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Cash flow volatility and intangible investment: Evidence from Nigerian publicly quoted firms

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Abstract

This study examined the effect of cash flow volatility on intangible investment of publicly quoted firms in Nigeria. The study finds that cash flow volatility had a positive and significant influence on intangible investment. In the sub-sample of high levered, low levered, constraint, unconstraint, older, and younger firms, we recorded related and mixed outcomes. The results showed that the sensitivity of intangible investment to cash flow volatility does not matter whether the firms are highly or lowly levered and older or younger firms. The sensitivity of this effect is a matter of financial constraint confronting the firms.

JEL classification: G31, G32

Keyword: Cash flow volatility; Investment; Leverage; Growth opportunity

1. Introduction

Cash flow affects firm's decision to allocate limited resources between tangible and intangible investment. Investment in tangible assets provide cash flows for debt services and collateral in the event of default, while investment in intangible assets have a higher net present value which is captured only if debt is repaid (Anderson & Prezas, 1999). Intangible investments have several characteristics that make it more difficult to finance than tangible investments and these characteristics vary among risk and uncertain of the investment (Al-Twajry, 2009; Hall, Moncada-Paternò-Castello, Montresor & Vezzani, 2015; Martins & Alves, 2010). Bloch (2005) asserts that firms may be willing to take on more risk than otherwise when intangible investments are financed by external funds given the complications to collateralize this investment. Intangible assets do not have a real physical presence, while tangible assets have a real physical presence (Yallwe & Buscemi, 2014).

Investment in tangible assets strengthens the borrowing power which in turn gives room for further investment in tangible assets (Almeida & Campello, 2006). Hence, firms with more tangible assets may have greater access to external funds because tangibility eases contractibility problems as it increases the value that can be recaptured by investors in default states. The authors stress that asset tangibility may determine whether a firm is financially constrained or unconstrained, investment-cash flow sensitivities of financially unconstrained firms are not affected by the degree of asset tangibility. This argument confirms the presumption that financing of intangible investment by external sources is expensive due to the characteristics of this type of investment, hence firms depend more on internal funding for their investment in intangible assets to some great extent (Hosono, Miyakawa & Takizawa, 2017; Mendoza, 2017; Tudor, Dima, Dima, & Ratiu, 2014). Firms' investment in intangible assets is considered as a measure of financial constraints. Highlighting that a firm is considered to be financially unconstrained if it can carry out all its intangible investment at

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optimal scale and constrained if it cannot due to insufficient financing (Brown & Petersen, 2011; Czarnitzki & Binz, 2008).

The problems of opportunistic behaviour, adverse selection and moral hazard inherent in the financing of tangible investments are severe in the financing of intangible investment due to opaqueness and asymmetric information between firms and investors (Bloch, 2005; Borisova, G. & Brown, 2013; Boujelben & Fedhila, 2011; Hall & Lerner 2010). On the same note, Brown, Martinsson and Petersen (2015) assert that intangible investment may be confronted with significant adverse selection and moral hazard problems for the reasons that intangible investment is characterised by lack of collateral value and asymmetric information problems. These asymmetric information problems may impede intangible investment, though; this does not appear to be the same for all firms given that extent may significantly depend on firm characteristics (Adam, 2002; Czarnitzki & Binz, 2008). Brown, Martinsson and Petersen (2015) claimed that the problems are more evident in younger and smaller firms. While Adam (2002) noted that firm size is negatively related to the cost differential between internal and external funds.

Brown et al. (2015) affirm that intangible investment adjustment costs contribute to firms to hostilely cushion intangible investment from momentary volatility in cash flow generated internally, which is the most reasonable means for firms to maintain a smooth path of intangible investment. Though, this smoothing effect does not exist in the long run given that cash holdings exhausted in the current period to cushion intangible investment must be rebuilt in future periods, transferring future finance for intangible investment. Bloch (2005) argues that intangible investments are a function of firms' cash flow given that firm borrowing is subject to capital market imperfections. On the contrary, cash flow may also function as an indicator of future profitability, proposing that cash flow may help enlighten intangible investments basically because it forecasts future earnings, and not due to financial constraints.

Alexander and Eberly (2018) affirm that investment in tangible assets have shifted toward intangible investment. A trend that can be call "hollowing out" of investment (Alexander & Eberly, 2018) or "the new in the new economy" (Nakamura, 1999). Notwithstanding the global position, Nigerian firms have a poor approach to investment in intangible assets. Our sample firms recorded a growth rate of 1.6% which appears to be far below the global growth rate of 5.8% as of 2016 (European Commission, 2017). This apathetic approach to intangible investment among firms will have an inhabitant effect on the growth opportunities of these firms. Siyanbola, Egbetokun, Isola and Adelowo (2011) claim that poor funding is one of the key issues that work against this developmental impact in Nigeria.

