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Article

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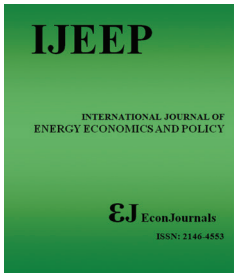

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Examining Capital Structure Determinants for ASEAN Energy Firms

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ABSTRACT

Increasing energy insufficiency is the main trench for the South East Asian countries. Though, there are rare empirical inquiries in relation to the energy firms' capital structure determinants for the firms functioning in the Association of Southeast Asian Nations (ASEAN). Therefore, this study is an attempt to discover the capital structure determinants of energy firms that are functioning in the six key economies of ASEAN region which are Malaysia, Indonesia, Thailand, Philippines, Cambodia and Vietnam. In this setting, a total of 144 energy firms' yearly Panel Data is involved over 14 years period from 2007 to 2020. The seven core determinants of capital structure, namely tangibility, return on equity, current ratio, non-debt tax shield, inflation and annual gross domestic product are inspected in relation to capital structure which is measured by ratio of debt to total asset. Employing both Panel Data models that are Static and dynamic models via using robust estimator i.e. Generalized Method of Moments (GMM), the results reveal that tangibility and profitability are the most prominent determinants among all others. Evidently, the two newly introduced capital structure determinants that are inflation and energy consumption for ASEAN region energy firms are also reported significant by dissimilar estimators. The significant character of tangibility, profitability and lagged dependent variable directly infers the relevance of Dynamic Trade-Off theory. The findings provide new ways for policymakers to construct parallel strategies which will not only help out to overcome the energy scarcity issues but also to enhance regional-level integration.

Keywords: Capital Structure, ASEAN, Static Model, GMM, Dynamic Model
JEL Classifications: G31, G32, P18

1. INTRODUCTION

Capital structure is the core studied area in finance. However, it is still measured as an unresolved puzzle for the firms. Technically, capital structure is the way in which any firm finances its assets by availing different funding choices such as equity, retained earnings and debts (Rajan and Zingales, 1995). Thus, firms always use these funding options to formulate an optimal capital structure. The optimal capital structure is the best mixture of debt, retained earnings and equity which uplifts a firm to its ultimate goal of profitability. Therefore, an optimal capital structure is designed in such a way that it lessens a firm's cost of capital and boosts its overall market value. From the past few decades, the fundamental capital structure theories and presently their recent dynamic forms have been helping firms to adopt suitable determinants of capital structure. Hence, the main capital structure theories which are Modigliani Miller (MM) theory, Pecking Order theory and Trade-Off theory are broadly used to elucidate the connotation of capital structure with its determinants (Abdul Hadi et al., 2018).

Notably, the investigation of capital structure determinants for the energy-generating firms in the Association of Southeast Asian Nations (ASEAN) is still an unsettled issue. Visibly, the earlier inquiries that were conducted in the ASEAN setting

are country-specific (Suyono and Amin, 2022; Mikurus, 2019; Hamzah and Marimuthu, 2018; Hussain et al., 2021), therefore, not carrying holistic and irrefutable findings for the entire region. Evidently, Southeast Asia is among one of those regions which is facing an energy shortage problem (Rahman and Velayutham, 2020). The ASEAN foundation was laid in August 1967 by five Southeast Asian nations named Malaysia, Indonesia, Singapore, Philippines and Thailand. Later, Brunei Darussalam, Vietnam, Laos, Cambodia, and Myanmar also joined the association. For ASEAN, the energy problem indicates a massive challenge on different fronts. For instance, foreseeing energy scarcity is the main challenge and problem for ASEAN incorporation itself because it may either move member nations toward robust regional integration and unity or it may also push all of them apart (Verbiest, 2014).

Also, Asian Development Bank projected that by 2035 except Brunei all ASEAN member countries would be very far from self-sufficiency in energy-generating resources (Verbiest, 2014). Similarly, International Energy Agency (IEA) specifies that by 2030 energy demand in the ASEAN nations may upsurge to 80% from now (Shadman et al., 2016; IEA, 2009). Likewise, rapid economic activities and growth in the region also move ASEAN toward energy scarcity issues that may reach to 80% to 250% and 10% to 100% by the end of 2040 (Umbach, 2021). Seeing this hiking issue, ASEAN has taken several initiatives such as in 1986 ASEAN members signed their initial agreement to enhance collaboration on energy-renewable projects (ASEAN, 1998). Subsequently, in the year 2015 ASEAN members agreed to enhance their share in several energy resources to 23% by 2025 (Vakulchuk et al., 2022; IRENA and ACE 2016; Bahrami et al., 2022). On the flip side, energy-producing firms in Southeast Asia face numerous issues and one of them is that low-cost and long-term leverage is not easily accessible to them. According to IEA (2022) only 3% sustainable debt is available for these firms which is less than half of the overall regional GDP share. Thus, in this scenario it is warranted to identify the region-specific debt equity determinants for energy firms which are functioning in the ASEAN region. Indeed, fitting adjustment of equity, debt and retained earnings to articulate an optimum capital structure moves a business toward its finest financial performance which is profitability (Derbali, 2022).

In view of the deliberated context, the main goal of the present investigation is to add numerous additions to the prevailing literature by discovering region-specific determinants of capital structure for the energy firms that are functioning in the ASEAN economies. Hence, adhering to the goal of this investigation, fundamental theories of capital structure which are MM theory, Trade-Off theory and Pecking Order theory are tested to clarify the theoretical association among the capital structure and its nominated determinants. This investigation relies on the Panel Data model of six ASEAN economies that are Malaysia, Indonesia, Thailand, Philippines, Cambodia and Vietnam over the time period of 14 years, starting from 2007 and ending in 2020. Furthermore, a Static Panel Data Modelling tactic is implemented to perform the inquiry. To the best of scholars' information, this investigation is the first-ever study that discovers region-specific determinants of capital structure for the energy-producing firms which are functioning in the ASEAN region.

