# THEORETICAL ANALYSIS OF FIRM AND MARKET-SPECIFIC PROXIES OF INFORMATION ASYMMETRY ON EQUITY PRICES IN THE STOCK MARKETS

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**ABSTRACT**

*Asset pricing has remained an issue of interest to scholars, investment managers and analysts without borders. Pricing of equities in environments characterized with imperfect information and determining the effect of information asymmetry on the asset have also remained a challenge. The risk the information uncertainty from the firm poses to the investors and analysts and the risk the information uncertainty from the investment opportunities of the firm poses to the managers need to be measured and incorporated into equity price. This study made an attempt to develop a model from the works of Lowry, Officer and Schwert (2007) and Reber and Fong (2008) for measuring the effect of firm and market-specific proxies of information asymmetry on equity prices in the stock market. The model developed is considered suitable for adoption in developing and emerging economies where information is considered prevalent. In addition to providing a model for measuring the effects of proxies of information asymmetry on equity prices, the study would to literature on the subject of information asymmetry as it relates to equity pricing and stock market.*

**Keywords**: *information asymmetry, proxies, capital market, equity pricing, impact.*

JEL Classification Codes: G12, G14

## 1.0 INTRODUCTION

New issues are made primarily to raise additional funds for expansion, diversification, acquisition of information technology infrastructures and others. The expectation of the promoters is for the issue to be successful. Many factors can be responsible for the success or failure of new issues, one of such is pricing. Efficient pricing is important in attracting new and existing investors and may be enhanced by the quality of information disclosed to the market. A relationship exists between asset pricing and information quality (Kang, 2004). It is expected that the quality of decision (output) is a reflection of the quality of information (input). The capital market to act as a catalyst for economic growth and development will depend, among other things, on the quality of market information available to investors. The ultimate is achieving information efficiency because each type of information asymmetry induces market inefficiency (Rosser, 2001; Oluba, 2008; Murray, 2008). The value of information may be determined by the quality of the decision made by the investors using the information.

Information asymmetry has been identified as one of the challenges facing emerging markets (Rosser, 2001; Ciner and Karagozoglu, 2005; Oluba; 2008, and Murray, 2008) and especially where the market is found to be exhibiting weak form efficient (Olowe, 1999; Adenikinju and Oyeranti, 2000 and Elumilade, 2008). Also, Lowry, Officer and Schwert (2008) posit that pricing of initial public offer is a complex process and the complexity of the valuation problem is greater in firms with high information asymmetry. Obviously, the problem of information asymmetry is not restricted to the primary market rather it is market-wide especially where the market is considered to be weak-form efficient. This study therefore develops a model addressing the

nature of effects that information asymmetry would have on equity pricing in both primary and secondary stock markets. Specifically, the model is designed to:

**i)** measure the impact of firm-specific measures (proxies) of information asymmetry on the pricing of new equities (initial public offer),

**ii)** measure the impact of market-specific measures (proxies) of information asymmetry on the pricing of equities, and

**iii)** measure the relationship between initial returns on new equities (IPO), firm-specific proxies for information asymmetry and market volatility measures.

The remainder of the study is set out as follows; Section Two contained discussion on the theoretical framework and review of relevant literatures. Section Three examined the methodology and models for measuring the effect of the firm and market-specific proxies of information asymmetry on equity prices. Lastly, Section Four contained summary, conclusion and recommendations.

## 2.0 THEORETICAL FRAMEWORK AND LITERATURE REVIEW

### 2.1 Theoretical Framework

The theoretical framework of this study is the theory of information as propounded by Akerlof (1970) who posits that the presence of information asymmetry in the market drives away new and good products from the market in favour of used and bad ones. Akerlof developed a model to explain the concept of information asymmetry in the market for ''Lemons'' by using new and used car markets to explain how used cars can price out new ones from the market in the presence of asymmetric information. In such a market used cars are overpriced while new cars are underpriced. With presence of product quality uncertainty (or information asymmetry between the buyer and the seller), the market may be stuck in an "adverse selection" process with "good" quality products leaving and only "lemons" staying in the market, leading to market inefficiency and possibly a shutdown (Chen, 2005).

