Impact of Capital Structure and Debt Characteristics on Default Risk of Listed Real Estate Firms in Vietnam

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Abstract

Research purpose: This study aims to examine the impact of capital structure and debt characteristics on the default risk of listed real estate firms in Vietnam stock market.

Research motivation: The real estate industry in Vietnam has experienced significant growth and transformation over the past decade, contributing to the country's economic development and attracting both domestic and international investors. However, various challenges and risks appear, especially since the Covid-19 outbreak, lead to the risk of default of real estate firms. Besides, research on the impact of capital structure and debt characteristics on default risk of listed real estate firms are still limited and not up to date, in particular for the Vietnamese context.

Research methodology:

The assessment of default risk is conducted in using KMV model to measure the distance to default (DD) and the probability of default (PD). The research focuses on various dimensions of capital structure and debt characteristics, including debt maturity, source of debt, and cost of debt. The study sample includes 42 listed firms in the real estate industry in the period from 2018-2022.

Main findings:

Regression model shows that a firm's capital structure, including long-term debt to assets (LTDA) and short-term debt to assets (STDA), significantly influences its likelihood of default. Balancing LTDA and STDA is crucial for mitigating default risk. Larger firms (SIZE) have a reduced probability of default due to their financial resources. Volatility (Vol) also impacts financial stability, emphasizing the need for robust market risk management.

Practical/managerial implications: This research contributes valuable insights for businesses, investors, financial decision-makers, financial institutions, and other stakeholders. It emphasizes the critical importance of debt management, financial stability, and risk mitigation strategies in reducing the probability of default among real estate companies.

Keywords: *Capital structure, debt characteristics, default risk, listed real-estate firms, Vietnam.*

1. Introduction

Even being a young market, the Vietnamese real estate market has been growing fast in this current decade (Anh et al., 2020). However, since the outbreak of the Covid-19 epidemic, real estate market fluctuations have become more and more complicated. Data from the General Statistics Office[1] indicates that the number of dissolved real estate businesses at the end of 2022 exceeded the count during the COVID-19 outbreak, with nearly 1200 enterprises ran out of business. In comparison, the number of dissolved

[1] http://gso.gov.vn

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enterprises stood at 861 in 2021 and 978 in 2020. According to survey findings from Vietnam report[2], over 70% of real estate businesses reported a significant decline in both revenue and profits in 2022 as compared to the previous year. This reflects a challenging scenario for many businesses in the sector. To survive in a highly competitive market, real estate firms have to effectively navigate among the challenges and risks associated with their operations. Among these, default risk stands out as a critical factor that can significantly impact a firm's financial health and stability. Default risk refers to the likelihood of a company being unable to meet its debt obligations, potentially leading to bankruptcy or financial distress. This risk is influenced by a complex interplay of factors, including capital structure decisions and debt characteristics. Capital structure refers to the mix of debt and equity financing used by a company to support its operations and growth, while debt characteristics encompass aspects such as debt maturity, source of debt and cost of debt, which directly affecting a firm's ability to service its debt obligations.

Research on capital structure are quite a lot, with various type of firms, such as household businesses and SMEs (Nikolaos et al., 2017; Stefania et al., 2018) as well as listed firms (Barry & Theodorus, 2014; Zeitun and Refai, 2017; Gul and Cho, 2019). Among them, Zeitun and Refai (2017) and Gul and Cho (2019) have investigated on the impact of capital structure on default risk for certain markets. Impact of debt characteristics on default risk of listed companies is also less researched, with only some notable examples Cooper (2001), Goyal and Wang (2013), Chiu et al.(2017), Wang and Chiu (2019). Thus, there is a lack of comprehensive studies on the impact of capital structure and debt characteristics on the risk of default of real estate firms. By addressing these gaps through diligent research efforts, we stand to enrich our insights into the intricate connections between debt characteristics and default risk. These insights would not only enhance risk management strategies but also empower informed financial decisions in corporate and economic contexts. It is imperative to acknowledge that addressing these research gaps holds pivotal significance in refining our comprehension of default risk determinants, thereby facilitating more effective risk mitigation and strategic decision-making.

We choose real estate sector of Vietnam to study, partly because of the default risk they have encounterd recently, and also to understand the impact of external financing, especially debt, which plays a crucial role in funding capital-intensive projects of real estate firms, to risk of default. Existing literature in Vietnam on this specific topic also remains limited, indicating a notable research gap in exploring the intricacies of default risk management in an emerging country's real estate sector. Hence, this research seeks to address this critical gap by conducting a comprehensive examination of the relationship between capital structure and debt characteristics on the default risk of real estate firms listed on the Vietnamese stock market. Focused on the period from 2017 to 2022, in applying the KMV model to analyze a comprehensive dataset of financial and market variables, the study contributes to provide valuable insights into the financial dynamics and risk profiles of real estate companies operating in this evolving market.

2. Literature review

2.1 Risk of default

Default occurs when a firm's cash flows are insufficient to cover its debt service costs and principal payments (Brogaard, Dan, & Ying, 2017), then it may lead to the important effects on the company’s productivity and its existence. Default risk (or default probability) happens may due to financial management, corporate governance issues or also due to market changes or economy recession. Companies need to generate enough net income and cash flow to minimize the risk of default if the risk is predictable.

[2] https://vietnamreport.net.vn

Default risk of real estate companies are different and influenced by business cycles as well as market impacts. In an upturn in the business cycle, credit is easily available, banks are willing to fund property loans at very low interest rates, which boost economic activity. That increase the confidence of lenders, the expected profitability of new developments improves, and the probability of default of real estate firms is kept at reasonable levels. In contrast, in a downturn with an oversupply in the market, monetary authorities often follow tighter monetary policy to decrease liquidity in the system and to combat potential inflationary pressures in the economy which results in higher interest rates and increase the debt burden of real estate firms. Refinancing becomes more difficult when lenders switch to more cautious lending policy. Consequently, the probability of default of the real estate investment companies increases dramatically as well as bankruptcies (Vlamis, 2007).