The results clarify that sales, profitability, tangibility and gross domestic products are the core capital structure determinants that influence energy firms' capital structure maintaining choices in the region of ASEAN. The outcomes help out ASEAN nations, policymakers and regional functioning energy firms to formulate a matched policy that rapidly boosts integration to overcome foreseeing energy scarcities across the whole region. Undoubtedly, regional-level cooperation, integration and diversification of energy resources to overcome the existing energy scarcity can be resolved by applying parallel strategies.

After an in-depth overview, the rest of this study is organized as follows: Section 2 focuses on former literature on the issue; Section 3 elucidates the data and recognized methods for this inquiry; Section 4 elucidates the observed findings. Afterward, Section 5 explains in detail the findings of this investigation. Finally, Section 6 ends with the ending conclusion, implications and core limitations of the research.

2. LITERATURE REVIEW

From the several decades, the subject of capital structure has constantly been inspected by corporate finance researchers (for example, Roslan et al., 2022; Rehan and Abdul Hadi, 2019; Myers, 2001; Harris and Raviv, 1991; Abubakar and Abdullahi, 2022). The search for an accurate mix of debt and equity that formulate an optimal capital structure is still not found. Clearly, researchers are still not able to present an exact model of formulating debt and equity mix which is measured as an optimal capital structure. However, core traditional theories of capital structure which are named as Modigliani Miller theory, Pecking Order theory, Trade-off theory and freshly their dynamic models offer recommendations to adopt those factors which help businesses to create an appropriate mix of debt and equity. Modigliani and Miller (1958) presented proposition I that explains that in a capital market which is treated as a perfect market the firms' selection of debt and equity to construct capital structure has no influence on its whole market value. Afterward, proposition II elucidates that dividend payment has no influence on shareholders' income or share prices. Also, MM proposition II highlights the existence of debt risk for the business. Then, another theory of capital structure which is called as Trade-off theory proposes the idea that a firm can create a best mix of debt and equity for formulating a capital structure. Subsequently, Pecking Order theory which is also considered as a Trade-off theory competitor, explains that firstly the firms pick retained earnings to meet their capital structure needs then debt and as a last remedy they go for the option of equity finance. Newly, the dynamic models of these capital structure theories suggest an idea of adjustment speed. According to these theories, the capital structure of any business is dynamic and not static in nature. Therefore, in case of any divergence from its level which is optimal, it rapidly moves back to its former level (Khan et al., 2021; Rehan, Abdul Hadi and Hussain, 2019).

Subsequently, the key determinants of capital structure that have been nominated as significant for energy firms by above mentioned

theories are tangibility, profitability, size and taxation. For example, Berkman et al. (2016) explored debt equity determinants for 79 European energy firms for the period of 4 years which started from 2009 and ended at 2012. Interestingly, the outcomes stated that liquidity, profitability and tangibility are core significant capital structure determinants for those European firms which are functioning in the energy sector. They additionally explained that the Pecking Order theory is more relevant in defining capital structure practices of firms that are operating in the European context.

Likewise, Jaworski and Czerwonka (2021) examined capital structure determinants for the firms which are operating in the European energy sectors. This study adopted Multiple Regression model and 6122 firms from 25 European nations. The obtained outcomes of this study are consistent with the prior findings of Berkman et al. (2016). The findings suggested strong and significant positive relationship of capital structure with firms' size and asset tangibility. However, significant but negative association of firms' capital structure is detected with profitability and liquidity. Additionally, this study added new variables of capital structure for energy firms which are renewal energy share, consumption of energy and market share of the largest energy share firms. Moreover, this investigation also inspected some macroeconomic determinants which impacted on firms' capital structure related decision and described negative but strong significant influence of gross domestic products on European firms' capital structure. Evidently, the above discussed investigations of (Berkman et al., 2016; Jaworski and Czerwonka, 2021; Guedie et al., 2022) postulate that liquidity, tangibility, sales, profitability and gross domestic products are the core capital structure determinants of energy firms that are operated in the European region. In the same vein, several investigations have been done that explored capital structure determinants for the energy firms which are operating in Asia. For instance, Shrestha (2019) discovered capital structure determinants of the firms operating in Asian Economies.

Shrestha (2019) inspected capital structure determinants for power-generating firms of Asian economies. By using Multiple Regression methodology, this study investigated cross-country debt equity determinants. In order to perform the analysis a total of 22 firms' 5 years data is extracted from the core audited financial statements. The results postulate that debt and equity of Asian power generating firms are significantly impacted by size, interest rate, financial market development, and profitability. Notably, in this research, profitability of firms is measured by using key financial ratios that are return on equity (ROE) and return on assets (ROA). It is important to note that in several Asian countries' energy shortage is a core problem such as firms which are operating in SAARC nations. In SAARC region, Pakistan is facing energy shortage issues that have become trench for its entire economy (Khan et al., 2022). Therefore, several researchers (Ghani and Bukhari, 2010; Liaqat et al., 2017; Zhang et al., 2018) performed analysis to identify the capital structure determinants of energy firms which are operating in Pakistan. The outcomes of studies which are performed in the Pakistani context indicated that profitability, tangibility and size are the main determinants that formulate capital structure of the firms which are operating in Pakistan. Similarly, in India Chakrabarti and Chakrabarti (2019) and also Panicker (2013) investigated capital structure determinants for energy firms. The results confirmed that profitability, capacity of debt, liquidity, asset tangibility are the main capital structure determinants for Indian energy firms. Additionally, Chakrabarti and Chakrabarti (2019) specified that non-debt tax shield is also one of the main capital structure determinants for Indian based energy firms. Also, in Bangladesh, Uddin et al. (2022) specified that tangibility, liquidity, non-debt tax shield, size of the firm and age are the main capital structure determinants of the energy generating firms which are functioning in Bangladesh.