Ever since the concept of information asymmetry or lemon market was introduced by Akerlof (1970), it has become the toast of many scholars cutting across several fields of human life, but unfortunately not so much has been done in the areas of equity pricing in the capital market. Several studies revealed that activities in the financial markets thrive on the amount and quality of information available to all the parties. This determines the efficiency of the market with the hindsight that it is not possible that all parties to a transaction would have the same amount of information available to them. Even where the same information is available, cognitive dissonance could set in. Most likely there would be varieties in the amount of information available. Information asymmetry is present in financial markets and its degree of presence varies from one economy to the other depending on the level of the economic or market development. Given this position, several attempts have been made by scholars to identify its impact on various financial market variables (Javid, 2009; Lowry, Officer and Schwert, 2007 and Reber and Fong, 2008). Myer and Majiluf (1985) examined information asymmetry between management and investors in the financial market and found information asymmetry playing important role in determining a firm's financing and investment decisions. To investors, information asymmetry affects the liquidity of a stock (Kyle, 1985) which in turn affects the cost of capital (Amihud and Mendelson, 1986).

Leland and Pyle (1977), Grossman and Hart (1981) and Myers and Majiluf (1985) proved theoretically that information asymmetries can have a profound impact on a firm's financing and investment decisions as well as on managerial incentive compensation policies. Leland and Pyle (1977) developed a model of capital structure and financial equilibrium to examine entrepreneurs intending to finance projects with certain prospects. They believe that information asymmetry may be the main reason behind the existence of market intermediaries. They considered an investment project with a capital outlay ($K$) with future return $\mu + \chi$, where $\mu$ and $\chi$ are the expected end-value of the project and random variable with mean and variance equal zero. The investor's conviction that the project is viable is demonstrated by his investment of

$\propto$ and this according to them addresses the problem of adverse selection. The total market value ($V$) of the project is therefore expressed as:

$$V(\propto) = 1/(1+r) + [\mu(a) - \lambda] \quad . \quad . \quad . \quad . \quad (2.1)$$

Where:

| | | |
|---|---|---|
| r | = | the riskless interest rate |
| μ(a) | = | the market valuation schedule, expressing the market's perception of the true expected return as a function of $\propto$, the fraction of equity retained by the entrepreneur |
| λ | = | the market's adjustment for the risk of the project with return $x$ about the mean μ(a) was assumed to be a differentiable function |

Extending the frontier of impact of information on stock market activities, Myers and Majluf (1985) relying on Akerlof (1970), Leland and Pyle (1977) and Bhatacharya and Ritter (1983), among others, came up with a "three date model" to explain investment decision when the insiders have superior information than the outside investors. They discovered that it is better to issue bonds (safe securities) than equities (risky one) as means of giving the impression that all is well with the organization and indirectly issuing equity through conversion of bonds. It is better for a firm to forgo good investments when it has cash flow problems than to issue risky securities to finance the investments. Low and non-declaration of dividend is one of the ways to manage financial stress when investment opportunities are modest. Stock price tends to fall when new stocks are issued while insiders possess superior information and this should be done if the new issue will not put existing shareholders at a disadvantage. To the uninformed investor, refusal to make new issues signals positive news while the issuance of new equities signals bad news. In either case, prices of new issues are affected by the information asymmetry, which in turn affects the investment decision of the firm and resource allocation among investible opportunities in an economy.

