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Interaction impact of cash flow volatility and fixed assets on debt maturity structure in MENA and African countries

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ABSTRACT

The empirical literature on the association of cash flow volatility and debt maturity structure is limited and inconclusive. This article investigates the impact of cash flow volatility on debt maturity structure, and the interaction effect of cash flow volatility and fixed assets on debt maturity structure. This article applies the two-step system generalized method of moments (GMM) method and uses 1672 non-financial public listed firms for a 10-year period starting from 2011 to 2020. The findings indicate a significant negative association between cash flow volatility and debt maturity structure of firms in Middle East and North Africa (MENA) and African countries. Moreover, the interaction of cash flow volatility and fixed assets is significantly and negatively related to debt maturity structure in MENA and African countries. These findings suggest the need for firm-managers to effectively manage the cash flow risk and consider collateral benefits of fixed assets when choosing the debt maturity structure.

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1. Introduction

Cash flow volatility refers to uncertainty in the level of cash outflows and inflows, which makes it difficult to forecast the future financial behavior of firms. The unexpected volatility of a firm's cash flows generally increases financial distress and default risk, as it weakens its ability to pay back its obligations (Custódio et al., 2012). Healthy cash flow promotes corporate stability and helps avoid debt rescheduling and investment disruption (Firmansyah & Novianti, 2020). Generally, volatility in cash flows is caused by factors beyond firms' control.

Debt maturity refers to the time at which a debt principal matures. In other words, it is the date on which the debt contract ends between the borrower and borrowing firm. The structure of debt maturity is a significant component of firms' financial decision-making because it defines debt cost and the timing of cash outflows. Fixed assets refer to the tangible assets held by firms to be used in the long term to generate revenue. It is considered a significant factor in association with debt financing because it is used as collateral assets by creditors, which affects the cost of debt and the financing capacity of firms (Custódio et al., 2012). Higher fixed assets reduce financial constraints, including agency and default costs, which allows for a higher capacity to have a longer debt maturity structure (Nguyen, 2022). Cash flow volatility and fixed asset levels within firms tend to affect their financing decisions, including their debt maturity structure.

The rich theoretical literature on cash flow volatility and financing choice, such as debt maturity structure, emphasizes different considerations, such as cash flow sensitivity, financing hierarchy, and agency cost (e.g., Fazzari et al., 1988; Myers, 1984). Pecking order theory proposes that firms generally follow a

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financing hierarchy. This finding suggests that managers prefer to fund their investments internally using retained earnings. However, when internal funds are depleted, managers tend to use debt over equity as a cheaper source of external funding (Myers & Majluf, 1984). The cash flow sensitivity theory of Fazzari et al. (1988) agrees with Myers' (1984) financing hierarchy. Likewise, Fazzari et al. (1988) argue that higher retained earnings expose firms to higher cash flow sensitivity and volatility at the liquidity level. Therefore, cash flow volatility represents a financial constraint that impacts the financing choice of firms, including their debt maturity structure. To control and minimize the agency cost and underinvestment problem, Myers (1977) noted that firms can match their asset and debt maturities.

There is a distinction in financial characteristics between developed and developing markets. Compared to firms in developed markets, firms in the MENA and African markets have significant differences in terms of financial behavior and structure (Vengesai & Kwenda, 2018). Developing countries have undeveloped capital markets (Thakur et al., 2023). There are differences in financing decisions in developing countries such as Africa due to cultural, regulatory, and institutional factors (Boateng et al., 2022). Prior empirical studies focused on developed markets and tended to exclude developing markets, such as MENA and African countries (Awartani et al., 2016; Boateng et al., 2022; Etudaiye-Muhtar et al., 2017).

Despite their significance in the global marker, MENA and African countries are experiencing many economic challenges. MENA and African markets are becoming increasingly significant components of the global economy (Shaheen et al., 2021). However, developing markets such as the MENA and African markets experience many economic problems that affect corporate debt and deteriorate market growth opportunities (Allen et al., 2011). Such economic problems include market illiquidity, banking system domination in capital markets, and inefficient equity markets (*e.g.*, Allen et al., 2011; Awartani et al., 2016). Moreover, the MENA markets experience the shortest debt maturity structure relative to global markets (Awartani et al., 2016). Information asymmetry, which is a common problem in inefficient financial markets, is a common problem in MENA and African markets that affects cash flow management and debt maturity structures (Matemilola et al., 2014).

This article contributes to the growing literature on volatile cash flows and debt maturity structures. Adachi-Sato and Vithessonthi (2019) note that firms with volatile cash flow have been growing in recent years. Denis and McKeon (2016) posit that the growing problem of cash flow volatility can be explained by the decline in firms' fixed asset investment. Few studies (e.g., Matemilola et al., 2014; Vengesai & Kwenda, 2018) have investigated the link between cash flow and corporate debt ratios in in the MENA and African markets. Unlike previous studies, this study makes contributions to theory and practice. Firstly, this article contributes the growing debt maturity literature focusing on how the interaction of cash flow volatility and fixed assets impacts debt maturity structure in developing markets, such as MENA and African countries. It is important to interact cash flow volatility and fixed assets because the collateral benefit of fixed assets may lower cash flow risk of firms and improve their debt maturity structure. Secondly, this article uses large sample of public listed firms from MENA and African countries which have received less attention in the debt maturity literature. Precisely, the article uses 1672 non-financial public listed firms from 2011 to 2020 to improve the robustness of the study findings and conclusion. The study finds negative association between cash flow volatility and debt maturity structure, and the interaction of cash flow volatility and fixed assets negatively impact debt maturity structure. Third, this article contributes to practice showing the need for firm-managers to effectively manage the cash flow risk and consider collateral benefits of fixed assets when deciding the debt maturity structure. Likewise, investors should consider firms' cash flow volatility risk when making decisions to invest money in firms to earn good returns.

The remainder of this article is structured as follows: Section 2 reviews the literature, Section 3 describes the data and methodology, Section 4 discusses the results, and Section 5 concludes the article.

2. Literature review

Previous research has investigated the impact on cash flow volatility on debt maturity structure concluding indecisive results. The following section reviews the theoretical and empirical literature related to the study. Moreover, this section develops the hypotheses to explain how cash flow volatility is related to

debt maturity structure and how the interaction of cash flow volatility and fixed assets is related to debt maturity structure.

