagged Independent Variables	Lagged ln(NPLA) and INTEREST	Results consistent with the main specification	Robust to time dynamics
Subsample Analysis	Indigenous vs. Regional banks	Similar patterns across subsamples	Findings are generalizable
Excluding Outliers	Banks with extreme loan values	Coefficients remained stable	Results not driven by outliers
Robust Standard Errors	Clustered by bank	Standard errors remained stable	Estimates are reliable

Source: Authors' Analysis from Stata 17.

The Hausman test result, with a p-value of 0.003, indicates the importance of using the fixed-effects model. The low p-value suggests that the random effects model would yield biased estimates due to correlation between the regressors and unobserved bank-specific effects.

Also, substituting lnAF with AF growth ensured that the results were not driven by the specific definition of the dependent variable, with coefficients retaining magnitude and significance. Incorporating lagged lnNPLA and INTEREST accounted for time dynamics, confirming the temporal robustness of the relationships. Comparing indigenous and regional banks showed consistent trends, suggesting generalizability of the findings across bank types. Again, removing banks with extreme loan values ensured that outlier observations did not drive the results. Finally, the standard errors were clustered at the bank level using the Arellano (1987) method, ensuring reliable inference by accounting for within-bank correlation over time.

3.6. Rationale for key variables

The study focuses on recapitalization and bank origin (foreign, regional, and indigenous) as primary explanatory variables due to their critical roles in shaping agricultural finance. Recapitalization influences banks' lending capacities and risk management, directly impacting loan disbursement. Banks' diverse ownership structures

reflect differing risk appetites, lending strategies, and operational models, which are pivotal in understanding the heterogeneity of agricultural finance in Ghana.

4. Results and discussions

This section details the analysis to assess the heterogeneous impacts of recapitalization and bank types on agricultural finance. It begins with a thorough analysis of the descriptive statistics obtained from the data.

4.1. Summary statistics

The summary statistics shown in Table 4 tested the statistically significant differences in the variables between the period before and after recapitalization. The period before recapitalization spans from 2015 to 2018, and the period after recapitalization is 2019 to 2022. The results shown in Table 4 show statistically significant differences in all the variables between and after recapitalization. The mean capital adequacy ratio before recapitalization (2015 – 2019) is 1713.95 compared to that after recapitalization, 2126.65. Since CAR after recapitalization is significantly higher than the period before recapitalization, it implies that the banks have become financially stronger with lower credit and operational risks than before. Therefore, after recapitalization, the bank is better at absorbing potential losses without rendering it insolvent.

Also, the recapitalization period witnessed a significant increase in non-performing agricultural loans to an amount of GH₵182.30 million compared to GH₵131.34 million before recapitalization. This indicates that a greater amount of the loans taken for agriculture purposes after recapitalization have not been paid as scheduled compared to the period before. It is important to note that the recapitalization period coincided with COVID-19, which affected the agriculture sector. In Ghana, the prices of inputs, especially fertilizer and pesticides, increased astronomically during this period due to supply bottlenecks, affecting crop yield and resulting in loan defaults.

The recapitalization lowered the average interest rate from 27.09% to 23.8% between 2015 and 2018, and from 2019 to 2022. Banks might have become well racialized, so they are prepared to lower their interest rate to attract borrowers. Ironically, the recapitalization increased inflation. The average inflationary rate before recapitalization (2015 to 2018) is 7.81%, which is against the average inflationary rate of 15.85% after recapitalization. This could result from the COVID-19 outbreak, which coincided with the recapitalization period. The economic crisis during and after resulted in food price hikes.

Lastly, the agriculture finance by banks after recapitalization is significantly higher than the amount of money loaned to the agriculture sector before recapitalization. The average amount of agricultural credit before recapitalization (2015 to 2018) is GH₵ 1.47 billion, as against the average amount of agricultural credit of GH₵ 2.01 billion after recapitalization. After recapitalization, banks are expected to have enough liquidity to advance loans to the agricultural sector. The credit and operational risks of the banks are minimal after recapitalization, thereby making them financially strong enough to advance credit to the agriculture sector.