Visibly, in the ASEAN region the former studies focused only on exploring country-specific capital structure determinants for energy firms. In Malaysia, Foo et al. (2015) explored capital structure determinants of oil and gas firms and report profitability i.e. measured by ROE as a significant determinant of capital structure. Later, the similar findings were reported by Mikurus (2019) for Malaysian energy based listed firms. Mikurus (2019) concluded that ROE has significant impact on long term debt of energy firms. Recently, in Indonesian context, Suyono and Amin (2022) explored the effect of risk and capital structure of energy producing firms. By using 53 firms data over the period of 5 years from 2016 to 2020, the results indicated that profitability and liquidity are significant determinants of capital structure.

Remarkably, the above studies from dissimilar contexts and regions indicated that liquidity, tangibility, profitability, non-debt tax shield, size and age of the firm are the main determinants of capital structure for energy producing firms (for example, Jaworski and Czerwonka, 2021; Shrestha, 2019; Chakrabarti and Chakrabarti, 2019; Berkman et al., 2016; Panicker, 2013). Evidently, there are only rare studies which explored capital structure determinants of energy generating firms of the ASEAN region. However, there are only few country specific investigations (for example, Suyono and Amin, 2022; Mikurus, 2019; Foo et al., 2015; Harun et al., 2022) that explored capital structure determinants for energy firms which are operating in dissimilar countries of the region. Thus, as per authors' knowledge this study is the first effort to fill the gap and explore the capital structure determinants of the firms which are operating in the ASEAN region. Additionally, this study considers inflation as an important variable for energy firms that are situated in the region. Visibly, inflation is at its peak in the whole ASEAN region after the covid-19 pandemic. For instance, only in Malaysia poverty rate moved from 5.6% in 2019 to 8.4% in 2020 (Department of Statistics Malaysia, 2020). Also, the overall poverty ratio in ASEAN is reported at 15% in 2020. Technically, increasing inflation means high borrowing cost, thus, less use of debt (Jaworski and Czerwonka, 2021). Besides, following the practices of Jaworski and Czerwonka (2021) this investigation also adopts energy consumption as an independent variable. Fundamentally, overall energy consumption explains a higher use of energy that decreases debt of firms and increases energy firms' profitability.

Considering the situation, this study adopts inflation as a main determinant that influences capital structure formulating practices

of ASEAN based energy firms. Remarkably, the earlier inquiries elucidate variation in nominated capital structure determinants of tangibility, inflation, liquidity, profitability, non-debt tax shield and sales. Therefore, it is assumed that capital structure of ASEAN energy firms are also in dynamic nature. Thus, the associated hypotheses of this investigation are:

- H_1: There is a positive significant association between capital structure and tangibility
- H_2: There is a negative significant association between capital structure and liquidity
- H_3: There is a negative significant association between capital structure and profitability
- H_4: There is a positive significant association between capital structure and GDP
- H_5: There is a positive significant association between capital structure and size
- H_6: There is a negative significant association between capital structure and NDTS
- H_7: There is a positive significant association between capital structure and inflation
- H_8: There is a positive significant association between capital structure and energy consumption
- H_9: There is a dynamic association among capital structure and nominated determinants.

3. DATA AND METHODOLOGY

This investigation includes a total of 144 energy sector firms from six main ASEAN economies that are Indonesia, Malaysia, Thailand, Cambodia, Philippines and Vietnam. For analysis purposes, the 14 years of annual secondary data over the time period starting from 2007 to 2020 of oil, gas, electricity, and other firms that are involved in energy generating process are extracted from the Thomson Reuters Eikon database. Nevertheless, because of data inaccessibility, this investigation eliminates the other four republics of the ASEAN. Furthermore, in order to check the statistical association, the data is mined for the below-given nominated determinants of Table 1.

Table 1 above explains the capital structure and its nominated determinants for this study. Visibly, capital structure is measured by Debt Equity ratio i.e. DR. Similarly, TANG specifies energy firms' asset tangibility, PROF is profitability of energy firms which is measured by using return on equity ratio. Subsequently, liquidity of firms that is indicated by LIQ is analyzed by using current ratio. Size indicates total yearly sales of the firms. NDTS is used to measure the effect of non-debt tax shield on energy firms' capital structure. Additionally, this investigation introduced inflation and energy consumption as capital structure determinants for ASEAN region energy firms. Principally, INF i.e. inflation is selected because of recent circumstances after covid-19 pandemic and continuous effects of last financial crisis in which inflation dramatically upsurged in the whole ASEAN region (Jaworski and Czerwonka, 2021, Department of Statistics Malaysia, 2020; Rahayu et al., 2022; Suhendra et al., 2022; Mubeen et al., 2022; Kasana et al., 2022). Likewise, energy consumption i.e. ENG_CON is introduced for ASEAN energy firms because it is measured as a key capital structure determinant of energy firms globally in other large economic regions (Jaworski and Czerwonka, 2021). Technically, energy consumption increases profit margin and decrease overall debt of energy firms.

Systematically, the Panel Data Analysis is executed to explore the robust association among the selected variables. Notably, Panel Data is a grouping of cross-sectional with time series data sets that is also named longitudinal data and pooled data (Gujarati, 2003; Abdul Hadi et al., 2018). Technically, the constructed Panel Data models are analyzed by applying core Panel Data tactics which are Static and also Dynamic Panel Data methods. Importantly, the Static Panel Data investigation includes both Random and Fixed Effects models. However, the Dynamic Panel Data model is analyzed by employing a vigorous estimator which is named as Generalized Method of Moments (GMM) to inspect the dynamic associations among the nominated determinants.