2.1. Theoretical review of cash flow volatility and debt maturity structure

The literature explained debt maturity decisions using financial behavior theories of capital structure. As capital structure has the same financial decision-making behavior as debt maturity structure, capital structure theories can be used to explain debt maturity structure decisions (Etudaiye-Muhtar et al., 2017). Typically, capital structure literature is mostly based on trade-off theory, pecking order theory, and agency theory (Matemilola et al., 2018). Therefore, this study mainly utilizes Myers (1984) pecking order theory, Kraus and Litzenberger (1973) trade-off theory, and Fazzari et al. (1988) cash flow sensitivity theory to explain the link between cash flow volatility and debt maturity structure decisions.

Myers's (1984) pecking order theory states that an ideal capital structure does not exist within firms but suggests that firms typically follow a financing hierarchy. The financing hierarchy theory suggests that firms internally finance their investments using retained earnings when financing needs arise. When external financing needs arise, firms tend to use debt financing over equity as a less costly financing option (Myers, 1984). Equity financing is considered the costliest financing option because of the information asymmetry and adverse selection problems. Fazzari et al. (1988) support the financing hierarchy proposed by Myers (1984) pecking order theory.

Kraus and Litzenberger (1973) trade-off theory considers the balancing of tax-shield benefits of using debt and increasing financial distress, such as bankruptcy costs produced by using more debt. Kraus and Litzenberger (1973) introduced bankruptcy cost as the major concern for increasing debt, which refers to the probability of cash flows being insufficient. The trade-off theory suggests that firm value is maximized by using debt financing over equity, as it provides tax shield benefits (Boateng et al., 2022).

The cash flow sensitivity theory of Fazzari et al. (1988) posits that the costs of internal and external financing are similar, which is consistent with the pecking order theory analogy. However, the information asymmetry problem and agency costs increase the costs of external finance. The theory posits that firms that highly retain their earnings have more cash flow sensitivity and more volatile liquidity positions. Fazzari et al. (1988) argue that cash flow sensitivity is a major financial constraint of external funds, which indicates that cash flow volatility is significantly linked to financing decisions, such as debt maturity structure.

2.2. Empirical review of cash flow volatility and debt maturity structure

Although the theoretical literature on cash flow volatility and debt maturity structure is rich, the empirical literature is considered indecisive (Memon et al., 2018). Cash flow stability projects appropriate financial management within firms, and the literature confirms that investors prefer firms with lower cash flow volatility (e.g., Firmansyah & Novianti, 2020). Increased cash flow volatility depresses firms' investments, leads to budget disruption, and affects the debt repayment capacity of firms (Shaheen et al., 2021). A high level of cash flow volatility in African markets discourages investments and increases financial distress (Vengesai & Kwenda, 2018).

The empirical literature on financing choice disregards the debt maturity structure and focuses on capital structure (Etudaiye-Muhtar et al., 2017). It is important for firms to align their cash inflows with debt repayment timings to avoid the cash flow mismatch problem. A long-term debt maturity structure offers more financial flexibility, lower payments, and higher default risk (Custódio et al., 2012). A shorter debt maturity structure requires frequent renegotiations, which increase financing and borrowing costs. The utilization of longer debt maturity structures by firms declines over time (Custódio et al., 2012). This decline can be justified by increasing asymmetric information problems, factors related to the supply of credit, lower fixed asset levels, and many other factors. The problem of mismatching debt and asset maturity structures is common, and firms with volatile performance seem to be a growing problem (Adachi-Sato & Vithessonthi, 2019).

2.3. Direct effect of cash flow volatility on debt maturity structure

Cash flow volatility significantly impacts the debt maturity structure of firms (Shaheen et al., 2021). Mainstream empirical studies suggest that cash flow volatility is inversely associated with debt maturity structure (e.g., Custódio et al., 2012; Keefe & Yaghoubi, 2016; Memon et al., 2018; Shaheen et al., 2021). Cash flow volatility typically increases financial constraints and financial risks within firms, which limits their capacity to use debt with longer maturity terms. Therefore, firms with higher cash flow volatility tend to use shorter debt maturity to reduce their financial constraints (Memon et al., 2018). Moreover, cash flow volatility affects the direction of debt repayments. Custódio et al. (2012) stated that these repayments are affected by the debt maturity structure and the rate of return on a firm's investment. Therefore, investment returns with shorter maturity are funded by a shorter debt maturity structure and vice versa. This finding suggests that increased cash flow volatility and lower liquidity levels lead to the use of a shorter maturity structure, which is consistent with Custódio et al. (2012). Therefore, the proposed fundamental hypothesis is as follows:

H_1: Cash flow volatility is negatively related to long-term debt maturity structure of firms in MENA and African countries.

2.4. Interaction effect of cash flow volatility and fixed assets on debt maturity structure

When firms experience financial distress, such as cash flow instability, fixed assets can act as collateral assets to minimize credit risk, which increases their capacity to raise debt with longer maturities. Default risk, which is associated with the cash flow volatility problem, is negatively associated with the debt maturity structure (Awartani et al., 2016; Custódio et al., 2012). Creditors examine a firm's fixed assets as a determinant of credit risk (Custódio et al., 2012) and find that higher levels of fixed assets could allow firms to obtain debt with longer maturity terms. As a result, fixed assets can mitigate the impact of cash flow volatility on firms' debt maturity structure. Therefore, Hypothesis 2 is proposed as follows.

H_2: The interaction of cash flow volatility and fixed assets affects long-term debt maturity structure of firms in MENA and African countries.

2.5. Firm-specific control variables

The literature on cash flow volatility and debt maturity structure discusses numerous firm-specific factors expected to be highly associated. Most of the debt volatility within firms can be explained using firm-specific factors (Jõeveer, 2013). However, the control variables associated with debt vary in terms of reliability, and many factors discussed in the literature are considered unreliable (Frank & Goyal, 2009). The effect of different control variables on the association between cash flow volatility and debt maturity structure varies in significance, degree, and nature of impact according to different factors. The huge change in debt nature over the years includes the decreasing importance of the profitability factor effect, since capital markets are financing growing firms irrespective of their profitability (Frank & Goyal, 2009). Therefore, the firm-specific control variables considered are firm size, non-debt tax shields, investment opportunities, profitability, and leverage.

