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The effect of financial leverage on firm investment: A dynamic panel data analysis of Nigerian listed firms

Chinyere Jennifer Uche-Udah [1], Itiri Idam Okpara [2*], Temple Akpa [3], Frankline Onyekachi Orji [4]
[1-4] Department of Business Education, Federal College of Education (Technical), Isu Ebonyi, Nigeria

* Corresponding Author: **Itiri Idam Okpara**

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Abstract
This study provides evidence on the effect of financial leverage on investment decisions of Nigerian firms using data from non-financial firms listed in Nigeria Stock Exchange. This evidence was established using dynamic panel data method. Specifically, we employed system generalized method of moments (SGMM) in order to address the issue of individual firm heterogeneity and endogeneity problems inherent in the relationship between financial leverage and firm investment. The results show that financial leverage is negatively related to the level of firm investment. This outcome is based on the idea that lack of free liquid funds results to underinvestment problem, which is based on the view that internal and external capital is not perfect substitutes. In view of this, our dynamic panel results provide strong supports for agency theory of financial leverage.

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1. Introduction

Financial leverage is the combination of debt and equity capital to undertake firm's investment decisions. The level of financial leverage of a firm indicates firm's risk exposure and its' vulnerability to bankruptcy. A firm that is highly levered apparently has high volatile net profit. Thus, leverage influences the rate of return for an investment relatively to magnitude of unsystematic risk. Risky firms need to borrow less and safer firms ought to borrow more before expected costs of financial distress offset the tax advantage of borrowing (Myers, 1984) [41]. The adjustment of leverage ratio to attain incremental value may lead to high agency cost if not rationally employed (Jensen & Meckling, 1976) [35]. Agency theory is most relevant in situations in which contracting problems are difficult (Eisenhardt, 1989) [27].

Financial leverage can ease asset substitution effect and underinvestment problem associated with agency theory when optimally employed. Though, at low levels of debt, substitution effects are likely to become vanishingly small. Indeed, when debt claims remain riskless, both the asset substitution and underinvestment problems disappear but at high level of debt, reverse are the case (Cuny & Pirinsky, 2004) [22]. A firm that is highly levered may experience a positive cross-effect of debt holdings and the interest rate volatility. Specifically for firms having low debt equity ratio, the benefits from the low debt equity ratio will be probably too low to cover the increase in interest payments. On this note, the cross-effect of debt holdings and the interest rate volatility is expected to be an important determinant of firm investment (Bo & Sterken, 2002) [12].

Parrino and Weisbach (1999) [44] claim that due to expected cost of opportunistic behaviour embedded on the managers is incorporated into the issued price of the debt, and the ex-ante solution to this problem is to ensure low level of debt equity ratio. Kang (1995) [37] opines that the interaction between investment increase, financial risk and the substitutability between tax shields and financial leverage may depend on endogenous factors of the firm. Modigliani and Miller (1958) [40] assert that the type of security employed to finance investment by a firm will not affect its investment. Irrespective of the financing mix, the marginal cost of capital to a firm is equal to the average cost of capital, which does not vary with capitalization rate for an unlevered stream in the class to that the firm belongs.

Financial factors are irrelevant given the fact that the optimization process of firms does not rely on these factors (Ismail, Ibrahim, Yusoff & Zainal, 2010) [34]. This irrelevant position which is based on neoclassical fundamentals is only obtainable in the world of certainty (see, Fazzari, Hubbard, & Petersen, 1987, Richardson, 2006) [29, 45]. The authors assert that in the world of uncertainty, investment decisions of a firm are dependent of its financial condition.

In the spirit of Faulkender, Flannery, Hankins and Smith (2012) [28], cost of leverage adjustment is relatively not only with the explicit transaction costs, but also with the incentive of the firm to source funds from capital market for other reasons. Jorgenson (1967) [36] argue that existence of adjustment costs induced by the discrepancy between the desired capital stock and actual capital stock is associated with investment. The shadow price differential inherent in debt-equity mix will differ across firms depending on the relative degree of information asymmetry and on differences in simple transacting costs (Calomiris & Hubbard, 1995) [18]. Firms with value-increasing investment opportunities that exceeded their available cash flow would not be expected to forgone these investments (underinvestment problem), given that cash flow shortfalls will easily be financed in capital market where investors are readily available to exploit the opportunity for profit (Bond & Meghir, 1994) [16]. Faulkender *et al*. (2012) [28] argue that profitable investment opportunities will motivate some firms to source external funds, and leverage can be adjusted by choosing a given proportion of debt equity ratio. This supports the position of tax-based theories that leverage increases when current and future investment opportunities become more profitable (Diamond & He, 2014) [24].