Easley and O'Hara (2004) argued that information-based transactions in the financial market impacts on a firm's cost of capital. In spite of divergence of findings by the various scholars that have examined the effects and impact of information asymmetry on the determination of price, interest rate, cost of capital and market efficiency, there is the consensus among them that the degree of information asymmetry is not directly observable (Sufi, 2005; Karlan and Zinman, 2006), and that proxy variables are required to measure the degree of information asymmetry's presence in any market. Information asymmetry is characterized by two major problems extensively discussed in the literature as adverse selection and moral hazard (Knutsen, 2001). Decision makers (fund raisers and investors) in the primary and secondary markets can suffer from the two problems in a situation where information asymmetry exists and is left unmanaged. Borooah (2003), Bjornstad and Brown (2004), Zerbe and McCurdy (2005) and Hall (2007) see market failure as consequence of information asymmetry. Thus confirming the position of Akerlof (1970) on how information asymmetry can lead to market failure.

For instance, adverse selection occurs in primary equity market where insufficient information is available in fixing the offer price. If the new issue is overpriced, the issuer would suffer under-subscription and the opportunity offered by the proposed project becomes unrealizable. The far-reaching effect of this is that the lost opportunities may have adverse impact on existing investment. On the other hand, the subscriber who did not have sufficient information to discover the overpriced stock would end up with less-than-expected return on the investment. A decision maker's ignorance of essential information may create moral hazard problem in addition to adverse selection effect (Caballero, 2008).

### 2.2 Measurement of Information Asymmetry

If information asymmetry has been attributed as a major cause of market failure, its impact needs to be measured and empirically tested. Since the degree of information asymmetry is not directly observable, the use of proxies in the measurement of information asymmetry becomes essential (Sufi, 2005; Karlan and Zinman, 2006). Variables such as research and development expenses, firm age, fixed assets, and firm size were used by

Helwege and Liang (1996) as proxies for measuring information asymmetry. In earlier study, Klein and Belt (1994) adopted shareholders' size, market liquidity and the sales volume as measures of information asymmetry. Total assets of the firm were used as proxy of information asymmetry by Jung, King and Stulz (1996). Analyst's coverage of stock prices has been used as proxy for measuring information asymmetry to stock price behavior in the stock market (Moyer, Chatfield and Sisneros, 1989; Barth and Hutton, 2004). Yi, Besley and Pantzalis (2005) modified the analyst coverage proxy to "change in analyst coverage" as a proxy for measuring information generation induced by securities offers. Moeller, Schlingemann and Stulz (2006) used the idiosyncratic volatility of the stock as a measure of information asymmetry with respect to diversity of opinion. Brown, Hillegeist and Lo (2006) conducted a time series analysis of the relationship between the earnings of a firm and changes in information asymmetry over a period of time using probability of uninformed trade.

### 2.2.1 Firm's Book Value to Market Value

Book to market value ratio has been a tool in the hands of financial analysts for several purposes including using it to proxy information asymmetry, investment and growth opportunities of a firm. The managers of firms are considered to be better informed of the expected risk and returns of potential investment projects than the investors. Smith and Watts (1992) reasoned that managers of companies with high growth rate potentials seem to possess better knowledge of the companies' investment opportunities and expected future cash follows. McLaughlin, Safieddine and Vasudevan (1998) applied the ratio of firm's market value of equity to book value of equity to measure the relationship between information asymmetry and the long-term performance of a company following the public offer of ordinary shares. They found a direct correlation between information asymmetry and negative abnormal performance following the public offer of ordinary shares.

The higher the ratio of the book to market value (a signal of better performance and prospects to investors) the higher the expected return or equity price of a firm (Fama and French, 1992). Moore and Beltz (2002) in their study of the factors that influence share price performance using S & P 500 index performance came to a conclusion that higher market value to book value ratio is a signal of better performance contrary to what Fama and French (1992) found. Higher market to book value and previous market values provide a good signal to some firms to issue equity rather than debt (Baker and Wurgler, 2002) Joos and Zhadanov (2007) developed a book and market values models for the valuation of earnings and equity of a Biotech Industry. They assumed that the book value and market value of a new start firm equal the value of the investment opportunities at given time, t. The value of the investment opportunities is the present value (PV) of the cash flows less the present value of the capital outlay. The model depicting the value of the firm's growth option is

$$GO(0) = \left(\frac{xo}{x*}\right)^{\beta 1} PV(x^*)\frac{\lambda}{r} - \frac{GA}{r} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (2.2)$$