2.5.1. Firm size

Firm size is one of the most significant and commonly used factors associated with cash flow volatility and financing choices. The major characteristics of larger firms include stable cash flows and debt structures that consist of high debt levels and longer debt maturity structures. This is justified by the fact that larger firms typically hold higher fixed asset levels, debt capacity, and more diversified investments with higher growth opportunities. Larger firms with diversified investments typically have a low default risk (Frank & Goyal, 2009). Larger firms are expected to have fewer agency and information asymmetry problems and higher fixed assets, which facilitate borrowing with longer maturity terms (Nguyen, 2022). In African markets, firm size is positively correlated with performance (Musa et al., 2021). Vengesai and

Kwenda (2018) argue that smaller firms face more financial constraints, whereas Fazzari et al. (1988) posit that financially constrained firms experience increased volatility in cash flows.

Even though most of the literature expects a positive association between firm size and debt maturity, such as Kraus and Litzenberger (1973) trade-off theory, pecking order theory argues that larger firms use lower debt levels. Firm size is predicted to have a higher capital and debt maturity structure (Awartani et al., 2016; Frank & Goyal, 2009; Harris & Roark, 2019; Öztekin & Flannery, 2012). This study follows Harris and Roark (2019), Nguyen (2022), and Frank and Goyal (2009) by using the logarithm of total assets as a measure of firm size.

2.5.2. Non-debt tax shield benefits

Some investments can generate non-debt tax shield benefits that are unrelated to the use of debt, including certain items such as tax credit and depreciation, and other items that can be used to lower tax payments (DeAngelo & Masulis, 1980). Öztekin and Flannery (2012) stated that the non-debt tax shield is free of debt-related costs but can be a substitute for tax shields. The literature establishes a significant association between non-debt tax shield benefits and debt choices (Boateng et al., 2022). Higher non-debt tax shields and the use of debt within firms are negatively associated (DeAngelo & Masulis, 1980; Guney et al., 2011). Memon et al. (2018) consistently suggested an inverse relationship between non-debt tax shields with volatile cash flows and the use of debt. This study follows Guney et al. (2011) and Memon et al. (2018) by using the depreciation to total assets ratio as a measure of the non-debt tax shield.

2.5.3. Investment growth opportunities

Generally, investment growth opportunities require higher cash needs, which forces firms to use more external sources of funds due to the depletion of internal funds. The pecking order theory analogy argues that firms with increased investment growth opportunities tend to use more debt (Myers & Majluf, 1984). Öztekin and Flannery (2012) and Guney et al. (2011) also posit a positive relationship between investment growth opportunities and debt use. Frank and Goyal (2009) state that higher investment growth opportunities tend to increase financial distress and agency costs while lowering cash flow problems, consistent with Awartani et al. (2016), suggesting that investment growth opportunities can lower the debt maturity structure. This study follows Jõeveer (2013) and Harris and Roark (2019) by using the market value of assets to total book value of assets ratio as a measure of investment growth opportunities.

2.5.4. Leverage

High leverage exposes firms to different financial risks such as default risk. Firms with higher level of leverage experience increased liquidity risk and therefore tend to use debt with longer maturity terms to lower such liquidity risk (Custódio et al., 2012). The pecking order theory argue that firms exposed to higher cash flow volatility and financing need tend to be more levered. Harris and Roark identified a positive effect of cash flow volatility and leverage. Conversely, Keefe and Yaghoubi (2016) and Memon et al. (2018) find a negative association between cash flow volatility and leverage. This study follows Denis and McKeon (2016) by using the total liabilities to total assets ratio as a measure of leverage.

2.5.5. Profitability

Firms with higher profitability have higher capacity of exploiting debt tax shield benefits therefore should have higher debt with longer linger maturities. Firms with higher profitability tend to experience lower financial distress and have higher benefits of debt tax shield (Frank & Goyal, 2009). The tradeoff theory suggest that profitable firms have longer lower maturity structure while the pecking order theory argues that more profitable firms tend to have debt with longer terms. This study follows Jõeveer (2013) by using the earnings before interest and tax to total assets ratio as a measure of profitability.

2.6. Market-specific control variables description

Market-specific factors are typically uncontrollable by firms and have a significant effect on firms' financial decisions and performance. Market-specific factors can increase cash flow volatility persistence. Firms' financing decisions are directly and indirectly affected by macroeconomic factors, changing economic characteristics, market nature and distinctive strategies, and many other factors (Li & Islam, 2019). Macroeconomic factors are highly sensitive to volatile cash flows and financing choice associations (Shaheen et al., 2021). Therefore, the market-specific control variables considered are stock market growth, market liquidity, interest rates, and economic growth rates.

2.6.1. Stock market growth

As a main part of the capital market, growth in the stock market indicates better access to equity funds to pursue growth investment opportunities. Myers and Majluf (1984) argue that as cash flow volatility becomes more persistent and cash needs arise, firms consider more equity funds as the need for external financing exists when the stock market is well-developed. Jõeveer (2013) argued that markets that have experienced a recent transition to become more liberal are predicted to experience more information asymmetry, which is considered a financing constraint in the stock market, such as the MENA and African markets. This study follows Al Samman and Jamil (2018), using the market capitalization to GDP ratio as a measure of stock market growth.

2.6.2. Market liquidity

Liquidity and improved access to funds are significantly associated with financing decisions and shorter debt maturity structures within firms. Nkoa (2018) stated that a country's financial system performance is a significant factor in economic growth, while Chu Khanh and Chu (2019) confirmed that liquid markets have a vital impact on economic growth. Increased capital market liquidity implies a better level of access to credit by firms and increased financing capacity of domestic firms. Allen et al. (2011) concludes that the market literature generally employs domestic credit to the private sector to capture the market liquidity. Domestic credit to the private sector refers to financial resources, such as loans, trade credit, and other credit items that are directed to private firms. Al Samman and Jamil (2018) find that domestic credit to the private sector is associated with short and long-term economic growth in the stock market. This study follows Al Samman and Jamil (2018) and Nkoa (2018), who use the credit to the private sector to GDP ratio as a measure of market liquidity.