Relating to the models to determine risk of default, Altman (1968) first proposed the famous Z-Score model and applied it to identify bankruptcy risk for non-financial firms. In 1973, the Black-Scholes model, introduced by Black, Scholes, and Merton revolutionized the field of financial derivatives by providing a mathematical framework for valuing European-style options, which even did not explicitly adress default risk but laid to the foundation for modern quantitative finance and risk management. Then, the well-known Menton structural model of credit risk proposed by Robert Merton in 1974 was the extension of the Black-Scholes model that incorporates the possibility of default in the valuation of corporate bonds and other debt instruments. The Fisher, Heinkel, and Zechner (1989) model after that builds upon the Merton framework by considering the impact of bankruptcy costs on a firm's capital structure decisions in taking consideration on the trade-off between the tax benefits of debt and the costs associated with financial distress. In 1993, KMV Company launched the KMV (Korona/McQuown/Vasicek) model, which could estimate the default probability of borrowing enterprises based on its asset value and volatility. The simplification and effectiveness of the model make it widely applied in practicle. In 1994, the Leland model developped by Hayne Leland focuses on the dynamic management of default risk and hedging strategies which helps firms manage their risk exposure and optimize their capital structure over time (Leland, 1994). In 1997, Morgan (1997) and other cooperative financial institutions put forward the CreditMetrics model based on value-at-risk. Bharat and Shumway (2008) have proposed the measurement of EDF (Expected default frequency) as a simple version of Merton model. In addition, there are logistic and neural network models proposed by Sanford and Moosa (2012).

2.2 Impact of capital structure and debt characteristics on default risk

2.2.1 Impact of capital structure on default risk

Capital plays a crucial role in the establishment and development of enterprises, as it is the source for all activities. Capital structure, also known as the financial structure, is the combination of the use of debt and equity in a certain proportion to finance the production and business activities of enterprises (Ross, 2021). Leverage, which refers to the proportion of debt in a firm's capital structure, is often considered a key determinant of default risk. Higher levels of leverage increase the probability of default because increased debt obligations can strain a firm's financial resources and its ability to meet interest and principal payments. When a firm faces financial distress or experiences a decline in cash flows, the burden of debt servicing becomes more challenging, potentially leading to default. Jensen & Meckling (1976) suggested that the probability of default or bankruptcy has an important role in the tradeoff theory of capital structure. Moreover, they stated that firms following the trade-off theory choose capital structure by trading off the costs of debt with the benefits of debt. However, the use of debt financing may lead to the agency problem.

Empirical research to examine the effect of firm’s capital structure on default risk have been done by several researchers. Loffler & Maurer (2011) investigate the relationship between capital structure dynamics and corporate default prediction in applying the two econometric approaches: the reduced-form approach and

the two-step approach with the cases of default of US non-financial firms for the period 1975-2005. The paper concludes that the two-step approach significantly improves prediction accuracy, as the restrictions imposed by the partial adjustment model enhance coefficient estimates. According to Bal (2012) after analyzing the financial position of selected Indian companies in applying the Alman Z Score, companies with a high leveraged capital structure are exposed to greater financial risk. This is because these companies rely more heavily on debt financing in their capital structure, leading to increased obligations for interest payments. Zeitun & Refai (2017) focus on investigating the impact of capital structure on corporate failure within the context of an emerging market - Jordan. The study utilizes a panel data analysis approach for 180 Jordanian companies during the period from 1990 to 2012 and found that the leverage ratio has a significant positive effect on the likelihood of default for firms, aligning with the conventional wisdom that higher leverage increases the probability of default. For the case of Korean manufacturing firms, in using the Moody's KMV option pricing model, Gul & Cho (2019) indicated that an increase in short-term debt to assets ratio leads to a rise in default risk, while an increase in long-term debt to assets ratio leads to a decrease in default risk. Size, tangibility, and interest coverage ratio are also other important determinants of default risk among Korean manufacturing firms. Wang & Chiu (2019) also conducted another study on the impact of short-term debt on default risk in five Pacific Basin countries from 2002 to 2016. The study found that a higher amount of long-term debt maturing in the next year significantly increases default probability for up to three years. In 2020, Cathcart et al. studied on the leverage and funding sources impact on default risk in large and small firms from six European countries from 2005-2015. The empirical findings of the research revealed that financial leverage has a greater impact on the default risk of SMEs compared to large corporations (Cathcart et al.,2020).

2.2.2 Impact of debt characteristics on default risk

Debt is a common financial instrument used by individuals, organizations, and governments to fund various activities and investments which plays an important role in shaping the financial landscape and has several characteristic features. Important characteristics of debt are debt maturity, source of debt and cost of debt.

a. Debt Maturity

Debt maturity is the date at which the final repayment of a debt instrument is due. Debt maturity has been studied by several researchers from long time ago (Titman & Wessels, 1988; Barclay & Smith, 1995; Guedes & Opler, 1996).. Debt maturity affects the financial planning and risk management of borrowers and lenders (Hart & Moore, 1994). Short-term debt may carry higher interest rates but provides more flexibility, while long-term debt offers stable repayment schedules but may lock borrowers into higher interest rates for an extended period hypothesis argue that firms match the maturity of their assets and liabilities.