Most extant empirical studies that have examined the inhabitant effect of cash flow on intangible investment have provide these findings with developed countries data (see, Hosono, et al., 2017; Mendoza, 2017; Peters & Taylor, 2017; Tudor, et al., 2014), which can be classified as developed economies specific findings and not representation for a possible effect of the theory on developing economies. It is against this gap that this research work seeks to examine the effect of cash flow volatility on intangible investment in developing economies considering publicly quoted firms in Nigeria. The rest of the paper is organised as follows in the proceeding sections of the work. Section 2 of this work will look at the review of related literature. Section 3 discusses the data collation and empirical method employed in the study; section 4 reports the empirical analysis from dynamic panel data estimations. Finally, section 5 presents the conclusions.

2. Literature Review

The relationship between prior cash flow volatility and investment will be negative for firms with negative cash flow growth realisations. While, with positive cash flow growth realisation within these firms, the relationship between prior cash flow volatility and investment will be positive (O'Connor-Keefe & Tate, 2013). Caloiniris and Hubbard (1988) opine that there is a significant relationship between internal finance and investment expenditure of many firms holding investment opportunities constant and also given that external finance will be differentially available to many firms.

Since profits are highly cyclical and investment is a function of availability of profits, therefore, investment of a firm will have greater sensitivity to fluctuations in economic activity than would otherwise be the case (Bond & Meghir, 1994). Though the credit restrictions to some classes of firms are a function of contract equilibrium, the severity can differ significantly concerning financial turbulences. The level of external funding of many firms depends on the distribution of internal finance, aggregate net worth positions and feasibility of the investment (Caloiniris & Hubbard, 1988).

However, Geczy, Minton and Schrand (1997) argued that firms with greater growth opportunities and tighter financial constraints are more likely to use currency derivatives. This is a suggestion that firms might use derivatives to reduce cash flow variation which may otherwise preclude firms from investing in growth opportunities. This argument supported the outcome of Denis and Sibilkov (2010) and Gomes (2001), which revealed that higher cash holding is

related with higher levels of investment for constrained firms with high hedging needs and that the relationship between investment and value is robust for constrained firms than for unconstrained firms. Also, Adam (2002) observed that hedging increases the likelihood that investments can be financed internally. On the same note, Chen and Chuang (2009) assert that firms with an abundance of investment opportunities have a strong incentive to hold cash to maintain their competitive positions.

Minton and Schrand (1999) revealed that cash flow volatility is related to lower investment in average annual capital expenditures, research and development costs, and advertisement expenditure. The authors' further findings as shown in their sensitivity analyses stressed that the outcomes are not as a function of firms in financial distress or cross-sectional difference in investment opportunities. Czarnitzki and Binz (2008) classifying financial constraints into internal and external constraints in their study, documented that internal constraints, measured by mark-ups, are more decisive for R&D than for capital investment. While external constraints showed a monotonic correlation between the level of constriction and firm size for both capital and R&D investment. Hence, external constraints turn out to be more binding with decreasing firm size. Opler, Pinkowitz, Stulz, and Williamson (1999) found cash reserves to be negatively related to the cost of external financing and cash flow volatility. Although cash reserves, on the other hand, were found to be positively correlated with a firm's growth opportunities, capital expenditures, research and development expenditure, and volatile cash flow supporting investment efficiency argument.

Aghion, Askenazy, Berman, Cette & Eymard (2008) carried out a firm-level study that recorded various outcomes on the relationship between financial constraints and firms' R&D behaviour over the business cycle. The ratio of R&D investment to total investment is countercyclical when a firm does not experience financial constraints, though it becomes less countercyclical as firms experience more financial constraints. An outcome that is more significant for firms in sectors with heavy reliance on external finance or characterized with a low degree of asset tangibility. The authors also observed further that the share of R&D investment decreases during recessions but does not increase proportionally during the economic boom for financially constrained firms. Seemingly, average R&D investment and productivity growth were found to be significantly negatively related to sales volatility in more financially constrained firms. The above outcomes were confirmed by the findings of Bloch (2005), establishing that internal funds are significant in explaining R&D investments. Hence, indicating that R&D investment decisions are affected by credit market imperfections.