2.6.3. Interest rate

Fundamentally, the interest rate is highly associated with cash flow volatility and financing decisions, as it represents the cost of borrowing debt. Nkoa (2018) stated that interest rates significantly affect the cost of capital and financial liberalization (less control on capital movements). Typically, a lower interest rate in the long run affects debt maturity structure decisions by making long-term debt more attractive. Therefore, interest rate variations change firms' debt maturity structure decisions (Shaheen et al., 2021). As higher interest rates increase borrowing costs and discourage borrowing, interest rates are inversely associated with the debt maturity structure. This study follows the definition of interest rate by using the annual real interest rate adjusted to inflation as a measure of the interest rate.

2.6.4. Economy growth

Economic growth, as denoted by the GDP growth rate in the literature, is associated with increased investment growth opportunities, and therefore, increased capital requirements and cash needs by firms. Economic growth is the most significant factor in cash flow management and financing choices (Shaheen et al., 2021). The pecking order theory suggests that economic growth is positively associated with financing choices, such as debt maturity structure, as higher economic growth and investment opportunities require firms to have an increased need for external funds. Shaheen et al. (2021) argued that

increased economic growth tends to produce longer debt maturity structures. This study follows Etudaiye-Muhtar et al. (2017), Shaheen et al. (2021), and Keefe and Yaghoubi (2016) by using the GDP growth ratio as a measure of economic growth.

The theoretical literature that investigates the impact of cash flow volatility on debt maturity structure is based on two major theories which are the pecking order theory and the cash flow sensitivity theory. Despite the rich theoretical literature, the empirical literature on volatile cash flow and debt maturity is indecisive. This study investigates the impact of cash flow volatility on debt maturity; and the interaction effect of cash flow volatility and fixed assets on debt maturity structure and control for different market-specific factors (e.g., stock market growth, market liquidity, interest rates, economic growth rates) and firm-specific factors (e.g., non-debt tax shields, investment opportunities, profitability, and leverage).

3. Methodology

This section describes the measurement of variables, sample selection and data, and the model specification and estimation methods used to analyze the impact of cash flow volatility on debt maturity and the interaction effect of cash flow volatility and fixed assets on debt maturity structure using several panel data estimation methods. However, the primary estimation method is the two-step generalized method of moments (GMM).

3.1. Cash flow volatility and debt maturity structure description and measurement

Healthy cash flow management evades investment disruption, requires debt rescheduling, and promotes firm's stability (Firmansyah & Novianti, 2020). Increased persistence in cash flow volatility leads to increased periodic cash needs. As internal sources, such as retained earnings, are depleted, firms tend to favor debt funding when external funds are needed (Myers, 1984). Therefore, volatility in cash flows tends to change firms' financing behavior, including their debt maturity structure (Denis & McKeon, 2016). Cash flow volatility is used as a measure of a firm's risk, and there is no consensus in the literature regarding cash flow volatility measures in the literature (Keefe & Yaghoubi, 2016). This study follows Shaheen et al. (2021) and Denis & McKeon (2016) by using the standard deviation of earnings before interest, tax, depreciation, and amortization (EBITDA) as a measure of cash flow volatility.

Typically, firms schedule their expected cash inflow returns with debt repayment outflows to avoid mismatching. A shorter debt maturity structure leads to an increased risk of debt renegotiations, which has negative financial implications, as Custódio et al. (2012) argue. Such implications can increase financial constraints, the cost of capital, and cause probable fund shocks. Therefore, cash flow volatility is expected to amplify the financial implications of debt maturity structure management. The majority of the literature argues for a negative association between cash flow volatility and debt maturity structure (e.g., Custódio et al., 2012; Keefe & Yaghoubi, 2016; Memon et al., 2018; Shaheen et al., 2021). This study follows Awartani et al. (2016) and Adachi-Sato and Vithessonthi (2019), using the long-term debt to total debt ratio as a measure of the debt maturity.

3.2. Fixed assets description and measurement

Fixed assets significantly affect and modify the association between cash flow volatility and debt maturity structure. As cash flow volatility generates financial distress by increasing financial constraints and default risk, high fixed asset levels can mitigate firms' financial constraints and risks. In MENA and African markets, the existence of the information asymmetry problem makes the fixed assets level a significant factor. Higher fixed assets are used as collateral, stimulating the use of more debt and longer debt maturities generally (Li & Islam, 2019). Shaheen et al. (2021) state that a higher level of fixed assets increases a firm's borrowing capacity, as it increases its capacity to match the debt maturity structure to its assets' maturity. Myers (1984) associated the information asymmetry problem with external finance. Higher fixed assets can mitigate such asymmetric information costs and therefore lower the cost of borrowing. Öztekin and Flannery (2012) and Frank and Goyal (2009) argue that firms with higher levels of

fixed assets, which can be used as collateral, are expected to use more debt. Custódio et al. (2012), Nguyen (2022), and Awartani et al. (2016) posit that high levels of fixed assets drive firms to use a longer debt maturity structure, suggesting a positive association. Therefore, firms with increased fixed asset levels are expected to use more debt with a longer debt maturity structure. This study follows Adachi-Sato and Vithessonthi (2019), Shaheen et al. (2021), Jõeveer (2013), Nguyen (2022), and Denis and McKeon (2016), using the fixed assets to total assets ratio as a measure of fixed assets.

3.3. Sample selection and data

The data for this study are derived from exchange-listed firms in 20 MENA and African countries for the fiscal years between 2011 and 2020. Firms listed in the financial industry and firms with missing main variable data were excluded. Financial firms were excluded because of the distinction in their characteristics related to financing choices (Frank & Goyal, 2009). This study follows Awartani et al. (2016), who selected sample data that included Kingdom of Saudi Arabia, Kuwait, United Arab Emirates, Qatar, Bahrain, Oman, Egypt, Morocco, Tunisia, and Jordan to represent the MENA region, and Mauritius, South Africa, Ivory Coast, Tanzania, Ghana, Botswana, Nigeria, Kenya, Zimbabwe, and Zambia to represent African countries. The data were mainly obtained using Refinitiv DataStream, while market-specific data were obtained using World Data Indicators.

3.4. Method and model specification

Dynamic models play a vital role in the literature on cash flow volatility and financing choice. However, many recent studies argue that this is associated with the endogeneity problem in which explanatory variables and error terms are correlated, such as Vengesai and Kwenda (2018) and Matemilola et al. (2018). Roodman (2009) focused on the persistency problem, which refers to the lagged dependent variable where the effect of previous observations on a present observation exists. The ordinary least squares (OLS) model is not a proper estimation model because of the correlation between unobserved effects and the lagged dependent variable (Thakur et al., 2023). While the fixed effects model is more appropriate, the problem of biased estimators with a lagged dependent variable is still present (Thakur et al., 2023). This study applies several major panel data models and uses the two-step generalized method of moments (GMM) as the primary estimation model.

