WORKING CAPITAL MANAGEMENT AND PROFITABILITY EVIDENCE FROM LISTED AGRICULTURE FIRMS IN NIGERIA

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ABSTRACT

This study has been carried out to investigate the effect of working capital management and profitability evidence from listed agriculture firms in Nigeria. The study used exposit facto research design. The population of the study was the five listed agricultural companies as at 31st December 2021 while the sample size was four listed agricultural companies using purposive sampling techniques because of the availability of complete data set for the period under study. Working capital management was proxies by account payable, inventory turnover, account payable, cash conversion period, current ratio and quick ratio while firm size was used as control variable to account for any difference in firm size among the firms and return on assets was used to proxy profitability. The study covered a period of 13 years (2009- 2021). Data collected were analyzed using both descriptive and inferential statistics. Pearson correlation matrix was adopted and panel data analysis (Pooled ordinary least square) was adopted in testing the hypotheses. The findings showed that account receivables and inventory turnover had positive and statistically significant effect on profitability (return on assets) of listed agriculture firms in Nigeria. Account payable and cash conversion had negative and statistically significant effect on profitability while current ratio and quick ratio had positive and statistically insignificant effect on profitability of listed agricultural firm for the period studied. Based on these findings, we concluded that working capital management is very crucial at all level of sector and its need proper management in order to achieve better profit from any business and invariably improve firm performance. The study concluded that management should put proper procedure in place for better working capital management in order to improve their profitability and achieve better performance in the long run.

INTRODUCTION

Background to the study

Working capital management plays a crucial role in the financial performance and sustainability of firms in the agriculture sector. Effective management of working capital ensures the availability of funds to support day-to-day operations, manage cash flow, and meet short-term obligations. It involves optimizing various components, including accounts receivable, inventory turnover, accounts payable, cash conversion cycle, current ratio, and quick ratio. Given the significance of these variables in working capital management and profitability, it is essential to examine their efficiency and impact on the performance and valuation of listed agriculture

firms in Nigeria. Understanding how these variables are managed and their influence on financial outcomes can provide valuable insights for both academics and practitioners in the agriculture industry. One of the key roles of working capital management in agriculture firms is ensuring smooth operations. These firms rely on working capital to facilitate various activities such as purchasing seeds, fertilizers, and equipment, as well as paying for labor and operational expenses. By effectively managing working capital, agriculture firms can ensure the uninterrupted flow of production and distribution processes.

Liquidity management is another vital aspect of working capital management in the agriculture sector. Due to the seasonal nature of agricultural operations, firms may experience fluctuations in cash flows. Effective working capital management enables these firms to allocate resources optimally, ensuring sufficient liquidity to meet short-term obligations such as loan repayments, utility bills, and employee wages. Maintaining a healthy liquidity position reduces financial stress and enhances the firm's ability to respond to unforeseen expenses or market volatility. Working capital management is closely linked to sustainable growth in agriculture firms. By balancing current assets and liabilities, firms can finance their growth initiatives without relying excessively on external financing. This reduces financial risks and the burden of debt servicing, fostering long-term sustainable growth.

Statement of the Problem

Working capital management is a crucial aspect of financial management in agriculture firms. However, in the context of listed agriculture firms in Nigeria, there is a lack of empirical research specifically focusing on working capital management and its impact on firm profitability. This research aims to address this gap by investigating the following problem:

Factors such as seasonality perish ability of produce, dependence on external factors like weather and market conditions, and limited access to financing pose specific challenges in managing working capital effectively in agriculture firms. However, the extent to which these challenges impact working capital management and firm profitability in listed agriculture firms in Nigeria requires further investigation.

Iqbal, Ahmad, Anwar, Hamad, (2014) examined the same for the textile sector and different studies mostly from the period of 1998-2011 have been included. Bashir Dar. Egbide, (2009) find that large number of business failures in the past has been blamed on the inability of the financial manager to plan and control the working capital of their respective firms. Vân Horne and Wachobvics (2004) pointed out that excessive level of current assets may have negative effects on a firm's profitability, whereas a low level of current assets may lead to lower liquidity and stock-out, resulting in difficulties in maintaining smooth operations. We observed that no study has been carried out in the agricultural sector of the economy. By addressing these gaps in the literature, this research project aims to provide valuable insights into the working capital management practices, their impact on firm profitability, of listed agriculture firms in Nigeria.