Relating to the relationship between debt maturity and default risk, we have to mention on the study of Goyal & Wang (2013) conducted a series of tests to investigate the correlation between debt maturities and the risk of default, with a focus on new debt issuers. Their study demonstrated a link between the mismatch between predicted and actual debt maturities and subsequent changes in default risk, offering insights into how the choice of debt maturity can impact a firm's default risk trajectory. Stanisic et al. (2016) examined the empirical determinants of debt maturity structure using a maturity structure measure that incorporates detailed information of the firm's liabilities. They find that larger, less risky firms with longer- term asset maturities use longer-term debt. Additionally, debt maturity varies inversely with earnings surprises and a firm's effective tax rate, but there is only mixed support for an inverse relation with growth opportunities. After that, research of Choi et al. (2018) focus on the decision to spread out maturity dates across time. The fixed costs involved in multiple issues make maturity dispersion expensive; uncertainty about credit–supply

conditions at the refinancing date renders maturity concentration costly which may affect to the firm's financial situation.

b. Source of debt

The source of debt refers to where a company or individual obtains borrowed funds to finance their operations or investments. Debt can be acquired from various sources, and each source may have different terms, interest rates, and repayment conditions. Some types of debt including public debt, non-bank private debt, bank loans, syndicate loans..The choice of using which type of debt from which source depends on information, costs, firm size.. (Johnson, 1997; Hadlock & James, 2002).

Not many authors investigate on the impact of source of debt on risk of default. Chiu et al. (2017) conducted a study exploring the impact of the source of debt financing on firms' default risk during the 2007-2010 financial crisis. They found that the debt financing source has significant effects on firms' default risk, and their research focused on two theories: credit supply shock theory and bank supply shock theory. According to their study, firms relying on bank debt experienced significantly higher increases in default risk compared to firms without such dependence, while firms relying solely on public debts did not experience significant changes in default risk during the financial crisis. Wang & Chiu (2019) also examine the extent to which the source of debt financing (banks or public debt markets) affects the default risk of firms in the U.S. market from 2006 to 2010. In the initial crisis stage (2007–2009), firms with close links to bank financing suffer significantly higher increases in default risks than similar firms that do not depend on bank financing. When firms rely solely on financing from public debt markets, they do not experience significant increases in default risk. Finally, their results indicate that bank-dependent firms, with or without an ability to replace bank loans with public debts, experience similar increased default risk in early periods of the crisis. Public debt markets thus have a limited role in offsetting funding shocks, as far as default risk is concerned.

c. Cost of debt

The cost of debt is the total interest amount owed on a debt, such as bonds or loans. In the evaluation of the cost of debt across various studies, diverse measurement methodologies were employed (Borisova et al., 2015; Shailer & Wang, 2015; Stanisic et al., 2016). Concerning the impact of cost of debt on risk of default, the research of Cooper (2001) have considered the parameter values reflective of both high-grade and low-grade debt situations. In instances involving high-grade debt, most of the indicated yield spread represents an anticipated return premium. Conversely, in the case of high-leverage companies with low-grade debt, the greater portion of the forecasted yield spread is indicative of potential default. According Stanitic et al. (2016), the ratio of interest expense in year "t" to the average interest-bearing debt outstanding during years "t-1" and "t" provides a measure of the company's financial burden and its ability to manage its debt obligations. This ratio reflects how much of the company's earnings are being used to cover interest costs relative to the average debt level over the preceding and current years. A higher ratio suggests that a significant portion of earnings is allocated to servicing debt, potentially indicating higher financial risk and reduced capacity for other business activities. Conversely, a lower ratio implies better debt sustainability and more favorable financial health. This ratio serves as a key indicator for evaluating a company's capital structure efficiency and its capability to meet interest payments on its outstanding debt.

2.3 Research on default risk of real estate firms

There are some papers investigate on the default risk of real estate firms, such as for the case of UK market such as Patel & Vlamis (2006) and Vlamis (2007). In Vietnam, several papers focused on the default risks of financial and non-financial firms, e.g. Binh et al. (2018), Hai et al., (2021)..but very few papers assess the default risk of real estate firms. As an example, Cong et al.(2019) have determined the impact of financial performance factors on bankruptcy risk of Vietnamese listed real estate companies and found that Return on Asset, Return on Equity, Total Asset Turnover have significant reverse effects to bankruptcy

risk. Besides, Linh and Steininger (2019) also have studied on the impact of underpricing of the default risk on investment and found that default probability is negatively related to investment. Previously there is no paper focus on the impact of capital structure as well as debt characteristics to risk of default of Vietnamese real estate firms.

3. Hypothesis development

Long-term debt is a form of fixed financial obligation that a company must pay over an extended period. Long-term debt generally involves more stable and predictable repayment schedules, which can enhance a firm's ability to manage its financial obligations. The presence of long-term debt might reflect the company's confidence in its ability to generate consistent cash flows over an extended period, reducing the risk of default (Panizza, 2022). Long-term debt might come with fixed interest rates, shielding the company from interest rate fluctuations. This stability in interest expenses can help the company manage its financial commitments more effectively and lower default risk (Zeitun & Refai, 2017). According to Gul & Cho (2019), long-term debt to total asset (LTDA) has a negative relationship with default risk. This result is consistent with the findings of (Hovakimian, Kayhan, & Titman, 2012). Considering the above information, the following hypothesis is developed:

H1: Long term debt to total assets has a negative impact on default risk.

The short-term debt to total asset (STDA) ratio can also have an impact on default risk for a firm. If a firm has a high proportion of short-term debt and faces cash flow challenges, it may struggle to meet its short-term debt obligations, leading to liquidity risk. Inadequate liquidity can increase the risk of default, especially during periods of economic downturn or financial stress (Gul & Cho, 2019). Short-term debt may be subject to variable interest rates, making it sensitive to changes in interest rates. If interest rates rise, the company's interest expenses on short-term debt may increase, putting additional pressure on cash flow and potentially increasing default risk. With a high short-term debt to total asset ratio, if the firm's operations are not generating sufficient cash flow to cover short-term debt obligations, it may struggle to maintain adequate working capital, leading to increased default risk (Zeitun & Refai, 2017). According to Gul & Cho (2019), Cathcart et al. (2020), Wang & Chiu (2019), a higher use of STDA leads to an increase in default risk. Based on previous studies, the following hypothesis is developed:

H2: Short term debt to total assets has a positive impact on default risk.