In line with the findings of Aghion, Askenazy, Berman, Cette & Eymard (2008) and Bloch (2005) as highlighted above, Brown, Martinsson & Petersen (2015) significantly recorded that availability of finance matters for R&D investment after controlling firm efforts to smooth R&D investment with cash reserves, and firm use of external equity finance. Observing the sensitivities of R&D investment to cash flow, Bloch (2005) established that this effect is due to firms' limited access to external funds, and also that the sensitivity is not because of capital market imperfections, but rather due to the role of cash flow as a predictor of firms' investment opportunities. This outcome also exists after controlling for the potential role of cash flow as a predictor of future profitability.

3. Data and Methodology

In an effort to examine the effect of cash flow volatility on intangible investment of publicly quoted firms in Nigeria. The panel data were collated from annual reports and statements of accounts of these firms. The study covers firms from non-financial publicly quoted firms within the period of 2006 to 2017. The items of interest in the financial statements are firm earnings, expenditure in intangible assets, total assets, total debt, gross sales, cash dividend, and years of experience for cross-section of 70 firms. The initial collection includes 119 firms listed in non-financial sectors as of 2017, producing 1,428 firm-year observations. After eliminating missing data, the sample size decreases to 840 firm-year observations.

The proxy variables used by the researcher are in line with the approach employed by existing literature and the extent of availability of data for measurement purposes. Intangible investment measured as investment in intangible assets divided by total assets is our dependent variable. Cash flow volatility is the independent variable. This variable is measured as a relative change in the prior period's earnings (Calomiris & Hubbard, 1995; Devereux & Schiantarelli, 1990; Hubbard, 1998). The study adopted control variables which are intrinsic factors that are responsible for the amount of investment in intangible assets in a given period.

Financial leverage is one of the control variables measured as total debt divided by total assets. Financial leverage influences the intangible investment of a firm. An increase in leverage ratio through a new debt issue as a form of financial innovation reduces the effect of cash flow volatility on firm investment, which is an indication that there is an expected relationship between financial leverage and firm intangible investment. Growth opportunity is also a control

variable measured as yearly growth rate in a firm's sales. If future growth extending today's investment will not occur, current investment is less attractive. Then growth opportunity will be directly related to intangible investment.

Other control variables are cash dividend and firm age, these control variables are measured as cash dividend divided by total assets and the log of number of years since inception to the date of observation respectively. Allocation of earnings away from the firms as dividend to shareholders may alter the level of funds for investment. Therefore, the cash dividend is expected to have a significant influence on firm investment in intangible assets. When there is cash flow shortfall for younger firms, these firms may face difficulties in financing their investment with an internal source of funds (Fagiolo & Luzzi, 2004). This implies that the extent of firm investment in intangible assets is a function of firm experience, since older firms can acquire experience-based economies and mitigate the liabilities of newness.

The study used dynamic panel regression instead of static panel regression (pool OLS, fixed effects and random effects) in order to guide against several criticisms on the later techniques. Clarke, Crawford, Steele and Vignoles (2010) claim that if the error terms are correlated, then the fixed effects are not suitable estimator since inferences may not be correct and you need to model that relationship with a suitable estimator. They stressed further that when there are no theoretical or other prior guidelines about which variables should have a random effect, the researcher can be led by the substantive focus of the investigation, the empirical findings, and the parsimony of modeling. Dynamic panel regression mitigates these limitations and controls for the endogeneity problem.

Although static panel data estimations assume that zero unobservable individual effect is too strong given the large heterogeneity across industries, and across firms within the same industry. Dynamic panel estimation assumes the existence of individual firm heterogeneity and endogeneity problem. Bond, Hoefler and Temple (2001) affirm that Generalized Methods of Moment (GMM) as a dynamic panel estimation is capable to correct for unobserved firm heterogeneity, omitted variable bias, measurement error, and endogeneity (time-varying component) problems. GMM assumes the (linear) regression model with an endogenous regressor ($y = x'\beta + \mu$) and controls the endogeneity of the lagged dependent variable.

GMM estimators are Difference Generalized Methods of Moment (DGMM) and System Generalized Methods of Moment (SGMM). The study applied system GMM due to its capability in mitigating 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). This estimator has been adopted in recent research in investment sensitivity (see, Aghion et al., 2008; Almeida & Campello, 2006; Baum et al., 2009; Bloom et al., 2006; Bond et al., 2003; Brown et al., 2015; Han & Qiu, 2007; Schiantarelli & Sembenelli, 2000).

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). This study meets the prime condition for the 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 ($70 > 12$). This implies that by having larger firms (N) than years (T), the system controls for dynamic panel bias (see, Bond, 2002; Roodman, 2006; Sarafidis, Yamagata & Robertson, 2006). The study also employed two diagnostics tests for system GMM such as Sargan and Arellano-Bond (AR(1) and AR(2)) tests. Hence, Sargan (1985) test of over-identifying restrictions and Arellano-Bond test for autocorrelation/serial correlation of the error term.