Research Objectives

The general objective is to examine working capital management and profitability evidence from listed agriculture firm in Nigeria. While specific objective are to:

1. Determine the effect of accounts receivables on profitability of listed agriculture firms in Nigeria

2. Examine the effect of inventory turnover on profitability of listed agriculture firms in Nigeria

3. Evaluate the effect of accounts payable on profitability of listed agriculture firms in Nigeria

4. Determine the effect of cash conversion circle on profitability of listed agriculture firms in Nigeria

5. Investigate the effect of current ratio on profitability of listed agriculture firms in Nigeria

6. Find out the effect quick ratio on profitability of listed agriculture firms in Nigeria

Research Hypotheses

The following hypotheses are to be tested:

Hypothesis One

Ho_1: Accounts receivables has no significant effect on profitability of listed agriculture firms in Nigeria

Hypothesis Two

Ho_2: Inventory ratio has no significant effect on profitability of listed agriculture firms in Nigeria

Hypothesis Three

Ho_3: Accounts payable has no significant effect on profitability of listed agriculture firms in Nigeria

Hypothesis Four

Ho_4: Cash conversion circle has no significant effect on profitability of listed agriculture firms in Nigeria

Hypothesis Five

Ho₅: Current ratio has no significant effect on profitability of listed agriculture firms in Nigeria
Hypothesis Six
Ho₆: Quick ratio has no significant effect on profitability of listed agriculture firms in Nigeria

LITERATURE REVIEW

The review of conceptual issues focuses on the relationship between working capital management and profitability, with firm evaluation as the dependent variable and working capital management as the independent variable.
Working capital management refers to the management of a company's short-term assets and liabilities to ensure efficient and effective use of resources. It involves managing components such as accounts receivable, inventory turnover, and accounts payable. Efficient working capital management can enhance a firm's financial performance, liquidity, and profitability.

Profitability is defined as the capacity to utilize all the available resources of the organization to make sufficient returns that will enable firms to run properly. Profitability ratios disclose the business ability to earn the adequate and reasonable amount of profit which further proves the financial goodness of the business operations. Profitability level is commonly interested by managers, creditors, and investors as well as the general public to evaluate the company's operation worthiness.

The concept of working capital has been reviewed and explained by various researchers using different forms and ideas. In the financial literature, the commonly accepted definition of working capital is the company's current assets (inventories, accounts receivable, cash and short-term credit) deducted from short-term liabilities (accounts payable and any short-term debt). Working capital refers to the money invested in the firms operating activities such as work in progress, finished goods, account receivables and cash etc., therefore, working capital is regarded the life-blood and nerve center of the commercial organization as it measures firm's efficiency and its short-term financial health. All assets owned by firms are classified into two main categories called long term assets and short term assets, long-term assets serve more than one financial year such property plant and equipment while short-term assets are restricted to the assets having one financial year useful lives such as cash, inventories, and accounts receivable, therefore, these are termed as working capital. In financial management, investment decisions taking by managers are grouped into two main categories; long-term investment decisions and short-term investment decisions. Long-term investment decisions are referred to capital budgeting which mainly concerns investment of fixed assets such as land, machines, buildings etc. while short-term investment decisions concentrate investment of short-term assets and it's known as working capital management.
Working capital management (WCM) is not new to the finance literature rather it has gone through series of developmental stages. In these stages, managers and academicians were working hand in hand for analyzing the best way to manage working capital.

In a simple and understandable term, working capital is the arithmetic difference between two balance sheet-aggregated sections: current assets and current liabilities; both of them comprised sub-accounts such as *cash accounts and short-term investments for marketable securities*:- these accounts are labeled cash on hand and in bank accounts, and any short-term investments which are marketable securities that management can use earn quick return, *accounts receivable:-* this is a category of current assets including all credit sales where the customers are expected to be cleared within one year, inventory:- is a combination of raw materials, work in process (that is, partially manufactured and assembled), and finished goods, *payables:-* the accounts payable account represents the amounts owed to creditors for purchases of goods or service at specific date and other working capital accounts: -prepaid expenses and accrued expenses often appear on balance sheets .