The total debt-to-asset (TDTA) ratio is an important factor that can significantly influence a company's default risk. The higher levels of debt may lead to an increase of the company's interest payments and financial obligations. If the company's cash flows are insufficient to cover these obligations, it might face difficulties in meeting its debt payments, potentially leading to default (Azhagaiah, 2011). Credit rating agencies and lenders often assess a company's debt-to-asset ratio as part of their credit risk analysis. Companies with excessively high debt-to-asset ratios might experience credit rating downgrades, which can increase their borrowing costs and limit their access to capital (Michaelas, Chittenden, & Poutziouris, 1999). According to Gill et al. (2011) and Acar (2006), TDTA has a positive relationship with default risk. The following theory is formed considering the previously mentioned literature:

H3: Total debt to total assets has a positive impact on default risk.

Debt maturity can have a significant impact on default risk for a firm. Debt maturity refers to the time remaining until a firm's debt obligations come due. It can be classified into short-term debt, which typically matures within one year, and long-term debt, which has a maturity period of more than one year. Short-term debt exposes the company to liquidity risk (Larsen, 2006), especially when the firm is unable to refinance its short-term debt when it matures (Goyal & Wang, 2013), during economic downturns or unexpected disruptions (Chatterjee & Eyigungor, 2012). Long-term debt is typically subject to interest rates

and if interest rates rise, the interest expenses increase, putting additional pressure on cash flow and potentially increasing default risk. Wang & Chiu (2019), Goyal & Wang (2013) have investigated on the importance of debt maturity in influencing default risk and found that short-term debt issues negatively affect default risk, possibly due to the manageable nature of short-term debt repayment. On the other hand, firms that issue long-term debt have a positive effect on default, possibly due to potential challenges associated with longer repayment periods (Goyal & Wang, 2013; Wang & Chiu, 2019). Considering the earlier research mentioned above, the following hypothesis is developed:

H4: There is a positive (negative) relationship between debt maturity and default risk.

The source of debt refers to the specific channels or markets from which firms raise debt financing. Different sources of debt can have varying implications for default risk. Bank debt is typically more flexible and may come with fewer restrictive covenants compared to public debt. If a firm raises a significant portion of debt through public debt markets with restrictive covenants, it may face higher default risk if it fails to meet those conditions (Denis & Mihov, 2003). Different sources of debt may have varying interest rates and costs associated with them. Higher interest rates on debt can increase interest expenses and put more pressure on the firm's cash flow, increasing default risk (Liu, 2004). The source of debt can also impact on the firm's credit ratings. Firms with higher credit ratings can access debt at lower interest rates and better terms, reducing default risk. On the other hand, firms with lower credit ratings may have limited access to credit or may be required to pay higher interest rates, increasing default risk. Firms that diversify their sources of debt financing may be better protected from the risk of default. Relying on a single source of debt, especially if that source is exposed to economic or market-specific risks, can increase default risk (Chiu, Wang, & Peña, 2017). Bank-dependent firms, with or without an ability to replace bank loans with public debts, experience a similar increased default risk in early periods of the crisis, and public debt markets thus have a limited role in offsetting funding shocks, as far as default risk is concerned (Wang & Chiu, 2019). Considering the above information, the following hypothesis is developed:

H5: Source of debt positively affects default risk.

The cost of debt refers to the interest rate a company needs to pay on its debt obligations, such as bonds or loans. This interest expense represents a significant financial obligation that companies must meet regularly. Companies with higher cost of debt might face credit rating downgrades by credit rating agencies. A lower credit rating can lead to higher borrowing costs and reduced access to capital markets, making it more challenging for the company to refinance its debt or raise additional funds (Borisova et al., 2015), potentially leading to liquidity problems and default risk (Raimo et al., 2021). The interest coverage ratio is a measure of a company's ability to cover its interest payments. A lower interest coverage ratio indicates a higher risk of default, as the company's earnings are less capable of covering its interest obligations (Stanišić, Stefanović, & Radojević, 2016). Prior research finds that firms with better performance and less risk have lower cost of debt (Ahmed et al., 2002); (Campbell & Taksler, 2003). According to Persakis & Iatridis (2015), cost of debt, which is measured by the ratio of interest expense in year t to average interest-bearing debt outstanding during years t and t – 1, has a positive impact on default risk. Based on this literature, the following hypothesis is developed:

H6: Cost of debt has a positive impact on default risk.

4. Research model, methodology and data collection

Multiple regression analysis will be used to explore the relationships between the independent variables (capital structure variables, debt characteristics variables, and control variables) and the dependent variable (probability of default).

Although there are many models to determine risk of default, we decided to use the KMV model (1993) as this is a quite simplified model aligns well with practical applications. Probability of default (PD) is calculated in following the KMV model based on the Distance to default (DD):

$$DD = \frac{ln(\frac{A}{D}) + (r - \frac{\sigma A^2}{2}).T}{\sigma A.\sqrt{T}}$$

$$PD(t) = N(-DD) = N\left(-\frac{ln(\frac{A}{D}) + (r - \frac{\sigma A^2}{2}).T}{\sigma A.\sqrt{T}}\right)$$

Where N is the standard normal distribution function, t is the current time, A is the value of the company's assets, D is the value of the company's debt, r is the risk-free interest rate, σA is the volatility of the company's assets and T is the time to maturity of the debt.

The multiple regression model thus may take the following form:

$$\boldsymbol{PD = \alpha 0 + \alpha 1 * LTDA + \alpha 2 * STDA + \alpha 3 * TDTA + \gamma * Mat + \mu * SoD + \delta * COD + \beta \sum Control + \varepsilon} \quad \textbf{(1)}$$

- PD: Probability of Default, which is the variable being predicted.
- α0: The constant
- α1 to α6: These are coefficients or weights associated with each corresponding variable in the equation.
- LTDA: Long-Term Debt to Assets ratio, representing the proportion of long-term debt relative to the company's total assets.
- STDA: Short-Term Debt to Assets ratio, indicating the proportion of short-term debt relative to total assets.
- TDTA: Total Debt to Assets ratio, showing the overall debt proportion relative to total assets.
- COD: Cost of Debt
- SoD: Source of Debt
- Mat: Debt Maturity
- $\sum Control$ = Sum of control variables (other factors that may influence default risk)
- ε: Represents the error term, accounting for unexplained variations in the model.