This article follows the most recent literature of cash flow volatility and debt choice such as Vengesai and Kwenda (2018), Musa et al. (2021), Nguyen (2022), Matemilola et al. (2018), Thakur et al. (2023), and Shaheen et al. (2021) by adopting the panel system two-step generalized method of moment GMM. The GMM model is recognized as one of the most competent estimation models, considering response variables and market effects (Öztekin & Flannery, 2012). The GMM model is considered more appropriate with persistency problem, consistent, and unbiased. Nkoa (2018), Nguyen (2022), and Thakur et al. (2023) stated that the GMM model is efficient and commonly used in recent finance literature, as it overcomes the problem of endogeneity bias.

To test Hypothesis 1, which states that cash flow volatility negatively impacts the debt maturity structure, the following specific model is employed:

$$\begin{aligned} LTTD_{ij,t} = {} & \lambda LTTD_{ij,t-1} + \beta_0 + \beta_1 SDEBITDAt_{ij,t} + \beta_2 LnTA_{ij,t} + \beta_3 DTA_{ij,t} + \beta_4 LD_{ij,t} + \beta_5 MB_{ij,t} \\ & + \beta_6 SMG_{ij,t} + \beta_7 ML_{ij,t} + \beta_8 IR_{ij,t} + \beta_9 GDPG_{ij,t} + \delta_i + \alpha_t + \mu_{it.} \end{aligned}$$

To test Hypothesis 2, which states that the interaction of cash flow volatility and fixed assets affects long-term debt maturity structure, the following model is employed:

$$\begin{aligned} LTTD_{ij,t} = {} & \lambda LTTD_{ij,t-1} + \beta_0 + \beta_1 SDEBITDAt_{ij,t} + \beta_2 FATA_{ij,t} + \beta_3 \left(SDEBITDA * FATA\right)_{ij,t} + + \beta_4 LnTA_{ij,t} \\ & + \beta_5 DTA_{ij,t} + \beta_6 LD_{ij,t} + \beta_7 MB_{ij,t} + \beta_8 SMG_{ij,t} + \beta_9 ML_{ij,t} + \beta_{10} IR_{ij,t} + \beta_{11} GDPG_{ij,t} + \delta_i + \alpha_t + \mu_{it.} \end{aligned}$$

4. Empirical results and discussion

This section presents descriptive statistics, correlation results, and the panel regression results of the impact of cash flow volatility on debt maturity structure and the results on the interaction effect of cash flow volatility and fixed assets on the debt maturity structure of firms in MENA and African countries.

4.1. Descriptive data

Table 1 shows the summary statistics of the associated variables for MENA and African non-financial firms from 2011 to 2020. The data start from 2011 and end in 2020 due to data availability and non-missing data for the major dependent and independent variables. The table reports the number of observations, mean, standard deviation, minimum values, and maximum values. Turning to firm-level control variable, the table shows that market capitalization 'SMG' has the highest mean at (71.501) followed by market liquidity 'ML' at (54.605). Based on the mean of long-term debt to total debt ratio 'LDTD' at (0.3655), it can be deduced that MENA and African firms tend to use below-average debt maturity structures.

The degree of dispersion as indicated by standard deviation shows that the standard deviation of growth opportunity 'MB' has the highest value at (341.24), followed by stock market capitalization 'SMG' at (88.834). It can be deduced that firms in the stock market have a higher growth opportunity variation in investment holdings when investment measures are scaled by the book value of total assets. On the contrary, the ratio of long-term debt to total debt standard deviation at (0.364) is the lowest, which indicates that the book value of total debt (used in debt maturity structure measure) is less volatile than the market value of debt. The disparity in SDEBITDA (i.e., cash flow volatility) at a minimum value of (0.000) and a maximum value of (145.76) indicates that firms in MENA and African markets face difficulties in stabilizing their cash flow. Additionally, FATA (i.e., fixed assets to total assets ratio) disparity ranges from a minimum of (0.1) to a maximum of (0.9994) which indicates the presence of large disparity in fixed assets in MENA and African firms.

4.2. Correlation results

Table 2 reports the correlations among the associated variables in the study which can be used to detect the existence of multicollinearity problem. Cash flow volatility and debt maturity structure has a negative correlation coefficient at (−0.011) while correlation coefficient between fixed assets and debt maturity structure is positive and insignificant at (0.0121) as presented in Table 2. Also, the variance inflation factor (VIF) results reported in Table 3 support the absent of multicollinearity problem.

Three of the firm-specific control variables are dropped because of its high correlations; non-debt tax shield correlation coefficient with fixed assets is 0.9946, leverage correlation coefficient with cash flow volatility is 0.9961, and profitability correlation coefficient with cash flow volatility is 0.9916.

Table 1. Summary of descriptive statistics for MENA & African markets (full sample).

Variable	Definition	Mean	SD	Min	Max
SDEBITDA	Standard deviation of earnings before interest, tax, depreciation, and amortization	0.3344	19.9969	0	145.76
LDTD	Long-term debt to total debt ratio	0.3655	0.3644	0	1
FATA	Fixed assets to total assets ratio	0.9502	39.9791	0.1	0.9994
LNTA	Natural logarithmic of total assets	7.7858	1.8999	0	11.1119
DTA	Depreciation to total assets ratio	0.0313	1.8013	0	0.330
MB	Market value of total assets to book value of total assets ratio	9.4706	341.24	0.01	3290.38
LEV	Total liabilities to total assets ratio	0.6975	18.763	0	1
PROFIT	Earnings before interest and tax to total assets ratio	30.6420	37.71	−24.428	39.50
SMG	Total market value of all publicly traded stock to GDP ratio	71.5018	88.834	0.02	345.3531
ML	Credit of private sector as a percentage of GDP	54.6051	40.081	0.1	138.857
IR	Annual real interest rate adjusted to inflation	2.6611	9.203	−79.803	40.8599
GDPG	Percentage change of annual real GDP	2.7127	3.7569	−14.894	19.675

Sources: Refinitiv DataStream and World Data Indicators.