Our system generalized method of moments (SGMM) model is specified as thus;

$$IITA_{it} = \beta_0 + \beta_1 IITA_{it-1} + \beta_2 CFV_{it} + \beta_3 FL_{it} + \beta_4 GO_{it} + \beta_5 CDTA_{it} + \beta_6 AGE_{it} + \mu_{it} \dots\dots\dots(1)$$

Where; $IITA_{it}$ is intangible investments divided by total assets of firm i at time t , $IITA_{it-1}$ is intangible investments divided by total assets lagged by one for firm i at time t , CFV_{it} is cash flow volatility measured as the relative change in earnings of firm i at time t , FL_{it} is financial leverage measured as total debt divided by total assets of firm i at time t , GO_{it} is growth opportunities measured as the yearly growth rate in sales of firm i at time t , $CDTA_{it}$ is cash dividend measured as cash dividend divided by total assets of firm i at time t , AGE_{it} is the log of number of years since inception to the date of observation for firm i at time t , and μ_{it} is error term of firm i at time t , $\beta_1 - \beta_5$ are coefficients, and β_0 is the intercept.

In an attempt to confirm the position of our empirical outcomes and extant literature, we conducted additional tests for the sub-sample of firms. A firm experiencing high cash flow volatility must cut dividends, cut investment, adjust cash holding or obtain external funds especially in the growth period (Deng, Li, Liao and Wu, 2013). Dudley and James (2015) affirm that the degree of the effect of cash flow volatility on investment decisions will vary with the level of financial constraints of the firm. When there is cash flow shortfall for younger firms, these firms may face difficulties in financing

their investment with an internal source of funds (Fagiolo & Luzzi, 2004). Schiantarelli and Sembenelli (2000) demonstrated that examining the sensitivity of investment to cash flow for different groups of firms is one of the standard methods to evaluate the substitutability of internal and external sources of funds. In order to take cognisance of the above highlighted factors, our sample firms were grouped into high levered firms and low levered firms in the first grouping, financially constrained firms and financially unconstrained firms in the second grouping and older firms and younger firms in the third grouping in additional dynamic panel estimations conducted. In ascertaining the position of each of these firms, the researchers employed variants of methods.

High levered firms need to borrow less and low levered firms ought to borrow more (Myers, 1984), because of expected costs of financial distress a high levered firm with value-increase growth opportunity cannot borrow beyond a certain level. The firms with financial leverage above the sample mean were grouped as high levered firms and firms with financial leverage below the sample mean were grouped as low levered firms. A reduction in cash dividend is an indication of financial constraint (Cava, 2005; Cleary, 2002). Cava (2005) affirm that unconstrained firms have no incentive to cut dividend payments, while constrained firms can cut dividends to free up internal funds for value-increasing investment opportunities. On this note, we grouped our sample firms into financially constrained firms and financially unconstrained firms if a firm cut cash dividend payment for three consecutive years or if a firm does not cut cash dividend payment for three consecutive years respectively. Fazzari, Hubbard and Petersen (1987) argued that business recessions and changes in corporate tax policy that invariably affect internal finance will likely have a greater effect on the growth rates and investment behaviour of small immature firms, if internal and external sources of funds are not perfect substitutes. Finally, the firms with years of experience above the sample mean were grouped as older firms and firms with years of experience below the sample mean were grouped as younger firms.

4. Empirical Results and Analysis

4.1. Descriptive Statistics

Our observation from table 1 highlights descriptive statistics of the adopted variables. The mean of intangible investment for the sample is 1.179; this indicates that the average firm invests ₦117.9 of ₦1,000 asset value in intangible investment within this period. This invariably is an indication that a low proportion of asset value was employed in intangible expenditures. This also implies that Nigerian firms do not show any commitment to research and development investment. The maximum and minimum was 53.578 and 0.00 for intangible investment respectively indicated high variation in investment in these outlays within the period under study. The standard deviation of 5.149 for intangible investment is four times the mean, indicating that investment in this outlay is a lot more volatile.

Table 1 Descriptive Statistics of the panel Data

Variable	Mean	Maximum	Minimum	Std. Dev.	Skewness	Kurtosis
Intangible investment	1.179	53.578	0.000	5.149	6.039	43.227
Cash flow volatility	-13.816	15196.96	-31900.26	1455.558	-11.864	326.565
Financial leverage	62.640	305.801	12.424	24.890	2.218	17.934
Growth opportunity	268.916	146888.6	-90.702	5574.586	24.639	635.010
Cash dividend	3.044	60.853	0.000	5.724	4.693	34.712
Firm age	3.658	4.543	0.693	0.536	-1.719	6.960

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 840 observations of 70 firms.