We then deploy the equation (1) to obtain a more detailed equation that provides a deeper level of insight:

$$\boldsymbol{PD = \alpha 0 + \alpha 1 * LTDA + \alpha 2 * STDA + \alpha 3 * TDTA + \gamma 1 * LTDD + \gamma 2 * STDD + \mu 1 * BDTA + \mu 2 * PDTA + \mu 3 * BDTD + \mu 4 * PDTD + \delta * COD + \beta \sum Control + \varepsilon} \quad \textbf{(2)}$$

Where:

- $\alpha 1, \alpha 2, \alpha 3, \gamma 1, \gamma 2, \mu 1, \mu 2, \mu 3, \mu 4, \delta$ are coefficients associated with the respective variables
  - + *LTDD* refers to the “long-term debt to total debt" ratio.
  - + *STDD* refers to the “short-term debt to total debt" ratio.
  - + *BDTA* stands for "bank debt to total assets" ratio.
  - + *PDTA* stands for "public debt to total assets" ratio.
  - + *BDTD* stands for "bank debt to total debt" ratio.
  - + *PDTD* stands for "public debt to total debt" ratio.

  Control variables including firm size (SIZE), profitability (PROFIT), tangibility asset (TANG), volatility (VOL), and growth opportunities (GROWTH).

Firm size is hypothesized to be negatively related to corporate failure. Large firms are assumed to have more access to external funds and more diversification in the sources of income and therefore, to be less risky (George & Hwang, 2010; Degryse et al., 2012), while small firms have a high bankruptcy risk that eventually makes debt finance less attractive (more expensive) for the firms thus increases the likelihood of default (Zeitun & Refai, 2017).

Goyal & Wang (2013) have shown that profitable firms are less risky due to their higher margins, which contribute to internal equity and reduce the likelihood of default risk. Chiu et al. (2017) considered profitability as a proxy for a firm's likelihood to default, predicting that a profitable firm is less likely to default due to its ability to generate sufficient earnings to meet its debt obligations.

Korteweg (2010), Degryse et al. (2012), Dasilas & Papasyriopoulos (2015) have demonstrated that the firm's tangibility has a positive correlation with leverage, it can mitigate the problems of information asymmetry. Mateev et al. (2013) pointed out that tangibility can help firms easily to borrow money from the banks because of their investment in assets. Therefor, tangible assets can help to reduce the credit risk and bankruptcy cost.

Volatility is defined as a measure of variation in the price of an asset over time and calculated as the annualized standard deviation of daily equity returns for a year. Higher volatility is naturally associated with greater potential for large losses (Silva et al., 2017). For explaination, volatility implies the probability that a firm's asset value is below the default boundary; thus, the higher the volatility, the greater the uncertainty, and therefore the higher the default probability (Chiu et al., 2017).

On the empirical literature aspects, there are number of studies that found a positive relationship between growth attribute, capital structure and profitability (Gill et al., 2011; Nha et al., 2016) and negative relation between sales growth and risk of default (Haerdle and Prastyo, 2014). Firms with good growth rate may be more deliberate in their use of debt, because they will have fewer financial constraints, and therefore less risk of default, than firms with bad growth rate. Growth ratio is calculated by using the difference between total assets previous year and current year over the total asset in the previous year.

The research model and details of variables are described as in following:

Fig.1: Research model

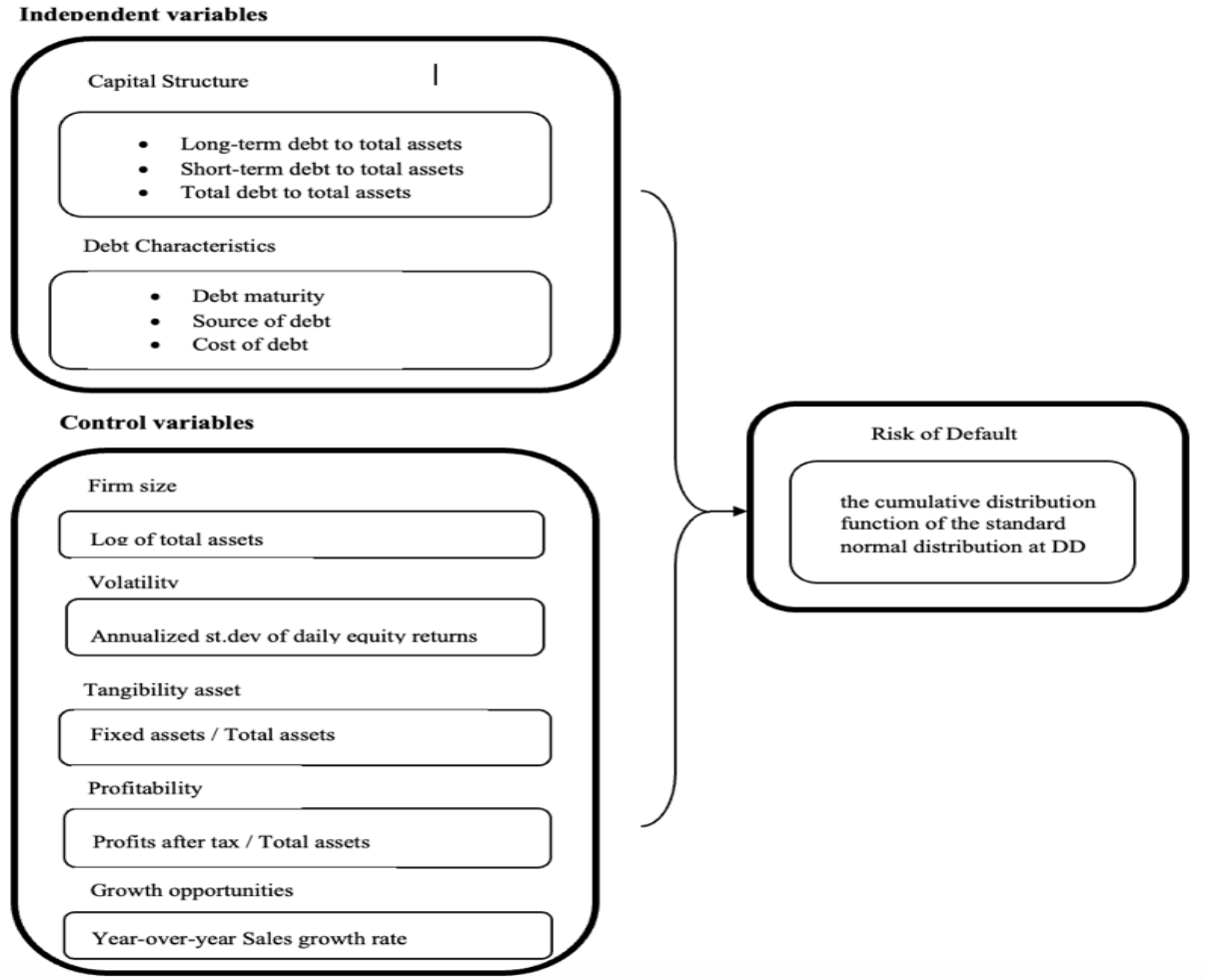

Table 1: Details of variables

	Variables	Measurements/ Formula	References
Dependent variables			
Default risk	Probability of Default (PD)	Computed as N(-DD), where N(.) is the cumulative standard normal distribution function.	Merton, 1974
	Distance to default (DD)		Merton, 1974
Independent variables			
Capital structure	Long term debt to total asset	Proportion of long-term debt to total assets	Zeitun & Refai, 2017; Hovakimian et al., 2012; Gul & Cho, 2019...
	Short term debt to total asset	Proportion of short-term debt to total assets	Gul and Cho, 2019; Cathcart et al., 2020; Wang and Chiu 2019…
	Total debt to total assets	Proportion of total debt to total assets	Gill et al., 2011; Acar, 2006; Azhagaiah and Gavoury, 2011…

Debt characteristics	Debt maturity	Long term debt to total debt	Peter & Larsen, 2006; Goyal & Wang, 2013; Wang & Chiu, 2019…
		Short term debt to total debt	
	Source of debt	The bank debt to total assets	Denis& Mihov, 2002; Liu, 2004; Chiu et al., 2017; Wang and Chiu, 2017…
		The public debt to total assets	
		The bank debt to total debt	
		The public debt to total debt	
	Cost of debt	The ratio of interest expense in year t to average interest-bearing debt outstanding during years t-1 and t	Ahmed et al., 2002; Campbell & Taksler, 2003; Persakis & Iatridis, 2015; Stanišić et al., 2016; …
Control variables			
Control variables	Firm's size	Log of assets	Refai and Zeitun, 2017; Degryse et al., 2012; George & Hwang, 2010;
	Volatility	Annualized standard deviation of daily equity returns for a year	Silva et al., 2017; Chiu et al., 2017
	Tangibility asset	Fixed assets / Total assets	Dasilas and Papasyriopoulos, 2015; Mateev et al., 2013
	Profitability	Profits after tax / Total assets	Goyal and Wang, 2013; Chiu et al., 2017
	Growth opportunities	Year-over-Year Sales Growth Rate = (Current year's sales - previous year's sales) / Previous year's sales.	Gill et al., 2011; Haerdle and Prastyo, 2014

(Source: Authors's own compilation)

Data is collected from fully audited annual consolidated financial reports of 42 joint-stock real estate firms listed on the Hanoi Stock Exchange (HNX), Ho Chi Minh City Stock Exchange (HOSE), and the Unlisted Public Company Market (UPCOM) for a period of five years, from 2018 to 2022, resulting 210 observations. These reports were extracted from Vietstock website.

5. Results

5.1 Descriptive statistics

Table 2. Descriptive Statistics

	PD	LTDA	STDA	TDA	LTDD	STDD	COD	SIZE	Vol	TANG	PROF	GROWTH	BDTA	PDTA	BDTD	PDTD
Mean	0.12909	0.15627	0.41753	0.57631	0.25740	0.74260	-0.03439	3.45111	0.35179	0.06410	0.03544	0.35999	0.10323	0.02995	0.17484	0.05165
Median	0.00053	0.12029	0.37979	0.57634	0.20836	0.79164	-0.01890	3.57120	0.16118	0.02236	0.03208	0.02928	0.06774	0.00000	0.13166	0.00000
Minimum	0.00000	0.00000	0.04787	0.04787	0.00000	0.10496	-0.18605	1.77085	0.00030	0.00000	-0.51040	-1.00000	0.00000	0.00000	0.00000	0.00000
Maximum	1.00000	0.64040	1.27280	1.37520	0.89504	1.00000	0.00000	5.41117	7.85023	0.62860	0.31986	19.80952	0.47898	0.20104	0.71492	0.36916
Kurtosis	3.66278	0.95480	2.23779	1.09253	-0.02774	-0.02774	3.05605	-0.22735	74.09454	9.98919	16.90288	73.54364	0.44667	1.99854	0.30129	2.70096
Skewness	2.09617	1.20296	1.04098	0.34719	0.83768	-0.83768	-1.83831	-0.09657	7.31555	2.79279	-2.50167	7.58695	1.12443	1.72142	1.01550	1.86246
Count	210	210	210	210	210	210	210	210	210	210	210	210	210	210	210	210