Cash Conversion Cycle
The cash conversion cycle is a financial metric that measures the time interval between a firm's inflow of cash from receivables and its outflow on payables for raw materials, wages, and other expenditures. It represents the average length of time cash circulates within a company's operations at a given time. The concept was introduced by Richards and Laughlin in (1980) as a performance measure to assess how well a company manages its working capital.

Management of Account Receivables
The management of accounts receivable is a crucial aspect of a company's working capital management. It involves formulating sound credit policies and collection procedures to ensure timely receipt of payments from customers. Accounts receivable serve as a monetary claim for goods and services received by customers and play a vital role in securing business sales

Management of Accounts Payable

Accounts payable is a significant component of working capital and serves as an economical and flexible source of finance for firms. Nilsen (2002) suggests that during economic downturns, businesses may prefer trade credit over financial institution credit for short-term financing.

Management of Inventory

Inventory management is a crucial aspect of business success, especially for manufacturing and retail/trading firms where inventory constitutes a significant portion of current assets. Effective inventory management helps control pilferage, wastage, and ensures material availability, leading to better operational results (Mittal, 2014). Proper and timely inventory management influences an organization's profitability and should be part of its strategic business plan (Gupta & Gupta, (2012).

Theoretical Framework

There are different theories that related with the short-term corporate financing.

Theory of Irrelevance:

Miller & Modigliani (1958) stated that the firm's value is independent irrespective of its capital structure and if firms' value depends on the capital structure then this opportunities must have to available in the perfect market. And WCM plays no role in firms' performance. This was the impractical statement by this theory but it provides the basic hypothetical framework for new studies.

Agency Theory:

Jenson and Mechling (1976) recognize the difference b/w managers and shareholders and have different stakes with organization. The manager's tries to reduce uncertainty and risk from their operations and owners want maximum profitability and owner's value. For avoiding risk the managers grant credits by setting sound standards that lead to effective management of trade receivables which is WCM and this would show the result of profitability that is owner's motive. So, according to this theory the work of management (WCM) contributes greater to owner's motives (profitability).

Resources Base Theory

Firm resources encompass both human and material inputs into the production process, forming the basis for business survival and profitability. These resources include capital equipment, labor (managers and employees' capabilities and knowledge), patents, brand names, funds, and more. Grant (1991) emphasizes that resources and capabilities form the foundation for a firm's strategy and are the primary source of profit.

Empirical Review

Iqbal, Ahmad, Anwar and Hamad (2014) they examined impact of working capital management on firm profitability evidence from textile sector of Pakistan. They used data period from (2006 to 2012).convenience sampling techniques was used to select a textile firms. Hayajneh and Yassine (2011) methodology was adopt and the results shows that working capital management and profitability has relative relationship.

Data from a sample of four out five Cement Companies quoted on the Nigerian stock Exchange from 2002-2009 were analyzed using descriptive statistics and multiple regression analysis. The result showed that there was insignificant negative relation between profitability and the number of days account receivable outstanding (DAR) and a significant negative relationship in the number of days inventory (DI) but was significantly positive in relationship to profitability and cash conversion cycle (CCC).

Various studies have analyzed the relationship of working capital management (WCM) and firm profitability in various markets. The results are quite mixed, but a majority of studies conclude a negative relationship between WCM and firm profitability. The studies reviewed have used various variables to analyze the relationship, with different methodology such as linear regression and panel data regression. This section presents the chronology of major studies related to this study in order to assess and identify the research gap.

METHODOLOGY

Research Design

The Research design adopted for this study is an ex-post facto design, where the variables under investigation were not manipulated since the phenomenon of interest has already transpired. This design has also been employed in similar studies such as those conducted by Duru (2014) and Ojeani (2014).

The population of this study consists of five (5) agriculture firms that were listed on the Nigerian Stock Exchange as of December 31st, 2017. These firms are FTN Cocoa Processing Plc, Ellah Lakes Plc, Okomu Oil Palm Plc, Livestock Feed Plc, and Presco Plc. As listed companies, they are required to adhere to the mandatory information disclosure regulations set forth by the International Account-

ing Standards Board (IASB) and comply with the listing requirements of the Nigerian Exchange group.

The study selected all the five agriculture firms that were listed on the Nigerian Stock Exchange as of December 31st, 2007, as the sample size. The sampling technique used was purposive sampling, specifically the Total Population Sample method

The study selected all the five agriculture firms that were listed on the Nigerian Exchange group as of December 31st, 2007, as the sample size. The sampling technique used was purposive sampling, specifically the Total Population Sample method. Two factors influenced the decision to opt for the total population as the sample size.