High leverage ratio and frequent changes in debt capital of Nigerian firms are highly associated with systematic depreciation of firms' assets due to high cost of debt financing. This effect is an implication of under developed debt market where major debt financing of most firms are short term in nature placing high burden and cost on the firm. There is an indication that this financing cost can discourage firm from the use of external capital to undertake investment in growth opportunity. Another notable implication of this financing pattern is mismatch of funds, that is, when short term debt is used to finance long term investment which sometimes overwhelms the conventional element of financial leverage. Fund mismatch concept assumes that firms choose the maturity of debt issues to match their asset maturities. Apparently, regular refinancing imposes high weighted average cost of capital to the firms and high risk investment due to mismatch of funds resulting to relatively high agency cost to the firms. Empirical study by Aivazian and Qiu (2005) [3] revealed that investment decisions of Canadian firms are negatively related to leverage and that this negative effect is significantly stronger for firms with low growth opportunities than those with high growth opportunities.

This study provides evidence on the effect of financial leverage on investment decisions of Nigerian firms using dynamic panel data to validate existing empirical studies which are mostly restricted to firms in United States, Canada and other developed economies. To our knowledge, this is the first paper in Nigeria that considered study of this nature. Nigerian evidence is of particular interest given that the country has dissimilar institutions and regulations with these developed countries. The remainder of the paper is organized as follows. In section 2 theoretical and empirical issues are discussed. Section 3 discusses data and description of variables employed in the study. Section 4 discusses the dynamic panel data analysis employed in the study. The final section concludes on the findings of the study.

2. Literature Review

Increase in financial leverage through new debt issue as form of financial innovation reduces effect of volatility, which is an indication that positive innovations in volatility, do not lead to a parallel reduction in debt (Dudley & James, 2015) [25]. Parrino and Weisbach (1999) [44] stress that optimal capital structure of a firm is the level that incremental increase in the cost of debt because of agency problems equals the tax shield benefits of debt from such an increase in leverage. According to Diamond and He (2014) [24], tax-based theories advocate that leverage increases when current and future investment opportunities become more profitable, while control and pecking order theories propose the opposite. High volatility of inflation and nominal interest rates will affect financial structure of a firm in the real terms. A higher interest rate will lead to a higher interest rate burden on the one hand, but it lowers the real value of debt on the other (Bo & Sterken, 2002) [12].

Diamond and He (2014) [24] assert that short term debt of a firm has a value that is less sensitive to its market value that seem to receive a smaller benefit from new investment taken just after the debt is issued, and this is equivalent to lower overhang than long term debt. The authors hold that for future investment opportunities, future prospects and the value of existing assets will fluctuate before these investment decisions are made. On this note, lower sensitivity to firm value of shorter term debt implies a more volatile equity value, and also more volatile future state contingent to debt overhang. In the word of Shleifer and Vishny (1992) [51], both the long term and short term debt are employed to discipline the management, and function of senior long term debt is to create, so that a firm with a negative NPV investment opportunity cannot raise more money by issuing new securities.

In the same view, Hasan, Rukh, Ali and Rehman (2014) [33] established that economic failure expenditures (the operation expenses of bankruptcy or reformation) always certainly demoralize borrowing. Kang and Stulz (2000) [38] stressed that the above problem is call "spurious correlation problem". An attempt might be made to dismiss the problem by the argument that shocks to firms should be unrelated to their financing source, so that there would be no correlation between this source and firm investment. Ozkan and Ozkan (2004) [43] affirm that costs relatively to external financing due to existence of imperfect capital markets can be minimized via financial flexibility when firms find it optimal to maintain sufficient internal funds. Financial flexibility is the ability of a firm to access and restructure its financing at a reduced cost, which can in turn mitigate financial distress in the presence of negative shocks, and create means to fund available profitable investment opportunities (Gamba & Triantis, 2008) [30]. Hence, financial flexibility is a function of external financing costs which may reflect firm characteristics and financing strategic decisions.