The negative average of 13.816 for cash flow volatility revealed relatively instability among the sample firms within the period of study, which resulted in average decline earnings of ₦13.82. This is an indication of high volatile earnings among the sample firms within this period, which was observed in standard deviation many times the mean and also a maximum of 15,196.96 and minimum of -31,900.26. These volatile earnings were relegated with external funding resulting in an average of 62.64% for financial leverage. This proportion is an indication of high financial leverage, which implies that 62.64% depletion in assets of Nigerian firms will affect bondholders' funds since owners stake in the firms covers only 37.36% of the firm's assets and thus contributing to high agency cost and reorganization cost. And the financial leverage of our sample firms within this period recorded a high discrepancy when a maximum of 305.80 is compared to the minimum of 12.42.

The firms' growth opportunity with the mean of 268.92 is an indication that our sample firms have a chance of growing every ₦1,000.00 invested capital in value-increasing investment opportunity by ₦268.92, which reflects market expectations of strong growth opportunities for Nigerian firms. This observed high growth opportunity can be deduced as one of the reasons for high average total debt ratio since our sample firms need to substitute internal cash flow that remained volatile with external capital to reduce underinvestment problem. Although, this growth opportunity varies highly among the years of the study as the maximum and minimum recorded respective value of 146,888.6 and -90.702 and the standard deviation almost twice the mean indicates strong volatility. However, cash dividend revealed a mean of 3.04, which implies that for every ₦100 earnings from the firms' investment in value-increasing investment opportunity, ₦3.04 cash dividend was paid to owners of the firms within the period under review. This observed proportion of cash dividend to shareholders relatively to proportion of their stake in the firms is evidence of asset substitution problem resulting in marginal benefits of monitoring and bonding activities less than the marginal costs as noted by agency cost theory. But cash dividend among the firms and within the period under study recorded high variation as depicted in maximum and minimum value of 60.85 and 0.00 respectively. The insight for strong volatility was confirmed with the standard deviation almost two times the mean.

The positive value of Skewness for our data set revealed that the data points are skewed to the right of the data average, except for cash flow volatility and firm age with negative Skewness which implies that data points are skewed to the left of the data average. The variables indicated that the data are normally distributed. Confirming the above insight, Kurtosis results in table 1 showed that the variables are normally distributed which revealed symmetric distribution with well-behaved tails. Although kurtosis confirmed that all the variables are heavily-tailed distribution with positive expected values.

Table 2 Correlation matrix

	Intangible investment	Cash flow volatility	Financial leverage	Growth opportunity	Cash dividend	Firm age
Intangible investment	1					
Cash flow volatility	0.061	1				
Financial leverage	-0.021	0.008				
Growth opportunity	-0.009	-0.002	-0.020	1		
Cash dividend	0.039	0.012	-0.133	-0.025	1	
Firm age	-0.156	-0.040	0.161	-0.006	0.029	1

The results in table 2 highlight the correlation matrix of the research variables. We obtained a positive correlation between intangible investment and cash flow volatility. This implies that the cash flow realisation of the firms within the period of study resulted to increase in investment in intangible assets. This positive correlation was also recorded between intangible investment and cash dividend. The outcomes are an indication that the cash dividend vary in the same direction with intangible assets. That is, as Nigerian firms increases in dividend payout to their shareholders more funds will be available to undertake investment in intangible assets. On the other hand, intangible investment is negatively correlated with financial leverage, growth opportunity, and firm age. This is an indication that high leverage ratio, high growth opportunity and high experience in the industry by the firms resulted in less investment in intangible assets.

4.2. Cash flow volatility and intangible investment

The observation in table 3 depicted the outcomes of system generalized method of moments (SGMM) estimation for the effect of cash flow volatility on intangible investment. The results indicate that cash flow volatility is positively and significantly related to intangible investment investments of Nigerian firms. Though the outcome revealed a marginal coefficient value of 0.00007, which implies that 1 unit increases in cash flow volatility resulted in 0.007 unit increase in investment in intangible assets by firms in Nigeria.

The financial leverage of the firms revealed a significant coefficient value of 0.007, that is, a unit increases in financial leverage contributed to 0.7 unit increases in research and development investment. This implies that the financial leverage of Nigerian firms exerts a positive and significant effect on intangible investment. The outcomes further

showed that growth opportunity and cash dividend turned out to have a negative influence on intangible investment of firms in Nigeria. The results of the estimated parameters indicated that growth opportunity influenced intangible investment negatively at a very marginal level and also the outcome appeared to be insignificant. While cash dividend indicated that 1 unit increases in cash dividend payment of Nigerian firms led to 2.9 units increase in investment in intangible assets within the period covered. Firm age contributed negatively to intangible investment. We found that as Nigerian firms gear more experience in their industry the lesser their investment in intangible assets.