Where x* is defined as "avg. max $\{(\frac{1}{xi})^{\beta 1}$ PV $(x_i)$ representing the optimal investment threshold, PV(x*) represents the value of the project initiated at a time when the current value of the stochastic revenue shock equals $x_i$. The GA represents the total annual general and administrative expenses. The $\beta_{1\ is}$ defined as $\left(\frac{1}{2}\right) - \left(\frac{\mu}{\sigma 2}\right) + \sqrt{\frac{1}{2} - \frac{1}{2}}\}2 + \frac{2r}{\sigma 2}$

For a new firm, the cost of research and development and general and administrative expenses are paid from the shareholders' initial capital contributions until the time the firm's investment opportunities start yielding revenues. At the point the investment opportunities start yielding revenue, the book value will not the equal to the market value in contrast to the time t when the firm started without any revenue from investment opportunities. The market value thereafter is defined as:

$$MV(t) = GO(t) + MV1(t) + MV2(t) + MV3(t) \quad \ldots\ldots\ldots\ldots\ldots\ldots (2.3)$$

where MV1, MV2, and MV3 represents the contributions to the market value from investment projects in conception, those currently in the R&D stage, and projects in the commercial stage, respectively.

The model assumed that the market is efficient and both the management and the investors are equally informed or uninformed at any point in time. They acknowledged the presence of information asymmetry in Biotech Industry but decided to ignore it in the development of the model.

In this study information asymmetry measures of a firm's growth and investment opportunities (especially the ratio of book value to market value) would be factored into the equity pricing model to be constructed for the purpose of striving at more efficient equity pricing.

### 2.1.2 Analyst Forecast Proxy

Analyst earnings forecast is an important ingredient in equity valuation (Shanthikumar, 2004; Zaima and Harjoto, 2005) for it helps to show the future expected earnings of the firm on the basis of forecast error. The forecast error is the difference between the actual earnings and the analyst forecast earnings, which is useful for updating earnings expectations (Abarbanell and Lehavy, 2003). The stock prices incorporate earnings forecast (Bauman and Dowen, 1988; Bradshaw and Brown, 2005) and regarded as vital information in market decision making (Chung, McInish, Wood, and Wyhowski (1995). As the fiscal year ends, Elton, Gruber and Gultekin (1984) observed that forecast errors decrease because information asymmetry is less and accuracy in available information is higher. The analyst forecast reduces information asymmetry in the market (Hughes and Ricks, 1987) and therefore adopted as a proxy for measuring information asymmetry (Krishnaswami and Subramaniam, 1999; Gilson, Healy, Noe and Palepu, 2001; Li and Zhao, 2008). Krishnaswami and Subramaniam (1999) used the analyst forecast error to test for change in the information environment before and after a spin-off transaction. According to Bradshaw and Brown (2005), output from forecast analyst in predicting target prices of stocks, can be used to predict earnings, make stock recommendations and predict stock prices.

So much research evidence abound on the importance of analyst forecasts to stock valuation, reduction of information asymmetry in the stock market and the information asymmetry that exists between the managers and the analysts (Kothari, Lewellen and Warner, 2003; Lehar and Randl, 2005; Bradshaw and Brown, 2005). Analysts methods of earnings and returns forecast can be classified into the fundamental and technical approaches. The fundamental analysis technique examines underlying (fundamental) factors using the economic and accounting indices that affect the firm's performance, growth and going concern. Fundamental analysts believe the market price does not reflect the actual value of a stock, suggesting a mispricing of either under or overpriced stock. On the other hand, technical analysis dwells on predicting future prices from the historical market and stock (price and volume) behaviour.