Highly levered firms have the incentives to reduce the agency costs of outside equity and encouraging managers to act more in the interests of shareholders (Jensen & Meckling, 1976) [35]. But the given incentive to the firms will benefit shareholders at the expense of debt-holders. The adjustment

of leverage ratio to attain incremental value may lead to high agency cost if not rationally employed. Agency theory is most relevant in situations in which contracting problems are difficult (Eisenhardt, 1989) [27]. Thus, the choice of financing decisions may help mitigate these agency costs. Agency problem between shareholders and bondholder arise due to asset substitution (Jensen & Meckling, 1976) [35], in which shareholders prefer high risk investment, because they can fully benefit from high earnings, while bondholders that have a fixed claim prefer low risk investment. The adjustment of leverage ratio to attain optimal financing decision may lead to high agency cost if not rationally employed. Similarly, Chang, Chen, Hsing and Huang (2007) [20] assert that asset substitution problem arises when low-risk assets are substituted by high-risk assets once a risky fixed claim is issued. Though, the employment of secure debt to undertake investments of a firm may avoid asset substitution problem and underinvestment problem.

Firm major objective is shareholders' wealth maximization and managers are likely to make investment that maximise shareholders wealth instead of total firm value (Parrino & Weisbach, 1999) [44]. Specifically, managers will avoid safe positive NPV investment that the value increase will comprise of an increase in the value of the debt and a smaller decrease in the value of the equity. On the flipside, managers will tend to accept risky negative NPV investment in which the value decrease comprises of a decrease in the value of the debt and a smaller increase in the value of the equity.

Agency problems can present a range in which investment may not be fully responsive, or may be over-responsive, to changes in economic fundamentals (Aivaziana, Ge & Qiu, 2005) [3]. Agency cost theory assume that firms cannot get access required external funds or obtain these funds at low enough cost owing to the anxiety by outside investors that managers have the motive to act in their own private interest (Demarzo, Fishman, He & Wang, 2012) [23]. Hence, the presence of the agency problem will limit the firm's investment in value-increasing assets. Bates, Kahle and Stulz (2009) [8] predict firms with agency problems to have access cash holdings if they do not have value-increasing investment opportunities and does not want to pay dividend to shareholders. But in the absence of agency problems, improvements in information and financial technology will lead to a reduction in corporate cash holdings given that firms can hedge more effectively with various derivative instruments.

Almeida, Campello and Weisbach (2011) [5] exhibited that high cost of external finance does not only determine investment but invariably the types of the investments. In financial markets where marginal costs of raising external finance are high, firms seem to have preference for investments that use more tangible assets and generate more collateral. This finding is line with Almeida and Campello (2006) [4], observing that asset tangibility positively and significantly influence the relationship between cash flow and investment (investment-cash flow sensitivities) of financially constrained firms employing various estimation techniques. Firm value is a function of hedging through its effect on capital investment. Carter, observed that link between hedging and capital expenditures capture a large majority of the hedging premium. Adam (2002) [1] found that the minimum revenue guaranteed by hedging is strongly positively correlated with investment expenditures of a firm, which is an indication that hedging increases the potential to internally finance value-increasing investment expenditures. Although, firms tend to finance their value-increasing investment expenditures externally rather than internally, if external funds is more costly than internal funds, firm has no choice as rational entity but to reduce its reliance on external funds.

3. Data and description of variables

The data used in this study were extracted from annual statement of accounts of publicly quoted firms in Nigeria. This covers non-financial publicly quoted firms within the period of study. The items of interest in the financial statements are operating cash flows, CAPEX, total assets, depreciation and amortisation expenditures, and total debt for each financial year on 119 Nigerian non-financial firms at the end of 2017. The annual panel data covers the period from 2006 to 2017. The problem of dealing with missing data is commonly encountered in empirical research (Cheema, 2014; Gleason & Staelin, 1975) [21, 31], especially in firms-level studies due to time-series and cross-sectional dimensions of the observations.

There are many factors that can cause missing data in the study but the major factor among all is missingness (non-availability) of annual statement of accounts of firms that fall within non-financial sectors for the period covered. Other factors that can cause missing data in the study as highlighted by the researcher includes: firms that change their financial accounting year-end within the period of the study, firms that ceased operation at any point during the period of the study, and as well as firms that had problems with NSE and Securities and Exchange Commission (SEC) within the period under review. After checking and screening for missing variables, 60 firms remained for the estimation.