Table 2. Correlation results.

	LDTD	SDEBITDA	FATA	LNTA	DTA	MB	LEV	PROFIT	IR	ML	SMG	GDPG
LDTA	1											
SDEBITDA	−0.011	1										
	0.253											
FATA	0.012	0.024	1									
	0.206	0.010										
LNTA	0.300	−0.033	−0.014	1								
	0.000	0.000	0.125									
DTA	0.013	0.020	0.994	−0.013	1							
	0.166	0.033	0.000	0.161								
MB	−0.018	0.486	0.193	−0.044	0.193	1						
	0.049	0.000	0.000	0.000	0.000							
LEV	−0.008	0.996	−0.0003	−0.026	−0.0002	0.882	1					
	0.380	0.000	0.975	0.005	0.983	0.000						
PROFIT	−0.009	0.991	0.003	−0.02	0.003	0.837	0.992	1				
	0.300	0.000	0.718	0.004	0.728	0.000	0.000					
IR	0.009	−0.003	0.002	0.016	0.002	0.004	0.004	0.003	1			
	0.303	0.738	0.827	0.089	0.828	0.656	0.652	0.740				
ML	0.084	0.010	−0.015	0.111	−0.012	0.023	0.011	0.009	0.121	1		
	0.000	0.274	0.114	0.000	0.203	0.014	0.250	0.325	0.000			
SMG	0.166	0.001	−0.009	0.167	−0.007	0.015	0.002	−0.001	0.071	0.580	1	
	0.000	0.880	0.341	0.000	0.407	0.097	0.815	0.842	0.000	0.000		
GDPG	−0.109	−0.045	0.020	−0.168	0.019	−0.045	−0.048	−0.044	0.070	−0.212	−0.332	1
	0.000	0.000	0.033	0.000	0.046	0.000	0.000	0.000	0.000	0.000	0.000	

Note. 'SDEBITIDA' is the standard deviation of EBITDA. 'DLTD' is the ratio of long-term debt to total debt. 'FATA' is the ratio of fixed assets to total assets. 'LNTA' is the natural logarithmic of total assets. 'DTA' is the ratio of depreciation to total assets. 'MB' is the ratio of market value of total assets to book value of total assets ratio. 'LEV' is the ratio of total liabilities to total assets. 'PROFIT' is the ratio of earnings before interest and tax to total assets. 'SMG' is the ratio of total market value of all publicly traded stock to GDP ratio. 'ML' is the ratio of credit of private sector as a percentage of GDP. 'IR' is the annual real interest rate adjusted to inflation. 'GDPG' is the percentage change of annual real GDP.

4.3. Regression results

4.3.1. Cash flow and debt maturity structure association (Hypothesis 1)

As presented in Table 3, the two-step GMM model establishes a causal effect between cash flow volatility and the debt maturity structure. The validity of the GMM model estimations is dependent on two post-estimation tests: first-order and second-order serial correlation of residual tests. The results show that the first-order serial correlation problem exists because of the correlation between the lagged dependent variable and the error term. Table 3 also shows that the Hansen/Sargan test is satisfactory because the p-value is insignificant.

In Table 3, cash flow volatility (i.e., standard deviation of EBITIDA) and debt maturity structure (*i.e.*, the long-term debt to total debt ratio) are negatively associated and statistically significant at the 1% level, with a coefficient of (−0.0002) and t-statistic of (−6.14), as suggested by the two-step system GMM model. In addition, cash flow volatility and debt maturity structure are insignificantly associated, as the random effects model and the fixed effects model suggest. Based on the two-step GMM, the major estimation model confirms a statistically significant negative association between cash flow volatility and debt maturity.

The overall evidence supports Hypothesis 1 and shows that as cash flow volatility increases, the debt maturity structure of firm decreases in MENA and African countries. Custódio et al. (2012) state that the negative association is caused by the fact that increased cash flow volatility impacts the direction of debt repayments. Such debt repayments are affected by many factors, including the debt maturity structure and the return rate of investments (Custódio et al., 2012). Therefore, firms meet their shorter investment return payment structure with a shorter debt maturity structure. Etudaiye-Muhtar et al. (2017) consistently stated that cash flow volatility causes a mismatch problem in investment returns and the timing of debt repayments. Therefore, the debt maturity structure must be matched with investment return payments or asset maturity to avoid a mismatch problem that discourages the existence of a longer debt maturity structure (Etudaiye-Muhtar et al., 2017). Keefe and Yaghoubi (2016) also report a significant association between cash flow volatility and debt maturity structure, as firms with higher cash flow volatility have a shorter debt maturity structure.

Table 3. Regression results of cash flow volatility effect on debt maturity structure (model 1).

	Pooled OLS	Random effects model	Fixed effects model	OLS with correction of Auto & Hetero	Two-step system GMM (without constant)
Variables	LDTD	LDTD	LDTD	LDTD	LDTD
L.LDTD (Lag of Long-term Debt Ratio)	Nil	Nil	Nil	Nil	0.6201***
					(133.54)
SDEBITDA (Cash Flow Volatility)	0.0077**	0.0004	0.0004	0.0007***	−0.0002***
	(2.06)	(1.44)	(1.22)	(2.98)	(−6.14)
FATA (Fixed Assets)	0.0002***	0.0001*	0.0000	0.0002***	−0.0007***
	(2.72)	(1.65)	(1.39)	(7.72)	(−39.42)
LNTA (Log of Total Assets)	0.0531***	0.0371***	0.0344***	0.0531	0.0181***
	(29.86)	(23.31)	(21.00)	(19.62)	(32.35)
MB (Market to Book Ratio)	−0.00005**	−0.0003*	−0.00003*	−0.00005	−0.00001***
	(−2.46)	(−1.98)	(−1.75)	(−3.16)	(−6.02)
IR (Interest Rate)	0.00006	0.00007	0.0001	0.00006	0.0005***
	(0.18)	(0.27)	(0.52)	(0.12)	(2.83)
ML (Market Liquidity)	−0.0002**	−0.0003***	−0.0004***	−0.0002	−0.0005***
	(−2.21)	(−2.69)	(−3.43)	(−1.24)	(−8.00)
SMG (Stock Market Growth)	0.0005***	0.0004***	0.0003***	0.0005	0.0004***
	(10.85)	(7.93)	(5.16)	(6.34)	(7.44)
GDPG (Economic Growth rate)	−0.0026***	−0.0056***	−0.0062***	−0.0026	−0.0008***
	(−2.83)	(−7.79)	(−8.51)	(−2.30)	(−2.13)
Constant	−0.0658***	0.0780***	0.1165***	−0.0658	
	(−4.31)	(4.64)	(6.89)	(−2.85)	
Observations (N*T)	10,890	10,890	10,890	10,890	9,900
R-squared	0.1060		0		
Number of firms	990	990	990	990	990
Number of Instruments	Nil	Nil	Nil	Nil	114
Breusch-Pagan LM test (Probability Value)		0.0000			
Hausman test (Probability Value)			0.0000		
Multicollinearity (VIF)			2.27		
Heteroscedasticity (Probability Value)			0.0000		
Serial Correlation (Probability Value)			0.0000		
Autocorrelation (AR 1) (Probability Value)	Nil	Nil	Nil	Nil	0.0000
Autocorrelation (AR 2) (Probability Value)	Nil	Nil	Nil	Nil	0.6721
Sargan/Hansen Test (Probability Value)	Nil	Nil	Nil	Nil	0.2301
Industry Dummy	Yes	Yes	Yes	Yes	Yes