Table 3 Cash flow volatility and intangible investment

	Dynamic panel regression (SGMM)
Intercept	5.504 *** (323.33)
Intangible investment $t-1$	0.806 *** (0.0002)
Cash flow volatility	0.00007*** (99.72)
Financial leverage	0.0074 *** (286.30)
Growth opportunity	-0.00000039 (-0.32)
Cash dividend	0.029*** (43.35)
Firm age	-1.563*** (-379.05)
Observations	840
	Sargan = 48.002 (0.932)
	AR(1) = -1.64 (0.101)
	AR(2) = -0.954 (0.340)

This table provides the empirical results of the effect of cash flow volatility on intangible investment using dynamic panel regression (SGMM) approach. z-statistics are provided in parenthesis below the coefficient estimates for SGMM. The SGMM result is a two-stage estimation. Sargan test of over-identifying restrictions measures the fitness of the model and failure to reject the null hypothesis gives support to the choice of the instruments. 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. Both Sargan and AR tests are diagnostics tests for SGMM. ***Significant at 1%.

To understand the importance of dynamics, we test for the influence of lagged intangible investment (lagged dependent variable) in explaining the variation of current investment in intangible assets. The coefficient of lagged intangible investment (IITAt-1 = 0.806) in our estimated model though with a high coefficient value indicated convergence by having a value less than unity. Otherwise, the use of SGMM as a method of estimation in this model is invalid. Therefore, this implies that the “steady-state” assumption holds. An indication of a high level of persistence and that the series in our dynamic panel estimation are nearly a random walk hence validate the usage of SGMM.

The Sargan test of over-identifying restrictions with the p-value of 0.932 confirms the overall validity of the instruments employed and gives support to the choice of the instruments as we could not reject the null hypothesis since the p-value is greater than the conventional significance level of 0.05 or 0.10. Arellano & Bond test for autocorrelation and serial correlation of the error term at order 1 and order 2 recorded respective value of 0.101 and 0.340 depict that the estimated model has no serial correlation problems since the p-values are greater than 0.05 (AR(1)= 0.101 > 0.05 and AR(2)=0.340 > 0.05).

4.3. Cash flow volatility and intangible investment for grouped sample

The study observed from table 4 that the outcomes of high levered and low levered firms differ significantly in most of the explanatory variables. Though lagged intangible investment and cash flow volatility revealed a positive significant relationship with investment in intangible assets within the period of study for this sub-sample of firms. The influence of financial leverage on intangible investment for high levered and low levered firms recorded mixed outcomes. We found that in the presence of volatile cash flow and value-increase growth opportunity, highly levered firms borrow more to undertake investment in intangible assets. The low levered firms, on the other hand, borrow less to undertake investment in intangible assets. The contribution of growth opportunity to intangible investment was positive but insignificant for high levered firms, while the contribution for that of low levered firms was positive and significant.

However, the estimations continue to reveal more distinct influence among the two groups of firms (high levered and low levered firms) as cash dividend recorded cash dividend negative and significant effect on intangible assets for the former firms. The later firms on the other showed that cash dividend contributed a positive and significant effect on intangible investment. Also, high levered firms leveraged on their experience in the social-economic network since our SGMM estimation revealed a positive and significant relationship between firm age and intangible investment. Unlike high levered firms, firm age for low levered firms exerts negative and significant effect on intangible investment, an indication that later firms did not leverage on their socio-economic network.