Table 4. Descriptive statistics

Variable	Before recapitalization	After Recapitalization	t- value
	No (2015 – 2018)	Yes (2019 – 2022)	
CAR	1713.95	2126.65	-27.50***
NPLA(million)	131.34	182.30	-4.70***
Interest ((%)	27.09	23.08	12.68***
Inflation (%)	7.81	15.85	-7.69***
Covid-19 (%)	0.00	70.83	-18.64***
Agric Finance	1.47e+09	2.01e+09	-7.8565***

Source: Authors' analysis from secondary data.

4.2. Test for multicollinearity

A test was conducted to check for any incidence of multicollinearity in the analysis. There is an incident of multicollinearity when the independent variables in a regression model are highly correlated (Shrestha, 2020). The Variance Inflation Factor (VIF) is used to ascertain the absence of multicollinearity in the regression model. From Table 5, all the regression model variables have a VIF of less than 10. The rule of thumb is that a VIF of less than 10 suggests the absence of multicollinearity (Duxbury, 2021). It is therefore evident that the model has no incidence of multicollinearity.

Table 5. Variance inflation factor test for multicollinearity

Variable	VIF	$^1/_{VIF}$
leaf	7.660	0.131
RECAP	5.360	0.186
CAR	4.630	0.216
lnNPLA	3.620	0.276
INTEREST	2.440	0.410
INFLATION	1.310	0.762
COVID	4.170	0.240

Source: Authors' analysis from secondary data (2024).

4.3. Hausman test for random effects versus fixed effects

The Hausman test evaluated the difference between the fixed and random effects estimates. It is used to determine the most appropriate model, either between fixed effects or random effects, that is appropriate for the analysis of a particular study (Bastardoz, et al., 2023). Table 4 is an illustration of the Hausman test results that were conducted to validate the following hypothesis:

H_0: The random effects regression model is more appropriate and consistent.

H_1: The fixed effects regression model is more appropriate and efficient.

From the results in Table 6, the chi-square coefficient of 879.68 explains the consistency of the estimated coefficients between the fixed and random effects regression models. The general null hypothesis assumes that the random effects model is consistent, and the alternate hypothesis indicates a difference (systematic) between both models, with the fixed effects model being appropriate (Ranger & Much, 2020). Therefore, the high chi-square with 1% statistical significance observed in Table 4 provides strong evidence to support the argument of systematic differences between the two models, hence the rejection of the null hypothesis. Therefore, we have strong evidence to reject the null hypothesis (random effects regression is more appropriate and consistent), hence adopting the fixed effects regression model.

Table 6. Hausman test

	Coef.
Chi-square test value	879.68***
P-value	0.000

Source: Authors' analysis from secondary data (2024).

4.4. Testing for heteroskedasticity

A further analysis was conducted using the Modified Wald test for groupwise heteroskedasticity to evaluate whether the error term's variance is constant across the banks. The results are shown in Table 7. The null and alternative hypotheses that were validated are stated as follows:

H_1: *The error term's variance is the same for all entities (the presence of homoskedasticity is assumed).*

H_0: *The error term's variance differs across entities (heteroskedasticity is assumed).*

From Table 7, the chi-square statistic, which measures the difference between the expected and observed distributions of the square of the residuals, is 343.69. This high value signifies the departure from homoskedasticity. Furthermore, the p-value associated with the chi-square of 0.000 shows strong evidence against the null hypothesis. Therefore, this analysis rejects the null hypothesis in favour of the alternative.

Table 7. Wald Chi-square test for heteroskedasticity

	Coef.
Wald Chi-square test (3)	343.69***
P-value	0.000

Source: Authors' analysis from secondary data (2024).

4.5. Effects of recapitalization and the origin of banks on agricultural finance

This section examines the various impacts of bank types on Ghana's agricultural finance. Holding foreign bank type as a base category, the analysis, among other things, evaluates the effects of each bank type on agricultural finance relative to foreign banks. The study also assessed the effects of the recapitalization of the financial sector on agricultural finance. The analysis also evaluates the effects of bank-specific variables (NPLA and CAR) and macroeconomic variables (interest rates and inflation) on agricultural finance. Table 8 shows the results of the fixed effect analysis of recapitalization and bank origin on agricultural finance. In Table 8, the recorded R-squared of 0.943 indicates that 94.3% of the variance in the percent change in agricultural credit advanced to farmers is explained by the variations in the independent variables included in the model. The low p-value of the F-test statistic of 0.00 also indicates that the model is 1% statistically significant.