Firstly, there was a limited number of agriculture firms listed on the Nigerian Stock Exchange during the study period. When dealing with a small number of cases, total population sampling is a more commonly used approach, as stated by Ilker, Sulaiman, and Rukayya (2016).

Secondly, the study focused solely on the listed agricultural firms on the Nigerian Stock Exchange during the specified period. These firms were chosen because they are expected to comply with the financial reporting requirements of the NSE.

Thus, all five listed agriculture firms were included in the study as the sample, enabling a comprehensive examination of the relationship between working capital management and firm valuation in the selected companies.

The study relied on secondary data extracted from the audited Annual Reports and statements of accounts of the selected agricultural firms. These financial data were obtained from two main sources: the Nigerian Stock Exchange Facebook and the official websites of the respective selected firms. The data covered a period of twelve years, from 2009 to 2021, allowing for a comprehensive analysis of the relationship between working capital management and firm valuation in the selected agricultural companies.

Model of Specification

This area is briefly explaining the method that has been chosen to analyze the financial data to be collected from the selected firm's annual report and account. The data analyzed using multiple regression analysis to establish the relationship between the independent variables of working capital management and the Dependent variable. According to Kothari (2004) regression analysis is concerned with the study of how one or more variables affect changes in another variable. Therefore, the regression result of the study is to explicit the extent of the influence of working capital management variables (i.e. AP, IV, AP, CC, CR & QR) on firm valuation evidence from listed agriculture firms in Nigeria measured by profitability ratio such return on assets (ROA). However, in determining the appropriate of the data set, classical linear regression assumption tests has been conducted on normality, Heteroscedasticity, autocorrelation and multicollinearity.

The functional model of the study is given as:

$$ROA = \beta_0 + \beta_1 AR_{it} + \beta_2 IV_{it} + \beta_3 AP_{it} + \beta_4 CC_{it} + \beta_5 CR_{it} + \beta_6 QR_i\varepsilon \dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots 1$$

Where:

ROA = return on asset (Profitability)

ARR = Account receivable ratio

IV = Inventory ratio

AP = Account payable

CC = Cash Conversion

CR = Current Ratio

QR = Quick Ratio

a = intercept

e = the error term

β = Regression model coefficient

DATA PRESENTATION AND ANALYSIS

The data analysis consists of both descriptive statistics (mean, standard deviation, minimum, maximum) and inferential statistics (normality, correlation, panel regression, post estimation test- serial correlation, heteroskedascity and cross-sectional dependence).

Data analysis

Descriptive Statistics

Table 1: Descriptive Statistics

Variables	Mean	Std. Dev.	Minimum	Maximum	Obs.
ROA	6.53	10.755	-16.06	29.16	50
AR	66.03	101.44	0.03	532.55	49
IV	167.70	90.86	51.09	385.59	52
AP	178.64	185.49	11.31	888.97	52
CC	50.94	130.14	-201.39	343.16	51
CR	3.76	4.60	0	22.73	52
QR	0.10	0.10	0	0.61	52
FS	7.02	0.52	6.03	7.99	52

Source: Author's Computation, 2023 (STATA 14)

Table 1 above the descriptive statistics of the variable used in the study. It shows the characteristics of the variables. Return on assets had mean value 6.53% with corresponding standard deviation of 10.755%, it had minimum value of -16.06% and maximum value of N29.16%. Account receivable has mean value of approximately 66 days with standard deviation of 101 days, minimum value of less than 1 day and maximum value of 532 days inventory showed mean value of approximately 168 days and standard deviation of 91 days with maximum value of 386 days and minimum value of 51days.Account payable showed mean of 179 days with corresponding standard deviation of 185 days, minimum value of 11 days and maximum value of 889 days. Cash conversion showed mean of 51 days with standard deviation of 130 days and minimum value of less than 1 days with maximum value of 343days.
Current ratio had mean of 3.76 with standard deviation of 4.60 and maximum value of 122.73 and minimum value of 0 while quick ration had mean of 0.16 with standard deviation of 0.10. Minimum value of 0 and maximum value of 0.61. The control variable (firm size) had mean of 7.02 with corresponding standard deviation of 0.52, minimum value of 0.03 and maximum value of 7.99