Systematically, the model of Dynamic Panel Data model is employed when the dependent variable depends on its former realizations (Flannery and Rangan, 2006). Remarkably, numerous researchers specified that the firms' capital structure is not a static property and possesses dynamic attributes (Rehan and Abdul Hadi, 2019; Hovakimian et al., 2001; Maheswaranathan and Bhavan, 2022; Liu, 2022; Muduli et al., 2022; Aidoo et al., 2022). Therefore, this investigation also selects different GMM estimator to explore the dynamic linkages among the designated

Table 1: Measurements of the Selected Variables

S#	Symbol	Variables	Measurement	References
01	DR	Debt to total assets	Total debt/total assets	Sarioglu et al. (2013), Syed (2012), Demirhan (2009)
02	TANG	Tangibility of firms' asset	Tangible fixed assets/total assets	Berkman et al. (2016), Bas et al. (2009), Sayilgan and Uysal (2011)
03	PROF	Return on equity	Net income/equity	Sarioglu et al. (2013), Kabakci (2007), Demirhan (2009)
04	LIQ	Current ratio	Current assets/current liabilities	Mahvish and Qaisar (2012), Ata and Ag (2010),
05	SIZE	Sales	Ln (Sales)	Jaworski and Czerwonka (2021), Nguyen (2020)
06	NDTS	Non-debt tax shield	Depreciation/total assets	Jaworski and Czerwonka (2021), Cortez and Susanto (2012), Gill et al. (2009)
07	INF	Inflation	Inflation, consumer prices (annual %)/100	Jaworski and Czerwonka (2021), Bas et al. (2009)
08	ENG_CON	Energy consumption per 1000 people	Final energy consumption x 1000/population	Jaworski and Czerwonka (2021).
09	GDP	Annual GDP growth	GDP growth (annual %)/100	Jaworski and Czerwonka (2021), Bas et al. (2009)

In the above-given Table 1, DR indicates the dependent variable. TANG: Tangibility, PROF: Profitability, LIQ: Liquidity, SIZE: Sales of the energy firms, NDTS: Non-debt tax shield, GDP: Gross domestic products

determinants. Procedurally, the difference GMM converts the variable of interest i.e. dependent variable into another independent variable by using its initial difference that is also persistent over time. Additionally, the model of Dynamic Panel Data is also used to discover the adjustment speed for the selected firms. Technically, the speed of adjustment (SOA) idea is explained by the model of Dynamic Trade-off theory that clarifies about the concept of targeted capital structure. According to SOA concept firms generally diverge from their optimal capital structure level (Ghose, 2017; Supra et al., 2016), though, in the presence of SOA, they move back speedily toward its target i.e. its optimal level of capital structure. Analytically, the Panel Data Model is explained as follows:

$$PDM = y_{it} = \alpha_i + \gamma_t + \beta x_{it} + \varepsilon_{it} \quad (1)$$

Here, PDM specifies Panel Data model, i designates individuals (*i=1, 2,3…., N*), t is measured as a selected time period *(t=1,2, 3,…..,T)* for inquiry, y_{it} explains the nominated dependent variable, α_i is used for explaining cross-sectional properties and γ_t clarified time series effects. Also, x_{it} is accepted to designate an independent variable and ϵ_{it} indicates an error term. Analytically, this investigation has nominated the Panel Data both i.e. Static and Dynamic models that were prior adopted by Zandi et al., 2022, Hernawati et al. 2021, Rehan and Abdul Hadi, 2019 and Chakrabarti and Chakrabarti, 2019. The assessment models of this investigation are expressed as follows:

1. POLS Model

$$DR_{it} = \beta_0 + \beta_1 PROF + \beta_2 SIZE_{it} + \beta_3 LIQ_{it} + \beta_4 GDP_{it} + \beta_5 NDTS_{it} + \beta_6 TANG_{it} + \beta_7 INF_{it} + \beta_8 ENG\_CON_{it} + \varepsilon_{it} \quad (2)$$

2. Panel Data Fixed Effects Model

$$DR_{it} = \beta_0 + \beta_1 PROF + \beta_2 SIZE_{it} + \beta_3 LIQ_{it} + \beta_4 GDP_{it} + \beta_5 NDTS_{it} + \beta_6 TANG_{it} + \beta_7 INF_{it} + \beta_8 ENG\_CON_{it} + \mu_{it} \quad (3)$$

3. Panel Data Random Effects Model (RE)

$$DR_{it} = \beta_0 + \beta_1 PROF + \beta_2 SIZE_{it} + \beta_3 LIQ_{it} + \beta_4 GDP_{it} + \beta_5 NDTS_{it} + \beta_6 TANG_{it} + \beta_7 INF_{it} + + \beta_8 ENG\_CON_{it} + \varepsilon_{it} + \mu_{it} \quad (4)$$

4. Panel Data Dynamic Model

$$DR_{it} = \delta DR_{i,(t-1)} \beta_0 + \beta_1 PROF + \beta_2 SIZE_{it} + \beta_3 LIQ_{it} + \beta_4 GDP_{it} + \beta_5 NDTS_{it} + \beta_6 TANG_{it} + \beta_7 INF_{it} + \beta_8 ENG\_CON_{it} \varepsilon_{it} + \mu_{it} \quad (5)$$

Here, dependent variable i.e. debt ratio is specifies by DR. $\delta DR_{i,(t-1)}$ indicates dependent variable lagged value that is a function of error term ε_{it}. Moreover, PROF, TANG, SIZE, INF, NDTS, LIQ, GDP, NDTS mention selected independent variables which are also described in above given Table 1. Similarly, ε_{it} indicates an error term and μ_{it} is randomly differences of individual.

The Pool Ordinary Least Squares (POLS) is measured as a sample which is homogeneous (Chakrabarti and Chakrabarti, 2019). Hence, the Breusch Pagan Lagrange Multiplier test (BPLM) is used to find the effects of individuals. Also, the test of Hausman is applied to identify the Fixed Effects or Random Effects characteristics. Primarily, the test of BPLM used *m* statistics of Hausman's (1978) to adopt the proper hypothesis. Technically, the null hypothesis (H_0) of this test identifies that Pooled OLS model is more appropriate (H_0: Pooled OLS is accepted). However, if H_0 is not accepted then the Random Effects model is considered for analysis (H_1: Random Effects is accepted). Notably, if null hypothesis for the acceptance of Pooled OLS of BPLM is not accepted then the test of Hausman is selected to explore the presence of Fixed Effects. Thus, Hausman's test is performed to select a suitable Panel Data model between models of Fixed Effects and Random Effects (Breusch and Pagan, 1980). The Hausman's test econometric model is given as below:

$$H = (b_1 - b_0)(Var(b_0) - Var(b_1))(b_1 - b_0) \quad (6)$$

Additionally, this investigation also has executed diagnostic tests to measure the fitness of the models. The Pearson Correlation test is used to measure the statistical relationship among all the selected variables of this investigation (Abdul Hadi et al., 2021; Chakrabarti and Chakrabarti, 2019; Abdul Hadi et al, 2015; Tahsin, 2022; Yuang and Zhang, 2022; Abubakar and Abdullahi, 2022; Nwaobia et al., 2022). Remarkably, the test of Pearson Correlation explains that at which level significant relationship exists among the studied variables (Abdul Hadi et al., 2019; Benesty et al., 2009). Thus, the coefficient i.e. "r" of Pearson Correlation test explains the relationship degree level between all the selected variables. Analytically, the "r" figure of Pearson Coefficient lies between values of −1 to +1. Exactly, the value +1 specifies a perfect and positive association, however, −1 recognizes the exact negative and perfect association between all the selected variables. However, if the value of coefficient lies at "0," then, it identifies the nonexistence of any relationship among the selected variables (Zou et al., 2003). The Pearson's correlation formula is as given below:

$$r = \frac{n\left(\sum xy\right) - \left(\sum x\right)\left(\sum y\right)}{\sqrt{[n\sum x^2 - (\sum x)^2][\, n\sum y^2 - (\sum y)^2]}} \quad (7)$$

Here, the "r" designates Pearson's correlation, whereas, ∑xy explains the total sum of the x and y product, ∑x specifies the sum of product of x. Moreover, ∑y indicates the sum of the product of "y," n identifies number x and number y. The Pearson correlation hypothesis is described as:

H_0: P=0 There is no correlation among the studied variables.
H_1: P<>0 There is a correlation among the studied variables.

Technically, the value of Pearson Correlation "P" explains the level of significance of the studied variables. Hence, if value of "P" coefficient is not more than α (1%, 5% and 10%), then alternate hypothesis is accepted. In addition, the multicollinearity presence is checked by applying Variance Inflation Factor (VIF)

test. Remarkably, the issue of multicollinearity exists because of robust correlation between the selected independent variables. Thus, if value of VIF test exceeds the 10 (Hernawati et al., 2021; Akinwande et al., 2015; Gujarati and Porter, 2009; Hieu et al., 2021; Hronova and Hindls, 2022; Odat and Bsoul, 2022; Isyandi and Trihatmoko, 2022) then strong multicollinearity problem is present. Statistically, the equation of VIF test is presented below:

$$R^2Y \rightarrow Y_{it} = \alpha_0 + \beta_2 X_{2it} + \beta_3 X_{3it} + \beta_4 X_{4it} + \beta_5 X_{5it} + e_{it} \quad (8)$$

$$j = R_Y^2,\ R_{X1}^2,\ R_{X2,}^2\ R_{X3,}^2 R_{X4,}^2 R_{X5}^2 \quad (9)$$

$$Tolrance = 1 - R_j^2\ VIF = \frac{1}{Tolerance} \quad (10)$$

In addition, to get accuracy for the Generalized Method of Moments (GMM) estimation, the AR (m) test is performed which is also known as test for identifying autocorrelation and Sargan test to find the exogeneity problem. Fundamentally, an exogeneity identifies a diagnostic issue in which independent variable is not dependent on regression variable. Similarly, the test for checking Autocorrelation issue that is named as AR (m) diagnostic test is performed to find the variable dependency on their own previous values. An exogeneity refers to a state where independent variables are not correlated with the dependent variable. Likewise, the Autocorrelation AR (m) test is used to check the variables dependency on its past values. Precisely, GMM estimation decreases these both autocorrelation and exogeneity related diagnostic issues in the model (Arellano and Bond, 1991). Notably, this investigation picks difference GMM estimation which converts the selected dependent variable into independent variable by making its first difference which does not change over the nominated time periods. Theoretical framework of the paper is presented in Figure 1.

4. FINDINGS

All of the designated determinants which are debt ratio, tangibility, profitability, liquidity, sales, non-debt tax shield and inflation data are coded into robust SAS package to execute analysis. The descriptive statistics analysis is performed to study the statistics of the nominated variables such as mean, standard deviation, minimum, median and maximum. The descriptive statistics is described in below given Table 2.

The results stipulate in Table 2 visibly validate that the mean value of DR is 0.632. Likewise, the results display that the mean figures of TANG is 0.557, PROF is 0.987, LIQ is 1.832, SIZE is 1.702, NDTS is 0.051, INF is 0.011, ENG_CON is 1.633 and GDP is 0.810%. Noticeably, the utilized data is not showing any variations because all the obtained figures seemed closer to others. Similarly, standard deviations of the studied variables are not exceeding the average figures.

Notably, this investigation also performed numerous diagnostic tests to find the raised models' fitness. For instance, the test of Pearson Correlation is executed to find the statistical relationship in the nominated variables.

Table 2: Descriptive Statistics of Nominated Variables

Variable	Obs.	Mean	Median	Max	Min	Std. Dev.
DR	2016	0.632	0.421	1.803	0.058	0.054
TANG	2016	0.557	0.346	2.124	0.021	0.220
PROF	2016	0.987	0.087	1.662	−1.040	0.011
LIQ	2016	1.832	1.344	18.45	0.076	1.054
SIZE	2016	1.702	1.011	32.21	−0.785	0.202
NDTS	2016	0.051	0.044	0.021	0.022	0.013
INF	2016	0.011	0.011	0.011	−0.014	0.001
ENG_CON	2016	1.633	1.001	31.13	−0.675	0.222
GDP	2016	0.810	0.013	0.011	0.071	0.321

TANG: Tangibility, PROF: Profitability, LIQ: Liquidity, SIZE: Sales of the energy firms, NDTS: Non-debt tax shield, GDP: Gross domestic products

Table 3 shows the Pearson Correlation matrix outcomes of all the designated nine variables. Remarkably, the coefficient figures range among −0.2342 and 0.6713. Noticeably, the maximum coefficient correlation figure is detected between DR and SIZE i.e. 0.6711. Here, it is important to observe that SIZE is found significant at 1% level. Thus, SIZE may be among one of those determinants which impact on ASEAN energy-based firms. Moreover, the initial results gained from the correlation analysis indicated that nominated determinants which are TANG, INF, ENG_CON, GDP and PROF are enough to influence on selected dependent variable i.e. DR which indicates capital structure. Additionally, this investigation also executed the Variance Inflation Factor (VIF) test to analyse the issue of multicollinearity in the studied predictors. The results achieved from the VIF test are displayed in Table 4.