Table 4 Cash flow volatility and intangible investment for grouped sample

	High levered firms ¹	Low levered firms ²	Constraint firms ³	Unconstraint firms ⁴	Older firms ⁵	Younger firms ⁶
Intercept	-3.610*** (-78.00)	11.187 *** (1036.76)	-3.686*** (-25.81)	13.029 (0.52)	2.203*** (47.07)	26.162*** (209.95)
Intangible investment $t-1$	0.994*** (4825.98)	0.743 *** (8802.84)	0.961*** (1686.95)	0.722*** (3.69)	0.942*** (3758.22)	0.660*** (190.22)
Cash flow volatility	0.0001*** (151.16)	0.00009*** (24.59)	0.00009*** (31.34)	0.0001 (0.15)	0.00009*** (44.59)	0.0003*** (11.45)
Financial leverage	0.006*** (82.70)	-0.005*** (-46.74)	0.007*** (62.52)	-0.019 (-0.30)	0.012*** (213.03)	-0.010*** (-5.54)
Growth opportunity	0.0000005 (1.04)	0.00003*** (27.14)	0.0000005* (1.75)	0.00006 (0.19)	-0.000001 (-0.73)	0.001*** (17.08)
Cash dividend	-0.089*** (-75.04)	0.167*** (81.82)	-0.031*** (-20.98)	0.248 (0.20)	-0.081*** (-196.47)	0.651*** (74.42)
Firm age	0.912*** (84.56)	-3.124*** (-850.19)	0.904*** (23.79)	-3.487 (-0.45)	-0.638*** (-46.90)	-8.551*** (-130.92)
Observations	408	432	636	204	540	300
Sargan	27.291 (0.9997)	32.690 (0.996)	34.591 (0.997)	10.296 (1.000)	37.020 (0.997)	21.337 (1.000)
AR(1)	-1.035 (0.301)	-1.387 (0.166)	-1.030 (0.303)	-1.174 (0.241)	-1.419 (0.156)	-1.136 (0.256)
AR(2)	-1.015 (0.310)	-0.112 (0.911)	-1.037 (0.300)	-0.238 (0.812)	-1.212 (0.226)	1.603 (0.109)

This table provides the empirical results of the effect of cash flow volatility on intangible investment for group of sample firms comprising of levered firms, unlevered firms, constraint firms, unconstraint firms, older firms and younger firms using dynamic panel regression (SGMM) approach. Estimation (1) examines the effect of cash flow volatility on intangible investment for a sample of high leverage firms ; estimation (2) examines the effect of cash flow volatility on intangible investment for a sample of low leverage firms, estimation (3) examines the effect of cash flow volatility on intangible investment for a sample of financially constrained firms; estimation (4) examines the effect of cash flow volatility on intangible investment for a sample of financially unconstrained firms; estimation (5) examines the effect of cash flow volatility on intangible investment for a sample of older firms, and estimation (6) examines the effect of cash flow volatility on intangible investment for a sample of younger firms. z-statistics are provided in parenthesis below the coefficient estimates for SGMM. The SGMM result is a two-stage estimation. Sargan

test of over-identifying restrictions measures the fitness of the model and failure to reject the null hypothesis gives support to the choice of the instruments. 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. Both Sargan and AR tests are diagnostics tests for SGMM; *Significant at 10% **Significant at 5%; ***Significant at 1%.

The outcomes of financially constrained firms differ significantly from the estimations of financially unconstrained firms. Although, the lagged dependent variable (intangible investment) that recorded positive and significant relationship is the only variable that does not differ among the outcomes of the two groups of firms (financially constrained and unconstrained firms). Cash flow volatility of financially constrained firms recorded a positive and significant effect on intangible investment, while that of financially unconstrained firms' recorded positive and insignificant influence. The effect of financial leverage on intangible investment remained positive and significant for constrained firms but financial leverage of unconstrained firms recorded negative and insignificant influence. We found growth opportunities for constrained firms to exert a positive and significant effect on intangible investment. An outcome that appeared to differs from that of unconstrained firms that exhibited positive and insignificant influence.

In respect to direction and magnitude, the outcomes for financially constrained and unconstrained firms depict mixed outcomes, which appeared to differ significantly with the main estimation. This outcome showed that the cash dividend had a negative and significant effect on intangible investment for financially constrained firms. This implies that constrained firms that are highly levered can reduce dividend payments to increase retained earnings. On the other hand, the estimation for financially unconstrained firms recorded insignificant positive outcome. The results of the estimations for firm age for both groups of firms continued with contrary outcomes with constraint firms recording positive and significant relationship between firm age and intangible investment. This is an indication that firms rely heavily on their experience to invest more funds in intangible assets. That is, an increase in firm age led to an increase in investment in research and development investment. Unlike financially unconstrained firms that appeared to reveal negative and insignificant outcome.

The results of the empirical models for older firms did not significantly change from that of the main estimation for most of the parameters, while that of the younger firms appeared to differ in most of the variables. The effect of lagged dependent variable (lagged intangible investment) and cash flow volatility exert positive and significant influence on intangible investment for both older and younger firms. We observed financial leverage to have a positive influence on older firms but the financial leverage of the younger firms appeared to have a negative influence on intangible investment. The influence on both group of firms were significant. In line with the outcome of our main estimation for growth opportunity, the outcome for older firms reveals negative insignificant influence on intangible investment. While the result for the younger firms recorded positive and significant effect. The effect of cash dividend for older firms appears to be negative and that of younger firms is positive and the magnitude of both groups of firms is statistically significant. The results showed there is no significant change in the effect of firm age on intangible assets for both older and younger firms. This is an indication that whether a firm is older or younger their experience contributes negatively to investment in intangible assets for the period of study.