Note. 'L.LDTD' is the lag of long-term debt to total debt ratio. 'SDEBITDA' is the standard deviation of earnings before interest, tax, depreciation, and amortization. 'FATA' is the fixed assets to total assets ratio. 'LNTA' is the natural logarithm of total assets. 'MB' is the market value of total assets to book value of total assets ratio. 'IR' is the annual real interest rate adjusted to inflation. 'ML' is the credit of private sector as a percentage of GDP. 'SMG' is the total market value of all publicly traded stock to GDP ratio. 'GDPG' is the percentage change of annual real GDP. Asterisks indicate significance at the 10% (*), 5% (**), and 1% (***) levels.

Turning to firm-specific variables, all panel data models confirm that the log of total assets (i.e., firm size) is positively related to the long-term debt-to-total debt ratio (i.e., debt maturity). Awartani et al. (2016) find that larger firms have lower information asymmetry problems and default costs and, therefore, have a higher capacity to use a longer debt maturity structure. Nguyen (2022) argued that smaller firms have high agency costs and information asymmetry problems that limit longer maturities' financing capacity, which establishes an inverse association between size and debt maturity structure. The two-step GMM result shows that the market-to-book ratio (i.e., growth opportunity) is negatively related to the debt maturity structure. Frank and Goyal (2009) argued that higher investment growth opportunities tend to increase financial distress and agency costs, which typically limit the capacity of a longer debt maturity structure. This is also consistent with Awartani et al. (2016), who suggest that investment growth opportunities can lower the debt maturity structure.

Turning to market-specific variables, interest rate is statically significant and inversely associated with the debt maturity structure. Typically, as the interest rate increases, firms are discouraged from using debts with longer maturities. Moreover, the major estimation model, the two-step GMM model, suggests a significant positive association between stock market growth and debt maturity structure. A well-developed stock market facilitates access to funds with longer maturity periods. This is consistent with Awartani et al. (2016), who reported a positive association between stock market growth and the

debt maturity structure. Market liquidity is significantly and negatively associated with debt maturity structure in the two-step GMM model. Well-developed and more liquid financial markets facilitate asset trade of assets (Awartani et al., 2016) to be converted into cash, and investors may be encouraged to invest more in equity than debt, which limits the use of longer debt maturities. The major estimation model shows a negative association between GDP growth and the debt maturity structure. In growing economic conditions, investors are encouraged to invest more in the stock market than in the debt market, thereby lowering their capacity for longer debt maturity. This is consistent with Etudaiye-Muhtar et al. (2017), who reported a negative effect of GDP growth on the debt maturity structure within firms.

4.3.2. Interaction effect of cash flow volatility and fixed assets on debt maturity structure (Hypothesis 2)

Volatile cash flow implies lower capacity to raise debt with longer term maturity. A higher cash flow volatility is associated with a shorter debt maturity structure (Custódio et al., 2012; Etudaiye-Muhtar et al., 2017; Keefe & Yaghoubi, 2016). A higher level of fixed assets is expected to increase a firm's ability to acquire a more mature debt structure. As the robustness check in Table 4 indicates, the estimated coefficient of fixed assets as an interacting factor in the association between cash flow volatility and debt maturity structure is negative and statistically significant at the 1% level, with a coefficient of (−0.0003) and t-statistics of (−23.15) in the major model of two-step GMM. Likewise, the OLS model also suggests that the interaction of fixed assets with cash flow volatility is significant at the 1% level and is negatively associated with the debt maturity structure (i.e., the long-term debt to total debt ratio). The interaction of fixed assets with cash flow volatility is significant at the 5% level and is negatively associated with the debt maturity structure using the random effects model. The fixed effects model suggests that the interaction of fixed assets with cash flow volatility is significant at the 10% level and is negatively associated with the debt maturity structure. As a result, all panel data models confirm that fixed assets are a significant interacting variable, as they have a negative interaction effect on the association between cash flow volatility (i.e., the standard deviation of EBITIDA) and debt maturity structure (i.e., the long-term debt to total debt ratio).

In the main model, which is the two-step system GMM model, the coefficient of the interaction effect of cash flow volatility and fixed assets remains significantly negative, indicating that increased cash flow volatility results in a shorter debt maturity structure, while fixed assets tend to reduce such associations. The reason for the significant negative interaction effect of cash flow volatility and fixed assets is that unpredicted cash flow volatility declines in firms with higher-quality fixed assets that can be used as collateral (Denis & McKeon, 2016). Denis and McKeon (2016) argue that a decline in fixed asset quality leads to a shift in the earnings pattern of a firm and its financing strategy. Such a shift within firms experiencing cash flow volatility creates more cash needs to meet their financial obligations, which eventually tends to limit and reduce the usage of longer debt maturity structures (Denis & McKeon, 2016). Conversely, Öztekin and Flannery (2012) and Frank and Goyal (2009) state that firms with higher fixed asset levels that can be used as collateral are expected to use more debt. Such collateral stimulates the use of more debt and a longer debt maturity structure (Li & Islam, 2019).