The results show that recapitalization positively and significantly affects the percentage change in agriculture finance. There is a 1% statistically significant effect of recapitalization on the percentage of loans advanced to the agriculture sector. Implicitly, an incident of recapitalization in December 2018 resulted in a 17.8% increase in agricultural finance, all equal. It can be concluded that the recapitalization exercise (400 million Ghanaian cedis, equivalent to $83 million minimum capital requirement) that the Central Bank of Ghana enforced has enhanced the financial resilience and competitiveness of the banking sector to support the agriculture sector. This finding supports the assertion by Kusi et al. (2023) that higher capital requirements capacitated banks to sustain a robust financial environment to absorb losses and provide a buffer against economic shocks. This is because a more substantial capital base allows banks to provide more credit to farmers, thereby enhancing agricultural productivity and finance. Research indicates that bank credit, which is positively influenced by recapitalization, is significant for the output growth of the agricultural sector. This suggests that recapitalization indirectly supports agricultural finance by increasing the availability of bank credit. The practical implication is that recapitalization enhanced banks' competitiveness, enabling increased investment in agricultural inputs and promoting food security. This also attracted foreign and domestic investors, reinforcing the banking sector's resilience.

Additionally, findings by Kukurah et al (2014) that bank recapitalization exercise has a significant relationship with the performance of banks are confirmed in this current study. Intuitively, recapitalization attracts foreign and domestic investors to invest in the banks, making them buoyant to lend money to risky ventures like the agriculture sector, for cascading economic effects. It can be deduced that the agricultural sector receives more investment from banks now than before December 2018, when the banks were not recapitalized. Farmers are better placed to acquire the necessary inputs (fertilizer, seeds, machinery, and pesticides) to expand their farms for improved agricultural productivity and food security. Theoretically, this aligns with the capital buffer hypothesis, suggesting that well-capitalized banks can extend more credit to risky sectors like agriculture. This finding also aligns with the financial deepening theory, which posits that a well-

developed financial system can lead to economic growth by mobilizing savings and allocating resources efficiently. Recapitalization contributes to financial deepening, which can enhance agricultural finance by providing more funding options for farmers. Finally, this finding of a positive significant relationship between recapitalization and agricultural finance is aligned with the risk management theory, as recapitalization can improve banks' risk management capabilities, allowing them to offer more credit to risky sectors like agriculture. This risk tolerance can lead to more agricultural finance being available.

From Table 8, indigenous banks have a negative and statistically significant effect on agricultural finance. The effects of indigenous banks on agricultural finance are 1% statistically significant. The negative coefficient of -0.10 implies that agricultural finance by indigenous banks is approximately 10% lower when compared to the base category, foreign banks. This makes intuitive sense as, generally, foreign banks with their foreign sources of capital are aligned more towards sustainability and agriculture and are more inclined to support agricultural finance than indigenous banks. Meanwhile, this is sad for the country regarding our preparedness and support for improving the agriculture sector and food security. Indigenous banks may perceive agricultural lending as riskier due to weather-related risks, market price fluctuations, and lack of collateral among small-scale farmers. Foreign banks may have sophisticated risk management systems that allow them to manage their credit risks better and therefore may provide relatively more agricultural lending (Yuan et al., 2022). Policymakers should therefore consider incentives, such as risk-sharing schemes and subsidized interest rates, to motivate indigenous banks to increase agricultural lending. This finding is supported by the credit rationing theory (Stiglitz & Weiss, 1981). Indigenous banks may ration credit to the agricultural sector due to higher perceived risks and information asymmetry, preferring safer, more profitable investments. This finding also aligns with the institutional theory. Indigenous banks may lack the institutional capacity, governance structures, and long-term strategic focus that foreign banks possess, limiting their engagement in sectors like agriculture, which require sustained financing and expertise. Again, this finding aligns with the pecking order theory. Indigenous banks, often relying more on internal funds due to limited access to international capital markets, may prioritize less risky lending opportunities, avoiding agriculture, which is characterized by volatility and uncertainty.