The variables used in this study are largely adopted from existing literature, in line with the research problem. The difference and similarities for the measurement of financial leverage and firm investment were compared among the extant literature. Therefore, variables of the study have been determined according to the approach used by the previous studies and how far data will be available for measurement purposes. Measure of financial leverage is total debt ratio. Total debt ratio is the aggregate fixed-charge external capital employed by the firm to finance assets. It measures the proportion of a firm's total assets that is financed with creditors' funds. It encompasses short term and long term debts divided by total assets. We use two measures of firm investment. One is capital investment, while the other is assets maintenance investments. Both measures have been used in the literature. Capital investment (capex) is investment in capital assets for a given accounting year. Capital investment is long term expenditures distinct from operating expenditures (opex). Most of the capital expenditures are investments in tangible assets. Capital investment is proxy by capital expenditures divided by total assets. Assets maintenance investments are expenditures in depreciation and amortization for a given accounting year for any firm. This is generally investment expenditure necessary to maintain assets in place (Richardson, 2006) [45]. Assets maintenance investment is proxy by depreciation and amortization expenditures divided by total assets. Cash flow is measured as the lagged sum of earnings before extraordinary items and depreciation, and growth opportunity is proxy by yearly growth rate in a firm's sales.

Table 1: Summary statistics

	Mean	Minimum	Median	Maximum	Standard deviation
Capital investment/Total assets	41.974	0.118	41.444	114.930	22.793
Assets maintenance/Total assets	4.212	0.033	3.463	34.962	3.583
Leverage	63.507	12.424	61.110	305.801	25.6713
Cash flow$_{t-1}$	-25.537	-31900.26	-7.577	15196.96	1538.535
Growth opportunity	307.1336	-90.702	8.647	146888.6	5993.317

The sample consists of non-financial firms listed in Nigeria Stock Exchange as at 2017. The annual data covers the period of 2006 – 2017 with balanced of 720 observations of 60 firms. Our observation from table 1 highlights descriptive statistics for the research variables. The mean of capital investment for the sample is 42.211; this indicates that average firm invests over 42% of their asset value each year in capital assets. This invariably is an indication that high proportion of asset value was employed in capital expenditures (CAPEX). The minimum and maximum was 0.118 and 114.93 for capital investment respectively indicated high variation in investment in these outlays within the period under study and the median recorded 41.44. The standard deviation of 22.66 for capital investment almost half of the mean, implies that capital investment is volatile.

On the same note, asset maintenance recorded average of 4.207, which implies that average firm invests over 4% of their asset value each year in assets maintenance. Thus for every ₦100 asset value within this period, ₦4.21 was actual expenditure incurred to maintain assets in place indicating poor assets maintenance culture when compare to assets value of these firms within this period. This investment outlay also depicted high variation within the sample and the period under review with minimum and maximum value of 0.07 and 34.96 respectively and the median recorded 3.46.

Volatile earnings highlighted below were relegated with external funding resulting to average of 63.39% for leverage. This proportion is an indication of high leverage ratio, which implies that 63.39% depletion in assets of Nigerian firms will affect bondholders' funds since owners stake in the firms covers only 36.61% of the firm's assets and thus contributing to high agency cost and reorganization cost. And the leverage ratio of our sample firms within this period recorded a high discrepancy when minimum of 12.42 are compared to the maximum of 305.80, while the median recorded 61.11. The negative average of 26.420 for lagged cash flow revealed relatively instability among the sample firms within the period of study, which resulted to average decline earnings of ₦26.42. This is an indication of volatile earnings among the sample firms within this period, which was observed in standard deviation many times the mean and minimum of -31,900.26 and maximum of 15,196.96 as well as the median that recorded the value of -7.58.

The firms' growth opportunity with the mean of 308.78 is an indication that our sample firms have chance of growing their sales by ₦308.78, which reflects market expectations of strong growth opportunities for Nigerian firms. This observed high growth opportunity can be deduce as one of the reason for high average financial leverage since our sample firms need to substitute internal cash flow that remained volatile with external capital to reduce underinvestment problem. Although, this growth opportunity vary highly among the years of the study as the minimum and maximum recorded respective value of -90.702 and 146,888.6, while we observed 8.65 values for the median. The standard deviation almost twice the mean indicates strong volatility.