No evidence could be found on how analysts' forecast can be factored into equity pricing models though research has also shown that there is instantaneous market reaction to analyst forecasts. The equity pricing model to be constructed would incorporate the analyst forecast as it helps to reduce information asymmetry in the stock market. One will ignore the observations made by earlier researchers that analyst's forecast in itself contains information asymmetry because of the information difference between managers and the analyst. The interest of this study, therefore, is not to examine or review analysts' forecast as a mean of predicting earnings or stock prices but its use as a proxy for information asymmetry can be deployed for a more efficient equity pricing.

### 2.2.3 Standard Deviation - Information Asymmetry's Proxy for Expected Return

Stock expected returns are fraught with different levels of uncertainty in prediction. The higher the level of information asymmetry confronting the managers and investors, the greater the probability of inaccurate prediction of the expected stock returns by either of them. A common proxy for information asymmetry in the prediction of stock returns is the standard deviation which measures the volatility of the prices to changes in the underlying factors. Blackwell, Marr and Spivey (1990) used standard deviation as a proxy to measure the residual volatility in daily stock returns while Kyle (1985) used a similar method to study informed trading with the expectation that the inability of non-insider to predict the firm's value accurately is directly and positively related to gains of insider traders. It was concluded that for as long as residual volatility remains a function of

uncertainty in the value of the firm, information asymmetry would continue to reflect the uncertainty. The standard deviation of abnormal stock returns is a measure of information asymmetry in the stock market. Fee and Thomas (1999) adopted this method of measuring information asymmetry in the stock market and they discovered that volatility is significantly lower in diversified firms than those that were undiversified, where diversification is a ploy to manage uncertainty.

There is positive correlation between expected stock returns and a firm's level of uncertainty (Kyle, 1985). Zhang (2004) posits that if the uncertainty associated with the impact of "good" information on stock return is high, it follows that the expected stock return will be high and vice versa for "bad" information in a less information asymmetry environment. Information uncertainty has negative impact on expected stock returns if the information coming to the market is regarded as bad news while it leaves positive impact on the expected stock returns if the information is considered good. This means that the market overreacts to both the good and bad information in an environment characterized with information asymmetry. Kelly (2005) examines information efficiency with regards to firm specific return variation and argues that incorporation of information to stock prices differs. Some stock price could be fast or slow to incorporate new information while some may not respond at all. He argues further that stock prices that are informationally efficiency (i.e. rapid response to new information) are a reflection of the quality of the firm's managerial decisions while also the informationally efficient stock provides positive signal to uninformed investors.

The risk the information uncertainty from the firm poses to the investors and analysts and the risk the information uncertainty from the investment opportunities of the firm poses to the managers need to be measured and incorporated into equity price. Roll (1988) argues that systematic risk accounts for an insignificant portion of stock return volatility. This suggests something is missing. Could this be the neglect of the unsystematic risk which the earlier stock pricing models deliberately ignored? The capital asset pricing model (CAPM in its estimation of the expected stock return gives effect to only systematic risk which implies that stock price is not efficiently priced. The risk associated with the firm (unsystematic risk) cannot be ignored for an efficient pricing of equity if resource allocation among competing investment opportunities would be optimally allocated. The model to be constructed for the pricing of equity would include the unsystematic risk and investor recognition, which (investor recognition) Lehavy and Sloan (2008) argue to be more important to stock price than information about market and firm fundamentals such as earnings, growth and investment opportunities.

### 2.2.4 Microstructure of the Stock Market Proxy

The last of the proxies to be considered in this study is in the measurement of information asymmetry on the stock market in the microstructure of the market. According to O'Hara (1995), market microstructure is concerned with the process and outcomes of exchanging assets as guided by certain market rules and regulations and in some effects the formation of asset prices. Gravelle (1999) argues that a significant part of the researches on the microstructure of the securities markets was devoted to equity market. The outcomes of the many studies done on microstructure of equity markets include the development of several information asymmetry models to cater for segments of the equity markets that possess insider information about the stock expected value.