4.4. Implication of the results

As observed from the estimated results, cash flow volatility had a positive and significant effect on intangible investment of firms in Nigeria. The outcomes for sub-sample firms depicted that it does not matter whether the firms are high levered or low levered and older or younger, this effect remained the same for all classes of firms. Further findings showed that what matters is the level of financial constraint experience as the results reveal that the sensitivity of intangible investment to cash flow volatility is attributed to the importance of financial constraints. Though, the magnitude of the result which recorded marginal influence validates previous evidence that the availability of cash flow matters for little variation in intangible investment (Brown et al., 2015). Also, the outcome does not seem to vary with the findings of Minton and Schrand (1999) that discretionary investment levels are sensitive to cash flow volatility, and that the significance of the sensitivity is a function of cash flow levels. However, this is an indication that high cash flow-investment sensitivity is consistent with the asymmetric information framework, an outcome that cannot be attributed to wasteful use of internal funds by entrenched managers.

Richardson (2006) documented that positive relationship between investment expenditure and cash flow is a manifestation of an agency problem given a situation where managers in firms with free cash flow engage in wasteful expenditure. But the marginal coefficient of our estimation does not support the postulation of the author. Rather, we observed a slight substitution effect where a small chunk of research and development investment was financed by debt capital (external finance) as obtained in the coefficient of financial leverage. This appears that firms could smooth internal cash flow volatility with external capital funding. An indication that the effect of some variability in the cash

flows generated by assets in place together with variability in the amount of money raised externally will, in turn, results in variability in investment in intangible assets (Froot et al., 1993). Our finding is in line with the argument that increases in financial leverage through a new debt issue as a form of financial innovation reduces the effect of cash flow volatility (Dudley & James, 2015). Bond and Meghir (1994) confirm that cash flow shortfall would easily be financed in capital market where investors are readily available to exploit the opportunity for profit. Although, a significant chunk of this growth opportunity was not exploited as the study observed growth opportunity to be irrelevant to intangible investment. An outcome that may be attributed to the payout policy of the firms since observed negative contribution of cash dividend to intangible investment implies that less cash was left to undertake value increasing investment opportunity conversely to investment efficiency argument. The assumption of investment efficiency is that cash reserves should be positively correlated with intangible investment, supporting the findings of Bloch (2005) that internal funds are important in explaining intangible investments. Fazzari et al. (1987) earlier warned that allocation of earnings away from the firms as dividend to shareholders may alter both the level of funds for investment and its allocation to the extent that firms face information related financial constraints.

5. Conclusions

The study examined the effect of cash flow volatility on intangible investment of publicly listed firms in Nigeria from 2006 to 2017. This work considered 70 firms in non-financial sectors for a period of 12 years. On this note, we employed dynamic panel (SGMM) estimation for a firm-year observation of 840. The drive for adoption of dynamic panel estimation instead of static panel estimation was to guide against the dual effect of individual firm heterogeneity and endogeneity problems. This study found that cash flow volatility had a positive and significant influence on intangible investment which implies that cash flow volatility contributed positively to intangible assets accumulation of Nigerian firms within the period of study. We also found that Nigerian firms experiencing volatile cash flow in the presence of value increase growth opportunity leveraged on debt capital to finance intangible investment. Although, significant chunk of this growth opportunity was not exploited as the study observed growth opportunity to be irrelevant to intangible investment and more cash as dividend to shareholders with resultant negative effect on intangible investment. These firms also failed to leverage their experience in socio-economic network as firm age contributed negatively to intangible investment. In the sub-sample of high levered, low levered, constraint, unconstraint, older, and younger firms, we recorded related and mixed outcomes. Although, the results showed that the sensitivity of intangible investment to cash flow volatility does not matter whether the firms are high levered or low levered and older or younger firms. The sensitivity of this effect is a matter of financial constraint confronting the firms. Thus implies that the sensitivity of intangible investment to cash flow volatility is attributed to the importance of financial constraints but the issue of the firms being high levered, low levered, older or younger is irrelevant. The outcomes of the study are conformity with the accelerator theory of investment that variations in sales or output motivate changes in intangible investment. Also, that degree of the effect of cash flow volatility on intangible investment decisions will vary with the level of financial constraints of the firm.

Compliance with ethical standards

Disclosure of conflict of interest

No conflict of interest to be disclosed.

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