Table 2: Correlation among variables

	1	2	3	4	5
1 Capital investment/Total assets	1				
2 Assets maintenance/Total assets	0.316	1			
3 Leverage	0.070	0.042	`1		
4 Cash flow$_{t-1}$	0.047	0.040	0.012	1	
5 Growth opportunity	-0.036	-0.036	-0.023	-0.002	1

The correlation results in table 2 above examine the correlation between the variables employed in the study. The results show that there is a positive relationship between capital investment and assets maintenance investment. However, this positive relationship was extended between financial leverage and these two dependent variables (capital investment and assets maintenance investment). This implies that financial leverage does improve firm investment using these measures of investment. Cash flow measure also exerts positive relationship with financial leverage and also with measures of firm investment. The outcomes are indication that cash flow of a firm strengthens its investment and borrowing power. On the contrary, we found there is negative correlation between growth opportunity with capital investment, assets maintenance investment, financial leverage and cash flow. This is an indication that growth opportunity faced by the firms did not led to increase in investment and also the firms did not leverage on external funding to avoid underinvestment problem, which may be attributed to financial constraint confronting the firms.

4. Dynamic Panel Data Analysis

4.1. Generalized Methods of Moment (GMM)

The GMM is a generic method for estimating parameters in statistical models. It uses moment conditions that are functions of the model parameters and the data, such that their expectation is zero at the parameters' true values. GMM assume the (linear) regression model with an endogenous regressor ($y = x^I \beta + \mu$), and controls endogeneity of the lagged dependent variable. Endogeneity is when there is correlation between the explanatory variable and the error term in a model. The specifics for design of GMM considers; (i) panel data with "small T and large N", that is, N (number of cross-sections or groups) greater than T (time span), (ii) uses instrumental variable (IV) estimation, (iii) instruments, Z must be exogenous, E(Z^I μ) = 0, and (iv) number of instruments, Z less than or equal to number of observation, N.

GMM estimators are Difference Generalized Methods of Moment (DGMM) and System Generalized Methods of Moment (SGMM). Difference GMM is widely known as Arellano Bond estimator. System GMM is proposed by Arellano & Bover (1995) [7] and Blundell & Bond (1998) [11] while the difference GMM is suggested by Arellano and Bond (1991) [6]. Difference GMM corrects endogeneity by

transforming all regressors through differencing, and removes fixed effects, and first difference transformation has a weakness – subtracts the previous observation from the contemporaneous one thereby magnifies gaps in an unbalanced panel (see, Arellano and Bond, 1991) [6].

System GMM on the other hand, corrects endogeneity by; (i) introducing more instruments to dramatically improve efficiency, and transforms the instruments to make them uncorrelated (exogeneous) with the fixed effects, (ii) builds a system of two equations; the original equation and the transformed one, (iii) uses orthogonal deviations – instead of subtracting the previous observation from the contemporaneous one, it subtracts the average of all future available observations of a variable. No matter how many gaps, it is computable for all observations except the last for each individual, so it minimizes data loss (see, Arellano & Bover, 1995; Blundell & Bond, 1998) [7, 11]. Thus, system GMM mitigates the problem of weak instrument fundamental in the difference GMM, and has been proven to perform much better compared to difference GMM as it is less bias and has more precision (Nordin & Nordin, 2016) [42]. Application of difference GMM estimator yield both a biased and inefficient estimation and this is particularly acute when *T* is short, and poor performance of this estimator in such circumstances attributed to the use of poor instruments (Blundell & Bond, 1998) [11]. The system GMM estimator involves use of a greater number of moment conditions but Monte Carlo evidence suggests that when *T* is short and dependent variable persistent, there are gains in precision and the small sample bias is reduced (see, Arellano & Bover, 1995) [7]. This estimator has been adopted in recent research in investment (see, Aghion, Askenazy, Berman, Cette & Eymard, 2008; Almeida & Campello, 2006; Baum, Caglayan & Talavera, 2009; Bloom, Bond & Reenen, 2006; Bond, Elston, Mairessea & Mulkay, 2003; Brown, Martinsson & Petersen, 2015; Han & Qiu, 2007; Schiantarelli & Sembenelli, 2000) [2, 4, 9, 10, 14, 17, 32].

On this note, in the application of system GMM in our study, we chose the two-step model over the one-step model because it takes care of heteroscedasticity. In the presence of heteroscedasticity and serial correlation, a two-step system GMM estimator should be used exploiting a weighting matrix using residuals from the first step (Blundell & Bond, 1998) [11]. This study meets the prime condition for adoption of GMM which states that *N* must be greater than *T* (*N*>*T*). That is, this prime condition is not violated for the adopted system GMM models (60 > 12). This implies that by having larger firms (*N*) than years (*T*), the system controls for dynamic panel bias (Roodman, 2006; Sarafidis, Yamagata & Robertson, 2006) [46, 48]. Another justification for employment of this estimator is due to inherent endogenous factors in firm investment decisions.