In general terms, market organizations and structures have impact on stock prices. This position is of interest to scholars and market analysts following the October, 1987 astronomical fall in the Dow Jones Index (Naes and Skjeltorp, 2006). Issues in assessing the importance of market structures on price formation include the level of transparency and information disclosure by firms, the effects of centralized and decentralized trading systems, the effects of manual and electronic trading system on the stock pricing process. For instance, Mendelson (1987) argues that decentralized trading systems reduce liquidity but increases price volatility. The kernel therefore is that information asymmetry relating to volatility induced by market microstructures should be incorporated into pricing of stocks.

Alford and Jones (1998) studied the effects of discrepancies in the registration and information requirements for foreign and local companies by the Securities and Exchange Commission on the adverse selection of investment portfolios. They discovered no relationship between relaxed registration and information requirements for

foreign investors and higher information asymmetry. In the same vein, Flannery, Kwan and Nimalendran (2000) did a study of asset structure of financial institutions in relation to the composition of their respective market microstructure characteristics. They discovered that there is a direct and proportionate relationship between domestic and non-performing facilities and effective bid ask prices. In another study using the proxy of microstructure of the market to measure information asymmetry, Bates, Coughenour and Shastri (1999) studied the composition of adverse selection spread around the completion of a spin-off. They discovered that information asymmetry is lower following the completion of spin-off. Brown and Hillegeist (2003) establish a negative correlation between firm's information disclosure quality and information asymmetry because private information decreases in relation to public information. The gap between informed and uninformed investor decreases as the firm increases its information disclosure. Deaves, Dine and Horton (2006) agree that increase information disclosure reduces information asymmetry in the market.

All proxies are subjective and none could be an accurate measure of information asymmetry as it is directly unobservable. Reber and Fong (2006) and Lowry, Officer and Schwert (2008) in separate studies that involved measuring information asymmetry with respect to pricing of IPOs adopted direct proxies of information asymmetry. Specifically, Reber and Fong (2006) in finding an explanation for mispricing of IPOs used offer price, firm value, underwriter reputation, subscription level and earnings per share (EPS) as some of the proxies of information asymmetry in determining mispricing as a function of information asymmetry in the equity market. Reber and Fong (2006) discovered that underpriced IPOs result in heavy trading in the secondary market. Similarly, in the study of the variability of IPO initial returns Lowry, Officer and Schwert (2008) adopted the underwriter's rank (reputation), trade volume, firm age, market sector, price update and market listed and it was discovered that information asymmetry affect both the level of the offer price and the precision of the price-setting process and also the IPOs of technology companies that enjoys venture capital and younger companies are most underpriced.

## 3.0 METHODOLOGY AND MODEL SPECIFICATION

Reber and Fong (2006) developed a model to examine the effect of firm-specific information asymmetry on IPO initial return dispersion. The model shows the IPO's returns and risk level depend on certain firm- specific characteristics. The characteristics were used by the authors to proxy for information asymmetry.

The model of Reber and Fong (2006) is as stated:

$$IR_i = \beta_0 + \beta_1 Rank_i + \beta_2 Log(Shares_i) + \beta_3 Tech_i + \beta_4 VC_i + \beta_5 NYSE_i + B_6 NASDAQ_i + \beta_7 Log(Firm\ Age_i + 1) + \beta_8\ IPrice\ Update_i I + €_{I.} \quad . (3.1)$$

Where:

Rank : The underwriters' rank as obtained from reputable raters. It is assumed that highly ranked underwriters are able to make precise estimate of firm value. Better estimate (underwriters rank) would have directly positive correlation with IPO pricing. Substitutes to the underwriters can be made of issuing houses that equally play vital roles in the initial public offers.