Clearly, the obtained values from VIF test explains the absence of multicollinearity issue as all the obtained values are not more than 10. Next, this investigation also executes Breusch Pagan LM test. Table 5 displays the results achieved from the accomplishment of Breusch Pagan LM i.e. BPLM test. Visibly, the value of p specifies the null hypothesis rejection ($P < 0.05$). Hence, the results stipulate that the model of Random Effects is more appropriate than the model of Pooled OLS.

Moving ahead, after the adoption of Panel Data Random Effects model, this investigation performed another important test which is Hausman test. Technically, Hausman test is executed to check the suitable Static model for the analysis. The results attained from this test are stated in below given Table 6.

Evidently, the results showed that the value of P is not smaller than Figure 0.05. Therefore, the model of Random Effects is more suitable for the further approximation. The outcomes gained from the Random Effects approximation are mentioned below.

Table 7 displays the outcomes attained from the Random Effects Two-Way Wallace-Hussain model analysis. Clearly, the results specify that selected variables that are tangibility of assets (TANG), return on assets i.e. profitability (PROF), sales of the energy firms (SIZE), energy consumption (EBG_CON) and inflation (INF) have significant effect on capital structure of ASEAN energy firms. Though, the other variables, which are liquidity (LIQ), non-

Table 3: Pearson correlations test

Variables	DR	TANG	PROF	LIQ	SIZE	NDTS	INF	ENG_CON	GDP
DR (P-value)	1	−0.2342	−0.2418	0.3841	0.6711	0.3122	0.6542	0.6222	0.6313
		(0.0001)	(0.03561)	(0.0161)	(0.0001)	(0.0112)	(0.0001)	(0.0001)	(0.0001)
TANG (P-value)	−0.2342***	1	0.5333	0.6123	−0.2112	0.6430	0.6331	0.5411	−0.1416
	(0.0001)		(0.1102)	(0.1100)	(0.1311)	(0.3131)	(0.3112)	(0.1321)	(0.1141)
PROF (P-value)	−0.2418**	0.5333	1	0.6122	0.41129	0.32211	0.6312	0.61132	0.3213
	(0.03561)	(0.1102)		(0.1102)	(0.2218)	(0.2114)	(0.1200)	(0.1210)	(0.0222)
LIQ (P-value)	0.3841	0.6123	0.6122	1	0.23110	0.3113	0.2131	0.3221	0.2110
	(0.0161)	(0.1100)	(0.1102)		(0.0100)	(0.0723)	(0.0652)	(0.0613)	(0.0100)
SIZE (P-value)	0.6711	−0.2112	0.41129	0.23110	1	0.3211	0.2142	0.3242	0.2123
	(0.0001)	(0.1311)	(0.2218)	(0.0100)		(0.0124)	(0.0213)	(0.0122)	(0.0122)
NDTS (P-value)	0.3122	0.6430	0.32211	0.3113	0.3211	1	0.2130	0.3210	0.3200
	(0.0112)	(0.3131)	(0.2114)	(0.0723)	(0.0124)		(0.0110)	(0.0001)	(0.0001)
INF (p-value)	0.6542***	0.6331	0.6312	0.2131	0.2142	0.2130	1	0.2100	0.1200
	(0.0001)	(0.3112)	(0.1200)	(0.0652)	(0.0213)	(0.0110)		(0.0100)	(0.1101)
ENG_CON	0.6222***	0.5411	0.61132	0.3221	0.3242	0.3210	0.2100	1	0.2210
(P-value)	(0.0001)	(0.1321)	(0.1210)	(0.0613)	(0.0122)	(0.0001)	(0.0100)		(0.1001)
GDP (P-value)	0.6313***	−0.1416	0.3213	0.2110	0.2123	0.3200	0.1200	0.2210	1
	(0.0001)	(0.1141)	(0.0222)	(0.0100)	(0.0122)	(0.0001)	(0.1101)	(0.1001)	

*** Significant at 1% and ** significant at 5% level. TANG: Tangibility, PROF: Profitability, LIQ: Liquidity, SIZE: Sales of the energy firms, NDTS: Non-debt tax shield, GDP: Gross domestic products

Table 4: Variance inflation factor test

Variables	VIF	1/VIF
DR	2.123	0.4710
TANG	2.122	0.4713
PROF	2.81	0.3559
LIQ	3.79	0.2639
SIZE	2.609	0.3833
NDTS	6.432	0.1555
INF	3.606	0.2773
ENG_CON	2.901	0.3447
GDP	3.01	0.3322

TANG: Tangibility, PROF: Profitability, LIQ: Liquidity, SIZE: Sales of the energy firms, NDTS: Non-debt tax shield, GDP: Gross domestic products

Table 5: Breusch pagan test (BPLM two way)

H_0: Pooled OLS model is suitable	
H_1: Random effects model is Suitable	
m value	**P >m**
9234	0.008

BPLM: Breusch pagan lagrange multiplier test

Table 6: Hausman test

H_0: Random effects model is suitable	
H_1: Fixed effects model is suitable	
Chi-square test value	9.12
P-value	0.6861

debt tax shield (NDTS) and gross domestic products (GDP) are insignificant variables for the capital structure of firms operating in the ASEAN region. Clearly, the overall model is also considered fit as R-Square mentions high figures (0.7632).