The two diagnostics tests for system GMM are Sargan (1985) [49] test of over-identifying restrictions and Arellano-Bond test for autocorrelation/serial correlation of the error term. Sargan tests the null hypothesis (all instruments as a group is exogeneous) of overall validity of the instruments used and failure to reject this null hypothesis gives support to the choice of the instruments. That is, higher p-value is better (insignificant). The rule of thumb for avoiding over-identification of instruments is that the number of instruments be less than or equal to the number groups in the regressions (Roodman, 2007) [47]. Arellano-Bond AR(1) and AR(2) tests the null hypothesis that the differenced error term is first and second order serially correlated. And failure to reject the null hypothesis of second-order serial correlation implies that the original error term is serially uncorrelated and the moment conditions are correctly specified (that is, the value of AR(2) > 0.05). Thus, we need higher p-value (insignificant). By construction, the differenced error term is probably serially correlated at AR(1) even if the original error is not. AR(2) test is most important since it will detect autocorrelation in levels. One should not reject the null hypothesis of both tests.

4.2. Model specification and results

The study estimates a reduced form investment equation to determine the effect of financial leverage on firm investment. Reduced-form approach argue that a positive leverage ratio coefficient may arise given that leverage ratio proxies investment demand rather than providing evidence for financial constraints, even after including variables such as growth opportunity. The model specifications are similar to Lang, Ofek and Stulz (1996) [39] and Aivazian, Ge & Qiu (2005) [3] but are extended to a dynamic panel data setting. Aivazian *et al*. (2005) [3] assume that zero unobservable individual effect is too strong given the large heterogeneity across industries and across firms within the same industry and employ pooling regression as well as fixed effect and random effect to control individual firm heterogeneity. Other extant empirical literature as such Lang *et al*. (1996) [39] employ only pooling regression in their study. Our study assumes the existence of individual firm heterogeneity and endogeneity problem and used dynamic panel estimation such as SGMM to address both problems. Bond, Hoefler and Temple (2001) [15] exhibit that the SGMM dynamic panel estimation is capable to correct for unobserved firm heterogeneity, omitted variable bias, measurement error, and endogeneity (time-varying component) problems. On this note, we estimate the following equations:

The effect of financial leverage on capital investment

$$CITA_{i,t} = \beta_0 + \beta_1 CITA_{i,t-1} + \beta_2 LEVERAGE_{i,t} + \beta_3 CF_{i,t-1} + \beta_4 GROWTH_{i,t} + \mu_{i,t} \ldots\ldots\ldots\ldots (1)$$

Where $CITA_{i,t}$ is capital investments divided by total assets of firm *i* at time *t*, $CITA_{i,t-1}$ is capital investments divided by total assets lagged by one for firm *i* at time *t*, $LEVERAGE_{i,t}$ is total debt divided by total assets of firm *i* at time *t*, $CF_{i,t-1}$ is lagged sum of earnings before extraordinary items and depreciation of firm *i* at time *t*, $GROWTH_{i,t}$ is growth opportunity of firm *i* at time *t*, and μ_{it} is error term.

Table 3: Financial leverage and capital investment

Variables	Coefficient	Std. Err.	z
Intercept	15.948***	0.848	18.81
Capital investment/Total assets L1.	0.691***	0.005	134.02
Leverage	-0.050***	0.008	-5.96
Cash flow$_{t-1}$	0.0004***	0.0001	4.41
Growth opportunity	0.0001***	5.09e-06	18.26
Observations	720		

Sargan test of overid. restrictions	Chi2(64) = 56.988 Prob > chi2 = 0.721		
Arellano-Bond test AR(1)	z = -4.241 prob > z = 0.000		
Arellano-Bond test AR(2)	z = -0.937 prob > z = 0.349		
Wald-Statistics	Chi2(4) = 28462.13 Prob > chi2 = 0.000		
Wald test for endogeneity	F-statistic = 1664.591*** Chi-square = 8322.953***		

This table provides the empirical results of dynamic panel data on the effect of leverage on capital investment. The SGMM result is two-stage estimation.
***Significant at 1%.