Table 8. Fixed effects analysis of recapitalization and bank origin on agricultural finance

leaf	Coef.	St.Err.
RECAP	0.178***	0.0260
CAR	-0.006	0.0060
lnNPLA	0.427***	0.0250
INTEREST	0.001	0.0060
INFLATION	0.005***	0.0020
COVID	0.058*	0.0330
: base foreign	0	.
Indigenous	-0.100***	0.0170
Regional	0.405***	0.0240
Constant	11.757***	0.6310
Model Diagnostics		
Mean dependent var = 19.9980		
R-squared = 0.9430		
F-test = 576.0140		

Source: Authors' analysis of secondary data (2024).

Conversely, regional banks demonstrated a positive and significant effect (40.5%) on agricultural finance, surpassing foreign banks. This supports Massand & Gopalakrishna (2018), who found foreign banks less committed to agricultural lending. Regional banks often have a deeper understanding of local market conditions, including the specific needs

and challenges farmers face in their region (Grivins et al., 2021). This local knowledge allows them to tailor financial products and services more effectively to support agricultural activities. Foreign banks might lack this localized expertise, potentially limiting their ability to provide targeted financial support. Regional banks often operate under local regulatory frameworks to support regional economic development, including agriculture (Mantino, 2021). This alignment can give them incentives or advantages in lending to the agricultural sector. These regional regulatory frameworks include initiatives like the West Africa Agriculture Productivity Program (WAAPP) and the Comprehensive Africa Agriculture Development Program (CAADP). Foreign banks may lack the same level of alignment with local agricultural development policies (Lipper et al., 2021). Several theoretical perspectives can support the positive effect of regional banks on agricultural finance. The proximity lending theory suggests that banks with closer geographical and informational proximity to borrowers are better positioned to assess creditworthiness and monitor loans, especially in sectors like agriculture that require detailed local knowledge. Regional banks' physical presence and relationship-based lending practices enable them to understand local agricultural dynamics better and mitigate informational asymmetries. Furthermore, the relationship banking theory posits that banks that cultivate long-term relationships with clients are more willing to extend credit, even in higher-risk sectors. Due to their embeddedness in local communities, regional banks are likely to invest in such relationships, enhancing trust and improving loan performance. The resource-based view (RBV) also provides understanding, suggesting that regional banks' unique local knowledge and networks constitute strategic resources that provide a competitive advantage in agricultural lending. From a policy perspective, the findings imply that strengthening the operational capacities of regional banks can further boost agricultural finance. Tailored policies that leverage these banks' locational advantages and relational capital may contribute significantly to agricultural sector growth and food security.

Meanwhile, the capital adequacy ratio (CAR) records an inverse relationship with the percentage change in agriculture finance. This association, however, is not statistically significant, confirming the findings of Madugu et al. (2020) that CAR has no apparent impact on local banks' profitability. Furthermore, the percentage change in agriculture sector non-performing loans has a statistically significant positive relationship with the percentage change in agriculture finance. In the agriculture sector, non-performing loans are statistically significant at 1%. Therefore, a 1.00% increase in agriculture sector non-performing loans results in a 0.43% increase in agricultural finance. This positive relationship between the agriculture sector non-performing loans and agricultural finance makes intuitive sense in economics as it supports the explanation by Madugu et al. (2020) that higher credit risk promotes banks' profitability, which can be lent to farmers. Meanwhile, this positive relationship is at variance with the assertion by Arhin (2017) that high non-performing loans negatively affect the financial performance of local banks in Ghana. Higher CAR requirements can limit banks' ability to lend, as they must maintain certain capital reserves (Oyetade et al., 2021). This can reduce their capacity to extend credit to sectors perceived as high-risk, such as agriculture. However, this means they have less capital for lending, potentially reducing their engagement in agricultural finance. If banks are focused on maintaining high capital buffers, they might be less inclined to engage in long-term or seasonal agricultural lending, which often requires more liquidity and flexibility. Theoretically, this observation aligns with the **Risk-Aversion Theory**, which suggests that banks with higher capital adequacy ratios tend to be more risk-averse, leading to reduced lending to high-risk sectors like agriculture. According to the **Buffer Capital Hypothesis**, banks hold additional capital to absorb unexpected losses. However, when capital levels are high, the incentive to extend credit to risky sectors diminishes, explaining the negative relationship observed.