5. Conclusion

This study investigates the impact of cash flow volatility (i.e., the standard deviation of EBITIDA) on the debt maturity structure (i.e., the long-term debt to total debt ratio) and the interaction effect of cash flow volatility and fixed assets on debt maturity structure. The article applied different panel data models including OLS, random effect model, and fixed effect model while the major estimation model is the two-step system generalized method of moment. The findings reveal a significant inverse direct association between cash flow volatility and debt maturity structure in MENA and African firms. Moreover, all panel data models confirm that the interaction of cash flow volatility and fixed assets is negatively related to debt maturity structures of firms in MENA and African countries.

The results support the mainstream literature that increased cash flow volatility is inversely related to debt maturity structure. The results indicate that firms in MENA and African markets experience cash flow risk problems that limits their capacity to obtain debt with longer maturity. Moreover, the results

Table 4. Regression results of the interaction effect of cash flow volatility and fixed asset on debt maturity structure (model 2).

	Pooled OLS	Random effects model	Fixed effects model	OLS with correction of Auto & Hetero	Two-step system GMM (without constant)
Variables	LDTD	LDTD	LDTD	LDTD	LDTD
L.LDTD (Lag of Debt Ratio)	Nil	Nil	Nil	Nil	0.6198***
					(133.54)
SDEBITDA (Cash Flow Volatility)	0.0008**	0.0005	0.0004	0.0008***	−0.0002***
	(2.32)	(1.60)	(1.22)	(2.82)	(−6.21)
FATA (Fixed Assets)	0.0061***	0.0026**	0.00009	0.0061	0.0016***
	(4.39)	(2.45)	(1.39)	(2.25)	(17.29)
SDEBITDA*FATA	−0.0001***	−0.0005**	−0.0004*	−0.0001**	−0.0003***
	(−4.22)	(−2.35)	(−1.99)	(−2.15)	(−23.15)
LNTA (Log of Total Assets)	0.0527***	0.0370***	0.0344***	0.0527***	0.0181***
	(29.59)	(23.18)	(21.00)	(19.47)	(32.29)
MB (Market to Book Ratio)	−0.00006***	−0.00004**	−0.00003*	−0.00006***	−0.00001***
	(−2.69)	(−2.11)	(−1.75)	(−2.90)	(−5.99)
IR (Interest Rate)	0.00009	0.00008***	0.0001	0.00009	0.0005***
	(0.27)	(30.31)	(0.52)	(0.19)	(2.85)
ML (Market Liquidity)	−0.0002**	−0.0003***	−0.0004***	−0.0002	−0.0005***
	(−2.21)	(−2.68)	(−3.43)	(−1.24)	(−7.99)
SMG (Stock Market Growth)	0.0005***	0.0004***	0.0003***	0.0005***	0.0004***
	(10.89)	(7.95)	(5.16)	(6.37)	(7.41)
GDPG (Economic Growth rate)	−0.0026***	−0.0056**	−0.0063***	−0.0026	−0.0009**
	(−2.81)	(−7.77)	(−8.51)	(−2.27)	(−2.20)
Constant	−0.0654	0.0780***	0.1165***	−0.0654	
	(−4.28)	(4.64)	(6.89)	(2.84)	
Observations (N*T)	10,890	10,890	10,890	10,890	9,900
R-squared	0.1075				
Number of firms	990	990	990	990	990
Number of Instruments	Nil	Nil	Nil		115
Breusch-Pagan LM test (Probability Value)		0.0000			
Hausman test (Probability Value)			0.0000		
Multicollinearity (VIF)			2.27		
Heteroscedasticity (Probability Value)			0.0000		
Serial Correlation (Probability Value)			0.0000		
Autocorrelation (AR 1) (Probability Value)	Nil	Nil	Nil	Nil	0.0000
Autocorrelation (AR 2) (Probability Value)	Nil	Nil	Nil	Nil	0.6836
Sargan/Hansen Test (Probability Value)	Nil	Nil	Nil	Nil	0.3300
Industry Dummy	Yes	Yes	Yes	Yes	Yes

Note. 'L.LDTD' is the lag of long-term debt to total debt ratio. 'SDEBITDA' is the standard deviation of earnings before interest, tax, depreciation, and amortization. 'FATA' is the fixed assets to total assets ratio. 'LNTA' is the natural logarithm of total assets. 'MB' is the market value of total assets to book value of total assets ratio. 'IR' is the annual real interest rate adjusted to inflation. 'ML' is the credit of private sector as a percentage of GDP. 'SMG' is the total market value of all publicly traded stock to GDP ratio. 'GDPG' is the percentage change of annual real GDP. Asterisks indicate significance at the 10% (*), 5% (**), and 1% (***) levels.

indicate the existence of mismatch problems in MENA and African firms that result in the use of debt with shorter maturity terms.

This study has several policy implications. First, firm managers are informed that cash flow volatility discourages the use of debt with long-term maturity and adversely influences their funding needs when cash flow volatility affects their liquidity position. Second, investors should consider firms' cash flow volatility risk when making decisions to invest their money to earn superior returns. Policymakers should create an enabling environment that lowers firms' cash flow risk and promotes financial health and stability.

The study has limitations that bound its results to be generalized despite the valuable insight offered by this study for developing markets, such as MENA and African markets. The validity of the results is

limited to the sample period because it uses data from 2011 to 2020, owing to data availability limitations. Future studies should investigate the effect of cash flow volatility on the debt maturity structure by adopting a comparative analysis of other developing regions in Asia and North America.

Authors' contribution

The authors confirm contribution to the article as follows: study conception and design: Abdulrahman Naser, Bolaji Tunde Matemilola, and Bany-Ariffin A.N; data collection: Abdulrahman Naser; analysis and interpretation of results: Abdulrahman Naser, Bolaji Tunde Matemilola; draft manuscript preparation: Abdulrahman Naser, Bolaji Tunde Matemilola, and Bany-Ariffin A.N. All authors reviewed the results and approved the final version of the manuscript.

Disclosure statement

In accordance with Taylor & Francis policy, the authors certify that they have no affiliations or involvement in any organization or entity with any financial or non-financial interests and report that there are no competing interests to declare.

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Data availability statement

The data supporting the findings of this study are available from the corresponding author, Abdulrahman Naser, upon reasonable request.

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