The results of system generalized method of moments (SGMM) estimated on the effect of financial leverage on capital investment are showed in table 3. We observed that financial leverage has negative and significant effect on capital investment. The outcome recorded coefficient of -0.050, which is an indication that a unit change in financial leverage resulted to 5 units decrease in capital investment of Nigeria quoted firms. The effects of other variables on capital investment have the expected signs. The result revealed that cash flow and growth opportunity have positive and significant influence on capital investment.

To understand the importance of dynamics, we test for the influence of lagged dependent variable (capital investment) in explaining current investment. The coefficient of lagged capital investment (CITA L1=0.691) in our estimated model is less than unity, which is a sign that the model is well specified. Otherwise, SGMM as our technique of estimation is invalid. This outcome is an indication of steady state assumption for validity of our instruments. In addition, an indication of a high level of persistence and also that the series in the estimation are nearly a random walk validating the use of SGMM as our method of estimation. Eberly, Rebelo and Vincent (2011) [26] affirm that firm level of lagged-investment effect is the best predictor of current investment.

The Sargan test is one of the most commonly used diagnostic test in SGMM estimation for measuring the fitness of the model. The Sargan test of over-identifying restrictions test the null hypothesis of overall validity of the instruments used and failure to reject the null hypothesis give support to the choice of the instruments. Basically, this test does not reject the null at any conventional level of significance (p=0.721) and this is an indication that the model has valid instruments. Extant literatures have suggested that number of instrumental variables employed in the dynamic panel study should be reported. Owing that the specified models can generate a huge number of weak instruments which can lead to biased outcomes. Too many instruments weaken the Sargan test and yield implausible p-value. Results are biased if instruments outnumber number of observations in the panel, which in the case of this study the number of instruments is less than the number of observations (70 instruments > 720 observations).The problem of how many instrument is "too many" instruments is still not clear on this in literature. Though Monte Carlo simulation evidence suggests that cutting the number of over-identifying instruments in half can reduce the bias by 40%.

Another diagnostics test for SGMM is Arellano-bond test, while Sargan test checks for the validity of the instruments but Arellano & Bond test for autocorrelation and serial correlation of the error term at order 1 (AR1) and order 2 (AR2). That is, tests the null hypothesis that the differenced error term is first and second order serially correlated. However, failure to reject the null hypothesis of no second-order serial correlation implies that the original error term is serially uncorrected and the moment conditions are correctly specified. In this study, we did not reject the null hypothesis of no autocorrelation (that is, the value of AR(2) greater than 0.05 (0.349 > 0.05)) in our estimation.

The Wald Chi2 which test for the joint significance of all coefficients with p-value less than conventional level of 0.05 as established in SGMM estimation suggest that all coefficients are significant. The outcome of Wald test for endogeneity which recorded F-statistic of 1664.591. That is significant at conventional level of 0.05 confirmed that there is endogeneity problem, which implies that the dependent variable correlates with the error term. The results of the SGMM estimations in table 3 presented above and respective analyses have satisfied all the relevant assumptions for the adoption of SGMM as unbiased, consistent and efficient estimator for a study of this nature.

The effect of financial leverage on assets maintenance investment

$$AMITA_{i,t} = \beta_0 + \beta_1 AMITA_{i,t-1} + \beta_2 LEVERAGE_{i,t} + \beta_3 CF_{i,t-1} + \beta_4 GROWTH_{i,t} + \mu_{i,t} \ldots\ldots\ldots\ldots\ldots\ldots (2)$$

Where $AMITA_{i,t}$ is assets maintenance investments divided by total assets of firm *i* at time *t*, $AMITA_{i,t-1}$ is assets maintenance investments divided by total assets lagged by one for firm *i* at time *t*, $LEVERAGE_{i,t}$ is total debt divided by total assets of firm *i* at time *t*, $CF_{i,t-1}$ is lagged sum of earnings before extraordinary items and depreciation of firm *i* at time *t*, $GROWTH_{i,t}$ is growth opportunity of firm *i* at time *t*, and μ_{it} is error term.

Table 4: Assets maintenance investment

Variables	Coefficient	Std. Err.	z
Intercept	2.858***	0.088	32.55
Assets maintenance investment/Total assets L1.	0.354***	0.003	139.30
Leverage	-0.003***	0.001	-1.96
Cash flow$_{t-1}$	0.0001***	0.00002	6.00
Growth opportunity	-9.98e-06***	2.38e-06	-4.20
Observations	720		
Sargan test of overid. restrictions	Chi2(64) = 58.936 Pro > chi2 = 0.656		
Arellano-Bond test AR(1)	z = -2.249 prob > z = 0.025		

Arellano-Bond test AR(2)	z = 1.399 prob > z = 0.162		
Wald-Statistics	Chi2(4) = 45939.28 Prob > chi2 = 0.000		
Wald test for endogeneity	F-statistic = 343.769*** Chi-square = 1718.846***		

This table provides the empirical results of dynamic panel data on the effect of financial leverage on assets maintenance investment. The SGMM result is two-stage estimation.
***Significant at 1%.