Normality TestTable 2 Shapiro-Wilk Test

Variables	W	V	Z	Prob.	Obs
ROA	0.959	1.927	1.399	0.080	50
AR	0.652	16.106	5.920	0.000	49
IVD	0.849	7.284	4.245	0.000	52
AP	0.794	9.984	4.919	0.000	52
CC	0.953	2.200	1.683	0.046	51
CR	0.785	10.409	5.008	0.000	52
QR	0.756	11.835	5.282	0.000	52
FS	0.920	3.842	2.877	0.002	52

Source: Author's Computation, 2023 (STATA 14

The above table 2 showed the result of the normality test for both dependent and independent variables. Return on assets showed p value of 0.080, account receivable had p value of 0.000, inventory showed p value of 0.000, account payable had p value of 0.000 while cash conversion showed p value of 0.046, current ratio had p value of 0.000 while quick ration had 0.000 and firm size has p value of 0.002. Hence, we assumed that the data are normally distributed and we estimated Pearson correlation.

Correlation MatrixTable 3: Pearson Correlation

	ROA	AR	IV	AP	CC	CR	QR	FS
ROA	1.00							
AR	-0.52	1.00						
IV	-0.22	0.42	1.00					

AP	-0.30	0.75	0.52	1.00				
CC	-0.14	-0.01	0.31	0.50	1.00			
CR	0.40	-0.06	-0.06	0.01	-0.11	1.00		
QR	0.08	0.12	-0.18	0.10	-0.20	0.67	1.00	
FS	0.47	-0.12	0.25	0.26	-0.32	0.41	-0.03	1.00

Source: Author's Computation, 2023 (STATA 14)

Table 3 showed the result of the Pearson correlation matrix which measure the relationship between the dependent and independent variables. Account receivable had negative (-0.52) correlation with return on assets while inventory had negative (-0.22). account payable had negative (-0.30) correlation with return on assets, cash conversion had negative (-0.14) while current ratio had positive relationship with return on assets, quick ratio had positive (0.08) association with return on assets and firm size had positive (0.47) relationship with return on assets. Hence, there is no evidence of multi collinearity of any kind between the variables in the study.

Multicollinearity Test
Table 4: Variance Inflation Factor

Variable	VIF	I/VIF
AP	1.19	0.00
CC	5.11	0.00
AR	3.51	0.00
IV	2.93	0.00
CR	3.76	0.26
QR	3.05	0.32
FS	2.88	0.34
Mean VIF	3.35	

Source: Author's Computation, 2023 (STATA 14)

Variance inflation factor was used to test for multicollinearity of the variable as shown in table 4 above. The mean VIF is 3.35 which shows that the variable under study is free from multicollinearity since the mean value is less than the variable under study is free from multicollinearity since the mean value is less than the accepted standard of 10. This also confirmed the Pearson correlation matrix in Table 3.

Regression Analysis
Table 5: Pooled Ordinary Least Square (POLS) Regression

Variable	Coefficient	T value	Prob.
Cons.	-59.91	-2.37	0.02
AR	484.37	2.35	0.02
IV	484.39	2.35	0.02

AP	-484.42	-2.35	0.02
CC	-484.40	-2.35	0.02
CR	0.26	0.57	0.57
QR	5.36	0.28	0.77
FS	10.01	2.72	0.01
R^2			0.56
Adjusted R^2			0.49
F.Statistics			7.60
Prob.			0.00
Heteroskedascity Test: Breusch-Pagan / Cook-Weisberg:			
Chi2			0.06
Prob.			0.812
Breusch and Pagan Lagrangian Multiplier Test for Random Effects:			
Chibar2			0.00
Prob.			1.00
Pesaran's test of cross-sectional independence:			
Chi2			0.887
Prob.			0.37
Wooldridge test for autocorrelation in panel data:			6.547
F stat.			0.08
Prob.			