Log (Share): This is the logarithm of the number of shares offered in the IPO. It is assumed that less information tends to be available about smaller offers and valuations of such issues are difficulty.

Tech: This equals 1 if the firm is a high tech industry (biotech, computer equipment, electronics) and zero (0) otherwise. It is assumed that the value of technology firms tends to be much harder to estimate because it depends on growth option

VC: This equals 1 if the firm received financing from venture capitalists prior to the IPO and zero otherwise. It is assumed that if venture capitalists share information about the firm, the issuing houses may be better to estimate firm value for such issues. This variable would be replaced with public declaration [Log(PUB)] by the issuing house to underwrite the IPO if it fails. It is therefore assumed that public declaration to underwrite the IPO would have positive correlation with the price. Public declaration to underwrite is 1 otherwise zero.

Log (Firm Age + 1): This equals the logarithm of (1 plus) the number of years the firm was established as at the time of issuing the IPO

I Price Update I: This is the absolute value of the percentage change between the offer price and the middle of the range of prices in the prospectuses. This proxy can be substituted the natural log of offer price of the IPO [Log(OP)] (Reber and Fong, 2008).

NASDAQ: This equals 1 if the IPO is listed on NASDAQ and zero (0) otherwise. We would substitute this proxy with 2nd Tier Market of the NSE (2nd Tier). Small and young firms tend ton list the 2nd Tier and it is assumed that issuing houses would find it difficult to value these firms

NYSE: This equals 1 if the IPO is listed on the NYSE and zero otherwise. This proxy would be substituted with 1st Tier of the NSE (1st Tier). Big and old firms tend to go public on NYSE and it is assumed that issuing houses would be able to value the firms more precisely

Eqn (3.1) is expanded to accommodate some of the proxies of information asymmetry examined by Reber and Fong (2006):

$$IR_i = \beta_0 + \beta_1 Rank_i + \beta_2 Log(Shares_i) + \beta_3 Tech_i + \beta_4 PUB_i + \beta_5\, 1^{st}Tier_i + B_6 2^{nd}Tier_i + \beta_7 Log(Firm\ Age_i + 1) + \beta_8 Log(OP_i) + \beta_9 Log(V_i) + \beta_{10} Log(EPS_i) + \beta_{11} Log(Vol_i) + \beta_{12} Log\,(SUBS_i) + €_I \quad . \quad . \quad (3.2)$$

Where:

Log(V): This is the firm market value on the first day of trading in the secondary market

Log(EPS): This is earnings per share in the accounting period immediately before the IPO

Log (Vol): This is the number of shares traded on the first day of trading divided by the total number of shares offered in the IPO. This is to determine the first investors' response in the secondary market

Log(SUBS): This is the number of times an IPO was oversubscribed ( > 1) or undersubscribed (< 1)

To correct for autocorrelation of the residuals in equation (3.2), we adapt the autoregression moving average (ARMA 1,1) model of Box and Jenkins (1976) and also used by Lowry, Officer and Schwert (2009).

$$Log\delta^2(€_i) = Y_0 + Y_1 Rank_i + Y_2 Log(Shares_i) + Y_3 Tech_i + Y_4 VC_i + Y_5 1^{st}Tier_i + Y_6 2^{nd}Tier_i + Y_7 Log(Firm\ Age_i + 1) + Y_8 Log(OP_i) + Y_9 Log(V_i) + Y_{10} Log(EPS_i) + Y_{11} Log(Vol_i) + Y_{12} Log\,(SUBS_i). \quad . \quad . \quad (3.3)$$

To also correct for autocorrelation in the *conditional variance* of the residuals from the *mean* in equation (3.2), we introduce the exponential general autocorrelation conditional heteroscedasticity (EGARCH) model (Nelson, 1991).

$$Log(\delta^2) = \psi + \propto Log[€_i - 1^2/\ \delta^2(€_i - 1)] + \delta Log(\delta^2_{t-1}) \quad . \quad . \quad . \quad . \quad . \quad (3.4)$$

and, the variance ($€_i$) of the error of the mean in eqn (3.2) is the product of the EGARCH factor from eqn (3.4) and the cross sectional factor from eqn (3.3).

$$Var(€_i) = \delta^2_t\,(\delta^2)(€_i) \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (3.5)$$

For the primary market analysis, equations (3.2), (3.3) and (3.4) will be used to regress the proxies of the information asymmetry.