An intriguing finding is the positive and statistically significant relationship between agricultural sector NPLs and agricultural finance. A 1% increase in agricultural sector

NPLs corresponds to a 0.43% increase in agricultural finance. This counterintuitive result supports the explanation by Madugu et al. (2020) that higher credit risk may promote banks' profitability when banks adjust interest rates to compensate for such risks. The finding suggests that banks may be willing to increase their lending to the agricultural sector even in the face of rising NPLs (Temsas et al., 2022). This could indicate a strategic decision by banks to support agricultural development, viewing it as a priority area despite the associated risks. External factors such as government incentives or policies aimed at boosting agricultural finance may encourage banks to lend more despite rising NPLs (Murungi et al., 2023). For instance, programs designed to enhance food security or rural development may prompt banks to increase their agricultural exposure. The relationship may also indicate broader economic trends where banks anticipate a recovery in the agricultural sector. If banks believe that the conditions for farmers will improve, they may be more inclined to increase lending, expecting that future repayments will stabilize (Khan et al., 2024). The positive relationship aligns with the **Risk-Return Trade-Off Theory**, which posits that higher risks are associated with higher expected returns. Banks may continue lending to the agricultural sector, anticipating higher profitability from increased interest margins. However, this finding contradicts the assertion by Arhin (2017), who argued that high NPLs negatively affect the financial performance of local banks in Ghana. The Credit Rationing Theory could explain the contradiction, which suggests that banks may ration credit when credit risk is perceived to be high. Nevertheless, in the Ghanaian context, banks may continue lending to the agricultural sector, driven by confidence in agricultural recovery or external support mechanisms that mitigate credit risk.

The results in Table 8 show that the interest rate has a positive relationship with agricultural finance. However, this relationship is not statistically significant. Also, though inflation has a positive and statistically significant effect on agriculture finance, the direction of effects does not meet the a priori expectation. Inflation can lead to higher nominal prices for agricultural products, which might increase the demand for agricultural finance (de Camargo Barros et al., 2022). Farmers may seek more credit to capitalize on higher prices, even if their purchasing power is reduced. This finding aligns with the monetary policy and agricultural sector interaction theory. The interaction between monetary policy and the agricultural sector can increase agricultural finance during inflationary periods. As inflation rises, monetary authorities might implement policies that inadvertently support agricultural lending, such as reducing interest rates or providing subsidies to farmers. The finding also aligns with the relative price variability theory. Inflation can lead to increased variability in relative prices, which might encourage investment in sectors like agriculture that are perceived as inflation-resistant. This could result in more agricultural finance as investors seek to capitalize on potential gains. The **Fisher Effect** also provides a theoretical lens through which this relationship can be understood. The Fisher Effect posits that nominal interest rates adjust to expected inflation, preserving actual returns. In the agricultural context, rising inflation may lead to higher agricultural commodity prices, improving farmers' repayment capacities, and encouraging banks to extend more credit. This relationship may also reflect inflation-induced increases in agricultural profitability, which improve the creditworthiness of borrowers in the sector.

Similarly, COVID-19 has a positive and statistically significant relationship with agricultural finance. However, the direction of effects does not meet economic intuition. Pandemic measures implemented by governments included financial incentives, subsidies, or emergency loans for the agricultural sectors, leading to increased agricultural finance etc. The pandemic accelerated a shift towards essential sectors like agriculture, which are critical for food security and economic stability (Mumtaz et al., 2022). This shift could have attracted more financial resources to agriculture as investors and governments prioritized these sectors. Also, the **Countercyclical Lending Theory** suggests that government interventions, such as stimulus packages and sector-specific relief programs,

during economic downturns or crises, may encourage banks to lend more, particularly to critical sectors like agriculture. The Ghanaian government's agricultural resilience programs during the pandemic likely boosted banks' confidence in agricultural lending, explaining the positive relationship.

4.6. Normality test of residuals of the fixed effects with robust standard errors

A further assessment was done to evaluate the normality of the residuals of the fixed effects regression model with robust standard errors, with the results in Table 9. Since the adoption of robust standard errors indicates the presence of a potential violation of homoskedasticity, it becomes important to assess the normality of the residuals to meet the assumptions of the model (Huang et al., 2022).