Source: Author's Computation, 2023 (STATA 14)

Table 5 above shows the final result for the model estimation (Pooled Least Square Regression) of the hypotheses. The study estimated pooled least square and random effect model, Brusch and Pagan Lagrangian test for random effect was used to determine the appropriate model estimation between the two. The result shows a p value of 1.00 which is greater than 5% significant level this implies that Pooled Ordinary least Square was appropriate. Other post estimation test was conducted to establish the authentication of the result above among others are Breusch-Pagan/Cook-Weisberg Test for heteroskedasticity. The result shows a chi2 of 0.06 with p value of 0.812, it implies that there is heteroskedastic, meaning that the residuals of the model changes with time. To determine whether there is a serial correlation problem in the model, the Wooldridge test for serial correlation was used to test whether there are associations between the model's coefficients and its residuals. The results with p-values of 0.083 implied that the model has no serial correlation problem. To determine whether there is cross-sectional dependency in the model, a cross-sectional dependence test was carried out using Pesaran's test for correlation among all the units in the same cross-section. The results showed a p-value of 0.37, which suggests that the model has no cross-sectional dependence problem. In order to correct the error of heteroskedasticity and autocorrelation presence in the model, we adopted Pooled Least Square Regression, this was used in analyzing the hypotheses.

Table 5 above showed that account receivables had coefficient of 484.37 with corresponding value of 0.024, this is less than 5% level of significance which implies that account receivable had positive and significant effect on return on assets of listed agricultural companies in Nigeria. Also, inventory had coefficient of 484.39 with corresponding p value of 0.024 which is greater than 5% level of significance. This showed that inventory had positive and significant effect on return on assets of listed agricultural companies in Nigeria. However, account payable had coefficient of -484.42 with corresponding value of 0.024, this is lower than 5% level of significance, and hence account payable had positive and significant effect on the return on assets of listed agricultural companies in Nigeria.

Cash conversion had coefficient of -484.42 with corresponding p-value of 0.02, this implied that cash conversion had negative and significant effect on return on assets of listed agricultural companies in Nigeria. Current ratio has coefficient of 0.26 with corresponding value of 0.57, this shows that current ratio had positive and insignificant effect on return on assets, also, quick ration has coefficient of 5.36 with corresponding p-value of 0.77, and this implies that quick ratio has positive and insignificant effect on return on assets of listed agricultural companies in Nigeria. Lastly, firm size that was used as control variable in the model revealed coefficient of 10.01 with corresponding p-value of 0.04 which is less than 5% level of significance. This revealed that firm size had positive and significant effect on the return on assets of listed agricultural companies in Nigeria.

The F statistics showed value of 7.60 with corresponding p-value of 0.00 which confirmed that the model is of good fit, the R square was 0.56 while the adjusted R square showed a value of 0.49 this implied that independent variables in the model can explain about 49% of dependent variable.

Discussion of Findings

From the above analysis and findings, we discovered that account receivable has positive and significant effect on return on assets which implied that an increase in account receivable will increase return on assets of listed agricultural companies, to the best of the knowledge of the researcher no author's result is in line with this and on the contrary, it was against the findings of Angahar and Agbo (2014) and Gul et al. (2013) who found negative effect of account receivable on return on assets. The study discovered that inventory turnover had positive and significant effect on return on assets, this was in agreement with the findings of Mengesha (2014) and Philip et al. (2016)

Cash conversion period had negative and significant effect on return on assets of listed agricultural banks in Nigeria, this was in support of the findings of Mengesha (2014) and against that of Angahar and Agbo (2014), and they found positive and significant effect of cash conversion on return on assets.

Similarly, quick ratio had positive and insignificant effect on return on asset and to the best of the knowledge of the researcher no result was found against and in support of that of the study. The control variable used (firm size) had positive and significant effect on return on assets.

Conclusion

From the above results, the following conclusions were reached. Account receivable and inventory turnover had positive and significant effect on return on assets of listed agricultural companies in Nigeria while account payable and cash conversion had negative and significant effect on return on assets and current ratio and quick ration had positive and statistical insignificant effect on return on assets. This implies that working capital is very crucial to better return on assets of companies and this must be properly managed in order to achieve better performance.

Contribution to Knowledge

The following were some contributions to knowledge by the study:
1. The study provided empirical evidence of the effect of working capital management on profitability.
2. The study has contributed to knowledge by using agricultural listed companies in Nigeria which to the best of the knowledge of the research had no be looked at by other researchers.
3. Methodologically, the study used pooled least square method that was not common to what other have used before.
4. Also, the study cover scope 2009 to 2021 which other study had not covered

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