Also, this investigation executes GMM assessment to inspect dynamic and robust relationships among the nominated variables. For this purpose, the Sargan test is employed which is considered best to diagnose the issue of exogeneity in the model. Clearly, the results displayed in the below given Table 8 explains that GMM model is not suffering from exogeneity issue,

Table 7: Panel data random effects model (REM) results

Two-way random effects				
Wallace-Hussain				
Variables	**Coefficient**	**Standard Error.**	**t-value**	**P-value**
Intercept	0.1543	0.1560	0.9889	0.3227
TANG	0.1620	0.0722	2.2431	0.0249**
PROF	−0.0721	0.0211	−3.4175	0.0006**
LIQ	−0.0122	0.0050	−2.4400	0.0147
SIZE	0.0121	0.0020	6.0550	0.0001**
NDTS	2.3230	1.2220	1.9010	0.0573
INF	0.1620	0.0722	2.2435	0.0249**
ENG_CON	0.0112	0.0031	3.6129	0.0003**
GDP	0.1211	0.3100	0.3906	0.6961
R-square				0.7544

** significant at 5% level. TANG: Tangibility, PROF: Profitability, LIQ: Liquidity, SIZE: Sales of the energy firms, NDTS: Non-debt tax shield, GDP: Gross domestic products

Table 8: Sargan test (exogeneity analysis)

H_0: The adopted Instruments are valid	
H_1: The adopted Instruments are not valid	
Statistics	**Prob >Chi-sq**
39.01	0.1912

therefore, null hypothesis (H0: The adopted Instruments are valid) is accepted. The Sargan test confirms that the instruments adopted in this model are valid and not correlated with each other and residuals.

Table 9 presents the outcomes of AR (m) test. The AR (m) test is executed to find the issues of autocorrelation in the dynamic GMM model. The outcomes specify that the null hypothesis is accepted, advising that the used variables are not correlated with valid residuals.

Subsequently, after analysing the diagnostic issue, the GMM estimation is performed. Clearly, the obtained results from GMM estimation displayed below Table 10.

Table 9: Test AR (m) (autocorrelation analysis)

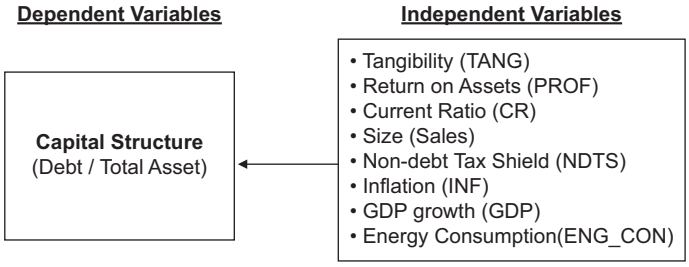
H_0: Absence of autocorrelation		
H_1: Presence of autocorrelation		
Lag	**Statistics**	**Prob >Chi-square**
1	−4.37	0.899

Table 10: Dynamic Panel Data Analysis (GMM Estimation)

GMM: First differences transformation					
Estimation method: Two-step GMM					
Parameter estimates of ASEAN energy firms					
Variables	**DF**	**Estimate**	**Standard Error**	**t value**	**Pr > |t|**
Intercept	1	−0.0133	0.0211	−0.63033	0.5285
DR_1	1	0.2983	0.0642	4.646417	0.0001**
TANG	1	0.2231	0.0686	3.252187	0.0011**
PROF	1	−0.2073	0.0541	3.831793	0.0001**
LIQ	1	0.3629	0.3087	1.175575	0.2398
SIZE	1	0.2423	0.2315	1.046652	0.2952
NDTS	1	0.1402	0.1029	1.362488	0.173
INF	1	0.2344	0.0316	7.417722	0.0001**
ENG_CON	1	0.2323	0.032	7.259375	0.0001**
GDP	1	−0.0613	0.046	−1.33261	0.1827

** significant at 5% level. TANG: Tangibility, PROF: Profitability, LIQ: Liquidity, SIZE: Sales of the energy firms, NDTS: Non-debt tax shield, GDP: Gross domestic products

Figure 1: Theoretical Framework



Source: Authors' own elaboration

Clearly, the outcomes in Table 10 disclosed that tangibility of assets (TANG), profitability (PROF), inflation (INF) and energy consumption (ENG_CON) have a significant relationship with the capital structure i.e. debt to assets ratio (DR). Also, the significant and positive dynamic lagged variable (DR_1) i.e. lag variable of dependent variable indicates the existence of dynamic capital structure and adjustment speed (SOA) for the ASEAN based energy firms.

Evidently, the significant value of lagged variable coefficient (0.2983) and significant value of P (0.0001**) explained that speed of adjustment for the ASEAN region energy firm is 70% (1–0.2348 = 0.7017). This clarifies that in case of any deviation of energy firms from their optimal capital structure level they moved back to their optimal level by 70%. In conclusion, the ASEAN energy firms returned back to their optimal or targeted level in not more than 1 year and 4 months (100 ÷ 70 = 1.428). Thus, this strongly suggests the application of the Dynamic Trade-Off theory in the ASEAN region energy firms.

5. DISCUSSION

Within the Panel Data dissimilar models' analysis i.e. Static and Dynamic, this investigation has exposed some exciting outcomes for the capital structure determinants of energy firms which are functioning in the ASEAN region. Remarkably, the outcomes which are attained from both dissimilar tactics of Panel Data have revealed that tangibility, profitability, size, inflation and energy consumption are the core determinants that formulate capital structure of ASEAN based energy firms.

Importantly, both Panel Data models that are Static and Dynamic models, reveal that the two newly introduce determinants for the ASEAN energy firms, which are inflation and energy consumption have significant effects on firms' capital structure. This endorses the validity of these two newly introduced determinants of capital structure for the ASEAN based energy firms. Clearly, inflation upsurges in the region after the global financial crisis and now after the Covid-19 pandemic. This confirms that capital structure maintaining practices of ASEAN based energy firms are affected by dissimilar inflation regimes. Likewise, the increase in energy consumption also results in increase in profitability of energy firms. Therefore, profitability is also found significant capital structure determinant for the ASEAN energy firms. The results are in line with the findings of Jaworski and Czerwonka (2021) who reported inflation and energy consumption as a significant determinants of capital structure for European energy firms. Moreover, the results are also consistent with the assumption of Zhao (2022) who reported that rising energy prices lead to surging inflation in Asian nations.