From the normality test results shown in Table 9, the recorded skewness of the residuals is 0.00, indicating the distribution's symmetry. The Bootstrap Standard Error of 0.00 suggests an intense precision in the skewness of the estimates. The observed coefficient of the kurtosis points to the similarity in characteristics to a normal distribution. This is buttressed by the bootstrap standard error of 0.00, highlighting the precision of the estimation for kurtosis. With a p-value of 0.054, which is above the standard 0.05, there is an indication that there is little evidence against the null hypothesis, which states that there is normality in kurtosis. Therefore, with skewness and kurtosis close to 0.00, there is a high indication of normality in the distribution above.

Table 9. Normality test of residuals

	coefficient	Bootstrap std. err.	z	P>z
Skewness_e	-0.000	0.000	-0.950	0.344
Kurtosis_e	-0.000*	0.000	-1.930	0.054
Skewness_u	0.000	0.000	1.140	0.255
Kurtosis_u	-0.000***	0.000	-3.080	0.002
Joint test for Normality on e:		$chi^2(2) = 4.61$*	Prob> chi^2 =0.0999	
Joint test for Normality on u:		$chi^2(2) = 10.76$***	Prob > chi^2 = 0.0046	

Source: Authors' analysis from secondary data (2024).

5. Conclusions

This study assessed the impacts of recapitalization and the origin of banks on agricultural finance in Ghana using a fixed-effect regression model. Secondary data was used for the analysis by classifying the period from 2015 to 2018 and 2019 to 2022 as periods before and after recapitalization. Using the foreign banks as the base, regional and local bank dummies were included as explanatory variables. The study established that recapitalization, agricultural sector non-performing loans, and interest rates played an important role in agricultural finance in Ghana. Recapitalization has improved the agricultural finance by 17.8% more than the period before recapitalization. Also, there are varying effects of the origin of banks on agricultural finance. Both indigenous and regional banks, when compared to foreign banks, show more distinctive and varying responses to agricultural finance. Regional banks demonstrated a pronounced increase in agricultural finance, suggesting targeted sector lending. Indigenous banks, however, showed reduced lending to the agricultural sector when compared to foreign banks. This has food security implications. Again, macroeconomic indicators and bank-specific variables adopted for the study also demonstrated varying influence on agricultural finance, which suggests and underscores the complex relationship between economic conditions and agricultural finance.

Considering the role recapitalization played in agricultural finance, it is recommended that the Central Bank of Ghana should enforce the minimum capital requirements for commercial banks. This minimum capital requirement should be

updated regularly to make the banks buoyant enough to continue to advance credit to the agricultural sector for cascading effects. Also, indigenous banks should be incentivized to increase credit allocation to the agricultural sector.

This study provides significant insights into the effects of recapitalization and bank origin on agricultural finance in Ghana. However, several avenues remain unexplored, providing opportunities for future research to deepen understanding and inform more robust policy interventions.

Future research could conduct longitudinal analyses to assess the long-term effects of recapitalization on agricultural finance. While the current study focuses on the immediate impacts following recapitalization, it would be valuable to understand how these effects evolve over extended periods. Such studies can reveal whether the positive impacts observed are sustained, diminished, or grown over time, offering understanding and clarity into the durability of recapitalization policies in promoting agricultural credit.

Comparative research involving economies with similar agricultural structures and banking sector dynamics can provide broader generalizability of findings. Researchers can determine whether Ghana's experience with recapitalization and agricultural finance aligns with regional patterns by examining countries within Sub-Saharan Africa or other developing economies. Such studies can also identify best practices that Ghana can adopt to optimize the role of indigenous banks in agricultural financing.

Further research could disaggregate agricultural finance into sub-sectors, such as crop production, livestock, fisheries, and agro-processing, to determine whether recapitalization and bank origin affect these sub-sectors differently. Understanding these aspects can help policymakers design more targeted financial interventions for each agricultural sub-sector.

Finally, future studies could explore how technological innovations, such as digital banking and fintech solutions, influence agricultural lending patterns. With the growing adoption of technology in financial services, examining its role in bridging financing gaps for agriculture could provide actionable insights for enhancing credit accessibility.

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