Table 4 present the results of SGMM estimation which was applied to examine the effect of financial leverage on assets maintenance investment of firms in Nigeria. Financial leverage of the firms exerts negative and significant influence on assets maintenance investment. The results revealed coefficient value of -0.003 which is evidence that 1 unit increase in leverage ratio (total debt ratio) contributed to 0.3 unit decrease in assets maintenance investment of Nigerian firms. Cash flow exerts positive and significant influence on assets maintenance investment of Nigerian firms. The outcome recorded coefficient value of 0.0001, which indicates that a unit increase in cash flow contributed to 0.01 unit marginal increase in assets maintenance investment of firms in Nigeria. The results indicate that growth opportunity had negative and significant influence on assets maintenance investment of firms in Nigeria. Though, with marginal influence as depicted in table 4, there is an indication that strong growth opportunity led to decrease in investment in assets maintenance.

In order to understand the importance of dynamics and also in determination for steady-state for the validity of our instruments in SGMM, we test for the influence of lagged dependent variable (assets maintenance investment) in explaining current investment in assets in place. The coefficient of the lagged assets maintenance investment (AMITA L1 = 0.354) in the estimated model showed that the steady-state assumption holds. Therefore, this is an indication of a high level of persistence and that the series are nearly a random walk and validate the adoption of SGMM.

Furthermore, the Sargan test of over-identifying restrictions confirms the validity of the instruments in the SGMM estimation. With the observed p-value of 0.656, we could not reject the null hypothesis since this outcome appeared to be greater than the conventional level of significance of 0.05 or 0.10. The number of instruments which did not outnumber the number of observations (70 instruments < 720 observations) confirmed that the study outcomes are unbiased. Further diagnostics test to ascertain if there is existence of autocorrelation and serial correlation of the error term in our SGMM estimation, Arellano-Bond test at order 1 and order 2 did not reject null hypothesis of no autocorrelation and serial correlation in the estimation. The position was on the basis that observed p-value for AR(2) is greater than 0.05 (0.162 > 0.05)) in our estimation.

The Wald Chi2 which test for the joint significance of all coefficients with p-value less than conventional level of 0.05 as established in system GMM estimation suggest that all coefficients are significant. The endogeneity problem assumption that the dependent variable correlates with the error term is established with the result of Wald-coefficient restrictions (endogeneity) test which recorded F-statistic value of 343.769 that is significant at conventional level of 0.05. On this end, the SGMM estimations presented in table 4 above and the respective analyses have satisfied all the basic assumptions for the adoption of SGMM as unbiased, consistent and efficient estimator.

5. Summary

The high cost of external capital can led financial leverage to have negative implication on investment especially when there is expectation of assets substitution problem. We found that financial leverage have negative and significant effect on the two measures of firm investment, which is an indication that financial leverage of the sampled firms was responsible to decrease in their investment. This is an implication that firms hoard the proceeds from debt issues undertaken during reduced volatile cash flow and in turn invest the proceeds from debt issues at volatile cash flow period (Dudley & James, 2015) [25]. This argument supports contracting cost explanations that debt may be costlier to issue when cash flow volatility is high.

6. Conclusions

This study used dynamic panel model to extend extant empirical studies on the effect of financial leverage on investment on the aim to address the issue of individual firm heterogeneity and endogeneity problems. We examined this relationship on publicly quoted firms in Nigeria focusing on non-financial firms between 2006 and 2017. Specifically, the study determined the effect of financial leverage on capital investment and assets maintenance investment using system generalized method of moments (SGMM). The results of the estimations showed that financial leverage is negatively related to the level of firm investment. The outcome support the claim that firms that need more external funding relative to internal funding will experience underinvestment problem given the presumptions that firms follow the basic NPV decision rule for capital budgeting. This deduction is based on the idea that lack of free liquid funds results to underinvestment problem, which is based on the view that internal and external capital is not perfect substitutes. In view of this, our dynamic panel results provide strong supports for agency theory of financial leverage.

7. References

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