Table 2 offers a concise overview of key metrics within the dataset. Notably, the mean for Probability of Default (PD) exhibits a relatively low average at 0.12909, with a median even lower at 0.00053, implying a generally secure default risk profile for Vietnamese listed real estate firms. The long-term debt to assets

ratio (LTDA) has an average of roughly 15.63% reflects the fact that real estate firms often maintain a certain percentage of long-term debt but not too much. Short-term debt to assets ratio (STDA) stands at approximately 41.75%, signifying a considerable reliance on short-term debt of real estate firms for financing their activities. This is quite risky in using short-term debt mostly as in the case when the debt is due but the real estates are unsold, the firm will face to cash flow difficulties and cannot immediately repay debt, especially during the times when the real estate market goes down. Total debt to assets ratio (TDA) is at the average of around 57.63%, underlining the significance of debt in these firms' capital structure, which is completely opposite to the case of Korean stock exchanges where firms (Gul and Cho, 2019).

5.2 Correlation analysis

Table 3. Correlation Matrix

	PD	LTDA	STDA	TDA	LTDD	STDD	COD	SIZE	Vol	TANG	PROF	GROWTH	BDTA	PDTA	BDTD	PDTD
PD	1															
LTDA	0.14406	1														
STDA	0.425696	-0.25632	1													
TDA	0.4864	0.407968	0.722505	1												
LTDD	0.017511	0.912494	-0.48057	0.191608	1											
STDD	-0.01751	-0.91249	0.48057	-0.19161	-1	1										
COD	-0.00873	-0.16474	-0.10515	-0.1727	-0.1314	0.1314	1									
SIZE	-0.18244	0.407909	-0.18008	0.049642	0.349386	-0.34939	-0.22336	1								
Vol	0.649072	0.022993	0.045296	0.045054	-0.0108	0.010796	0.10663	-0.06113	1							
TANG	0.06146	0.135993	-0.0063	0.051971	0.098038	-0.09804	-0.38578	-0.0015	-0.06497	1						
PROF	-0.20047	-0.16574	-0.3536	-0.45044	-0.15076	0.150761	0.205796	0.130535	0.109087	0.052877	1					
GROWTH	0.002346	-0.04107	0.058257	0.018401	-0.07136	0.071356	0.074779	0.023141	0.035613	-0.0629	0.158587	1				
BDTA	0.233945	0.24112	0.261206	0.414865	0.165841	-0.16584	-0.37599	0.143656	0.033882	0.307088	-0.145	-0.05622	1			
PDTA	-0.07498	0.290857	-0.01838	0.180404	0.26106	-0.26106	-0.15455	0.512768	-0.10729	-0.06402	0.001265	-0.03946	0.083459	1		
BDTD	0.062334	0.128608	-0.00439	0.080846	0.148561	-0.14856	-0.44457	0.201455	0.015142	0.30265	-0.0165	-0.05416	0.884762	0.057505	1	
PDTD	-0.13481	0.192276	-0.11973	0.013574	0.242055	-0.24206	-0.19301	0.491321	-0.11586	-0.06375	0.019756	-0.04728	0.042129	0.92401	0.100105	1

Exploring the correlations between these variables provides valuable insights into their relationships. Notably, there is a positive correlation between default risk (PD) and short-term debt to assets ratio (STDA), with a correlation coefficient of approximately 0.4257. This implies that as listed real estate firms increase their reliance on short-term debt, their default risk tends to rise as well. A similar positive correlation exists between PD and total debt to assets ratio (TDA), with a correlation coefficient of about 0.4864, indicating that higher total debt levels are associated with higher default risk. This is absolutely true for businesses not only in the real estate sector, because using a lot of debt creates good financial leverage to increase profitability but the risks are high.

Volatility (Vol) exhibits a strong positive correlation with default risk (PD), with a correlation coefficient of roughly 0.6491, suggesting that real estate firms experiencing greater price volatility are more likely to face with higher default risk. Conversely, firm size (SIZE) displays a negative correlation with PD, with a correlation coefficient of approximately -0.1824, indicating that larger firms tend to have lower default risk.

In terms of debt characteristics, short-term debt to assets ratio (STDA) and total debt to assets ratio (TDA) exhibit a strong positive correlation, with a correlation coefficient of approximately 0.7225. This suggests that as firms increase their reliance on short-term debt, their total debt to assets also tends to rise. Variables represent maturiry (LTDD, STDD), source of debt (BDTA, BDTD, BDTD, PDTD) and cost of debt (COD) does not reveal a strong correlation with PD.

5.3 Regression analysis

Table 4. Regression results

SUMMARY OUTPUT

Regression Statistics	
Multiple R	0.868460148
R Square	0.754223028
Adjusted R Square	0.731449297
Standard Error	0.138547686
Observations	210

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	15	11.48661	0.76577	39.89348	0.00000
Residual	195	3.74311	0.01920		
Total	210	15.22972			

	Coefficients	*Standard Error*	*t Stat*	*P-value*
LTDA	0.40444	0.22679	1.78334	0.07609
STDA	0.32035	0.17979	1.78179	0.07634
TDA	0.21531	0.16593	1.29760	0.19596
LTDD	-0.11091	0.15387	-0.72078	0.47191
STDD	-0.04166	0.07727	-0.53916	0.59039
COD	0.26176	0.28906	0.90557	0.36628
SIZE	-0.06308	0.01848	-3.41359	0.00078
Vol	0.21738	0.01471	14.78126	0.00000
TANG	0.17765	0.11226	1.58251	0.11515
PROF	-0.12781	0.15071	-0.84802	0.39746
GROWTH	-0.00224	0.00555	-0.40347	0.68704
BDTA	-0.07279	0.29510	-0.24665	0.80544
PDTA	-0.68249	0.62722	-1.08811	0.27789
BDTD	0.09521	0.17705	0.53775	0.59136
PDTD	0.44531	0.35114	1.26818	0.20625