For the secondary market analysis (hypothesis $H_{0b}$) and the "entire" equity market analysis (hypothesis $H_{0c}$), the same equations (3.2, 3.3 and 3.4) would be run but using market-specific and "entire" equity market (i.e. firm and market) information asymmetry proxies respectively.

The following are the market-specific proxies of information asymmetry to be used:

Log(SI): This is the logarithm of the Stock Exchange Share Index as a proxy for equity prices in the secondary market.

Log(DEAL): This is the logarithm of the total number of deals (annually) recorded by the market for equities. The number of deals traded is assumed to be a function of informed trading and this is expected to be positively correlated with equity prices

Log(GDP): This is the logarithm of the yearly Gross Domestic Product. This is expected to have positive correlation with equity prices

Log(INT) : This is the logarithm of the (annualized) lending interest rate. It is assumed that interest rate would have negative correlation with equity prices in the stock market

Log(OIL): This is the logarithm of the (annualized) crude oil price. It is assumed that the price of crude oil is positively correlated with the equity prices

Log(INFL): This is the logarithm of the inflation rate. Inflation affects the investing ability in the economy. It is assumed that inflation is negative correlated with equity prices

Log (CONI): This is the logarithm of the (annual) consumer index. It is assumed that consumption is positively correlated with equity prices.

Log(FX): This is the logarithm of the foreign exchange rate to the country whose currency serves as the benchmark like United States of America dollars (USD). It is assumed that a positive correlation exist between foreign exchange rate and equity prices.

The model to be tested in the secondary market is:

$$\text{Log(ASI)} = f[(\text{Log(DEAL), Log(GDP), Log(INT), Log(OIL), Log(INFL), Log (CONI), Log(FX)}]$$

In a linear expression where more than two variables are deployed, multicollinearity between variables may not be ruled out. To explain the effects of multicollinearity normally associated with multi-variables in cross-sectional regression analysis, multicollinearity test should be conducted to explain the extent of correlation between the independent variables.

Several methods exist to establish correlation and autocorrelation between the dependent variables. The variance inflation factor method, $[\text{VIF}(\boldsymbol{\beta}_i)] = 1/1 - R_i^2$ is preferred for ease of adaption and interpretation. In the alternative and for further confirmation of results of VIF method, the tolerance level method, $(1 - R_i^2) < 0.1$ is equally preferred for the same reasons. Where $R_i^2$ is the coefficient of determination derived from the cross-sectional regression analysis of each of independent variables. The multicollinearity would be considered strong if $\text{VIF}(\boldsymbol{\beta}_i) \geq 10$ (Kennedy, 2003)

## 4.0 CONCLUSION

Studies that empirically tested the impact of information asymmetry on equity pricing in emerging and developing economies, where market efficiency are mostly in the semi-strong and weak forms are very few. The shortage of such studies could not be divorced from lack of testable models to accommodate the peculiarity of market data in such informational inefficient markets. Also, is of importance to note that direct proxies of information asymmetry produce verifiable and less subjective outcomes than proxies derived from data manipulation, therefore identifying and selecting the firm and market-specific proxies require the understanding of the firm and market dynamics that impact significantly on equity pricing. The models derived can be tested in emerging economies that most studies examining the impact of information asymmetry on equity pricing have

neglected for reasons not various reasons including inability to assess testable models. The study has contributed to existing literatures in providing a platform for measuring the effect of information asymmetry on equity prices both in the primary and secondary markets of emerging economies.

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