Likewise, the Static and Dynamic Panel Data both models revealed that tangibility and profitability are the key determinants of capital structure for energy firms which are operating in the ASEAN region. Thus, the significant role of asset tangibility elucidates that with sound fixed assets the leverage connected activities of ASEAN based energy firms also rises. Certainly, in the presence of sound tangibility, financiers such as financial institutions consider their offered investments safe as it delivers security against their provided funds (Harc, 2015).

For other studied significant determinants, the Panel Data Random Effects Model shows that sales i.e. SIZE is positive significant determinant for ASEAN energy firms. Evidently, the outcomes predict that ASEAN energy firms are maintaining profitable businesses, thus, their sales are able to generate suitable income. This assumption is consistent with the conclusion of Zhao (2022) who reports that energy prices rising in Asia resulted in increased inflation. Clearly, the rising prices also result in an increase of the energy firms' sales. In other words, increasing prices definitely increase the sales. Thus, profitability and sales of ASEAN energy firms have recognized significant association with firms' capital structure. Evidently, the outcomes are also consistent with the results of Cole, Yan and Hemley (2015) who reported significant association of profitability and tangibility with capital structure for the firms operating in the United States Energy, Healthcare and Industrial sectors. Also, the outcomes are consistent with the assumption of Ghani and Bukhari (2010) who explained significant association of capital structure with the studied determinants that are tangibility, profitability and

sales in the context of Pakistan context. Though, the results are inconsistent with the reported outcomes of Tailab (2014) who discovered capital structure elements of American based energy firms and found insignificant association among the studied determinants asset tangibility, profitability and sales with capital structure. Notably, the Random Effects and Dynamic model both estimation designated insignificant relationship of non-debt tax shield with firms' capital structure. The outcomes are consistent with the results of Chakrabarti and Chakrabarti (2019) who found insignificant association of NDTS with energy firms operating in India. Overall, the confirmation of Hypothesis 1, Hypothesis 3, Hypothesis 5, Hypothesis 7 and Hypothesis 8 on the studied determinants is extremely supporting. Whereas**,** Hypothesis 2, Hypothesis 4 and Hypothesis 6 delivered dissimilar outcomes from those which are assumed in above discussion.

On the flip side, the Panel Data Dynamic model assessment informed insignificant relationship of studied variable GDP with capital structure. The outcomes are not in line with the results of Jaworski and Czerwonka (2021) and another findings of Škuláňová (2018) who described negative effect of energy firms "debt on republics" GDP. Similarly, the significant and positive role of lagged dependent variable postulates the presence of dynamic capital structure and SOA for ASEAN based energy firms. Thus, this endorses Hypothesis 9 which indicates the existence of dynamic capital structure determinants. Theoretically, the features of asset tangibility and profitability are clarified by Modigliani Miller theory and Dynamic Trade-Off theory. Generally, the significant lagged dependent variable, tangibility and presence of SOA specify that Dynamic Trade-off theory appears to be more prominent in explaining capital structure formulation practices of operating energy firms of the SAARC region.

6. CONCLUSION AND POLICY IMPLICATIONS

The identification of capital structure determinants for energy firms which are functioning in the region of ASEAN is still an unsettled matter. In view of this gap, this investigation is an effort to discover the capital structure determinants of main South East Asian economies which are Malaysia, Indonesia, Thailand, Philippines, Cambodia and Vietnam. The outcomes confirm positive connection of capital structure with tangibility, size, energy consumption and inflation. Though, a negative and significant connection of profitability is detected with energy firms' capital structure. Clearly, the significant association of the selected determinants with capital structure confirmed that the studied determinants play an important role in the construction of South East Asian energy firms' capital structure. Similarly, the significant and positive lagged dependent variable described the presence of adjustment speed for ASEAN energy firms. The significant capital structure determinants that are profitability, tangibility and lag variable of dependent variable indicate the application of Dynamic Trade-off theory in the energy sectors of dissimilar ASEAN nations. The results deliver a new insight to ASEAN policy makers to develop parallel plans for the construction of capital structure of energy firms that are functioning in the ASEAN region. Surely, this will control the energy scarcity problems and also increase regional integration.

The current investigation produces a distinctive place in the literature of corporate finance. Mainly, this investigation discovered the regional level capital structure determinants for the ASEAN energy firms. Previously, only rare inquiries have been conducted that discovered capital structure determinants of energy producing firms that are functioning in the ASEAN region. Remarkably, the outcomes deliver clear guidelines for the member countries governments and regional policy makers to develop parallel strategies for the energy firms to construct capital structure. Evidently, rising energy prices in Asia are the one of the core reasons of hiking inflation

(Zhao, 2022). Therefore, the recognized capital structure determinants help them to develop capital structure in such a way that moves energy firms toward their main aim of generating profitability. Exactly, the profitable and financially stable energy firms always produce a low-cost energy which is beneficial for the entire ASEAN region. Besides, similar policy for the capital structure of energy generating firms will enhance a cohesive energy zone and collaboration in the region that will help in forthcoming and existing energy scarcity issues. Certainly, an integrated energy market for the ASEAN is crucial to overcome foreseeing energy shortage problems (Chen, 2022).

The core constraint for the capital structure related inquiries is the approachability of data that is the key restraint mainly in the developing economics (Pandey, 2002). Likewise, due to unavailability of data, this investigation eliminates four ASEAN countries from the overall data sample. Another important limitation is that this investigation inspects only eight capital structure determinants. Remarkably, those determinants are included in the sample whose data for the nominated time period, that is 14 years, is available. Therefore, the future scholars could include other ASEAN republics which are removed from this inquiry. Likewise, some other main determinants of energy such as renewal energy related variables and another important capital structure measure variable i.e. debt to equity ratio needs be added in the investigation.

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