The regression analysis results presented in the provided statistics tables offer valuable insights into the performance of the model used to examine the dataset of 210 observations. The multiple correlation coefficient (Multiple R) stands at 0.8685, signifying a robust positive correlation between the independent variables, including capital structure, debt characteristics and other metrics, and the dependent variable, PD. Furthermore, the coefficient of determination (R Square) is notably high at 0.7542, indicating that approximately 75.42% of the variance in PD can be accounted for by the predictors in the model. This substantial explanatory power underscores the model's effectiveness in elucidating the relationships between financial variables and default risk. The adjusted R Square value of 0.7314, while slightly lower than R Square, continues to affirm the model's strong fit. Turning to the Analysis of Variance (ANOVA) table, the F-statistic of 39.8935 is highly significant, with a minuscule associated p-value (Significance F) of approximately 0.000 (<0.05).

The Regression Results table provides insights into the relationship between various independent variables and the dependent variable, PD. Among the variables considered in the regression model, LTDA, STDA, have an impact on PD, however the relationships are quite weak (P-value =0.07). An increase in both LTDA and STDA was linked to a higher PD, the adverse impact of these capital structure metrics on default risk. The result concerning LTDA one more time contradict to (Gul and Cho, 2019), as well as Merton (1977), Gruber and Warner (1977), while the correlation of STDA and PD is totally unified to previous studies (Forte and Pena, 2011; Gul and Cho, 2019). In contrast, larger real estate firms, as measured by SIZE, demonstrated a lower probability of default. Notably, higher volatility levels, as measured by VOL, strongly

correlated with an increased PD. These variables demonstrate as statistically significant predictors of PD. Actually, in Vietnam, larger listed real estate firms have many projects in various provinces, so cash flow can circulate between projects and they also have many forms of capital mobilization to have more opportunities to pay the due debt which helps to reduce risk. Besides that, in the period of 2018-2022 means before, during and after Covid-19, the Vietnamese real estate has many changes, as there are times of growth in demand, there are times of decline due to social distancing, these affect the fluctuation of equity returns or volatility and affect PD in consequence.

Conversely, several variables, including long-term debt to debt (LTDD), short-term debt to debt (STDD), cost of debt (COD), tangibility of assets (TANG), profitability (PROF), growth opportunities (GROWTH), bank debt to total assets (BDTA), public debt to total assets (PDTA), bank debt to total debt (BDTD), and public debt to total debt (PDTD), did not exhibit statistically significant impacts on PD within this regression model.

6. Conclusions

Prior to the Covid-19 pandemic, many Vietnamese real estate enterprises had established a significant presence in the market. They often relied on a mix of equity and debt to finance their operations and expansion plans. The capital structure was typically a combination of internal funds, investor contributions, bank loans, and bonds. When the Covid-19 pandemic hit, the real estate sector in Vietnam, like many others globally, faced challenges such as reduced demand, supply chain disruptions, and economic uncertainty. This had a direct impact on the capital and debt structure of real estate enterprises. Many companies experienced cash flow constraints, making it difficult to service their existing debts. Some had to defer or renegotiate payment terms with lenders to manage their financial obligations. The pandemic's impact on demand for real estate projects led to a slowdown in new developments and sales, which in turn affected companies' ability to generate revenue and secure new financing, which leads to the risk of default. This research contributes significantly to the existing body of knowledge by offering a comprehensive examination of the correlation between capital structure, debt characteristics, and default risk in the Vietnamese real estate market. While previous studies have explored aspects of capital structure and debt characteristics in listed companies in general, this research provides unique insights into their impacts on default risk specificcaly for the case of real estate industry, which was relatively unexplored in the context of Vietnam. By bridging this research gap, this study enriches the understanding of default risk management in the real estate industry.

In applying the KMV model with 42 listed real estate companies on the Vietnamese stock exchange, one of the key findings of this empirical study is the significant role played by the long-term debt to assets (LTDA) and short-term debt to assets (STDA) in predicting the probability of default (PD). This ratio, representing the extent to which a company's assets are financed by debt, emerged as a robust indicator of default risk. Companies with higher LTDA, STDA levels were found to be at a substantially greater risk of default, underscoring the importance of prudent debt management within the real estate industry.

Firm size (SIZE) also emerged as crucial factors influencing default risk. Larger companies, as measured by SIZE are associated with a lower likelihood of default. These findings highlight the potential advantages of scale of business .Moreover, the study identified the significant impact of Volatility on default risk. Higher levels of volatility, reflecting economic and market instability, were strongly correlated with an elevated probability of default. This underscores the vulnerability of real estate companies to economic fluctuations and emphasizes the importance of risk management strategies in times of market uncertainty.

It is important to note that several variables reflecting maturity, source of debt and cost of debt did not exhibit significant relationships with PD in this analysis. This suggests that the impact of these variables

may vary under different economic conditions or within the specific context of the Vietnamese real estate industry.

In summary, this research contributes valuable insights for businesses, investors, financial decision-makers, financial institutions, and other stakeholders. It emphasizes the critical importance of debt management, financial stability, and risk mitigation strategies in reducing the probability of default among real estate companies. Further research, encompassing a broader range of economic and industry-specific factors, would enhance our understanding of default risk dynamics of this evolving sector.

Moreover, the sample size and representation could be considered a limitation. The study concentrated on listed real estate firms, potentially excluding smaller or non-listed entities that could exhibit different financial dynamics. Additionally, it may not fully account for unlisted real estate projects, which often play a significant role in the Vietnamese real estate landscape. Future research might benefit from a more inclusive sampling strategy that incorporates a broader spectrum of industry participants. Segmenting the real estate sector into residential, commercial, and industrial subsectors and analyzing them separately can provide a more granular view of risk factors specific to each segment. This approach allows for tailored insights and recommendations based on the unique dynamics of each subsector.

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