Faculty of Economics and Business

The Effect of Capital Structure on Firm Performance During COVID-19 Pandemic: Evidence from Technology Listed Companies in Malaysia

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DECLARATION

I declare that the work in this dissertation was carried out in accordance with the regulations of Universiti Malaysia Sarawak. Except where due acknowledgements have been made, the work is that of the author alone. The dissertation has not been accepted for any degree and is not concurrently submitted in candidature of any other degree.

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ABSTRACT

This study examines the relationship between capital structure and firm performance of technology companies listed in Malaysia, incorporating the impact of the COVID-19 pandemic. The specific objectives are to assess the effect of capital structure on firm performance before and during the pandemic, as well as the moderating role of COVID-19. The analysis is based on a sample of 117 technology firms listed on Bursa Malaysia across the Leap, Main, and ACE markets. Using unbalanced panel data spanning from 1992 to 2022, this study employs return on assets (ROA) as the dependent variable. The independent variables include the total debt to total assets ratio (DTA) and long-term debt to total assets ratio (LTDA), while tangibility (TANG), firm size (SIZE), and firm growth (GROWTH) serve as control variables. The COVID-19 pandemic is incorporated as a moderating variable. Findings from the fixed effects panel regression analysis indicate that both DTA and LTDA have a significant negative impact on ROA, both before and during the pandemic. However, firms adjusted their capital structures throughout the crisis to mitigate financial distress, as evidenced by the moderating interaction terms. Additionally, firm size and growth are identified as key drivers of ROA, as they enable firms to scale operations and generate higher revenues. Ultimately, the study suggests that firms should adopt effective debt management strategies to optimize their capital structure and enhance financial resilience. Financial institutions, in turn, should develop adaptive financing solutions that support businesses in navigating economic disruptions.

Keywords: Capital structure, financial performance, technology, COVID-19, Malaysia

Kesan Struktur Modal Terhadap Prestasi Syarikat semasa Pandemik COVID-19: Bukti daripada Syarikat Teknologi Disenaraikan di Bursa Malaysia

ABSTRAK

Kajian ini mengkaji hubungan antara struktur modal dan prestasi syarikat teknologi yang disenaraikan di Bursa Malaysia, dengan mengambil kira kesan pandemik COVID-19. Objektif spesifik kajian ini adalah untuk menilai kesan struktur modal terhadap prestasi syarikat sebelum dan semasa pandemik, serta peranan pemoderasi COVID-19. Analisis ini berdasarkan sampel 117 syarikat teknologi yang disenaraikan di Bursa Malaysia merentasi pasaran Leap, Utama, dan ACE. Menggunakan data panel tidak seimbang dari tahun 1992 hingga 2022, kajian ini menggunakan pulangan ke atas aset (ROA) sebagai pembolehubah bersandar. Pembolehubah penentu merangkumi nisbah jumlah hutang kepada jumlah aset (DTA) dan nisbah hutang jangka panjang kepada jumlah aset (LTDA), manakala aset ketara (TANG), saiz firma (SIZE), dan pertumbuhan firma (GROWTH) berfungsi sebagai pembolehubah kawalan. Pandemik COVID-19 dimasukkan sebagai pembolehubah pemoderasi. Dapatan daripada analisis regresi panel kesan tetap menunjukkan bahawa kedua-dua DTA dan LTDA mempunyai kesan negatif yang signifikan terhadap ROA, baik sebelum mahupun semasa pandemik. Walau bagaimanapun, firma telah menyesuaikan struktur modal mereka sepanjang krisis untuk mengurangkan tekanan kewangan, seperti yang dibuktikan oleh terma interaksi pemoderasi. Tambahan juga, saiz firma dan pertumbuhan dikenal pasti sebagai pemacu utama ROA kerana ia membolehkan firma mengembangkan operasi dan menjana hasil yang lebih tinggi. Secara keseluruhannya, kajian ini mencadangkan agar firma harus mengamalkan strategi pengurusan hutang yang berkesan untuk mengoptimumkan struktur modal dan meningkatkan daya tahan kewangan.

Institusi kewangan, pada masa yang sama, harus membangunkan penyelesaian pembiayaan adaptif yang menyokong perniagaan dalam menghadapi gangguan ekonomi.

Kata kunci: *Struktur modal, prestasi kewangan, teknologi, COVID-19, Malaysia*

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ACE	Access, Certainty, Efficiency
CAGR	Cumulative annual growth rate
COVID	Coronavirus disease
DOSM	Department of Statistics Malaysia
DTA	Total debt to total assets
E&E	Electrical and electronic
FGLS	Feasible generalized least squares
FE	Fixed effect
GDP	Goss domestic products
GLS	Generalised least square
GMM	Generalised Method of Moments
GROWTH	Firm's growth
LM	Lagrange Multiplier
LTD	Long-term debt
LTDA	Long-term debt to total assets
MCMC	Malaysian Communications and Multimedia Commission
METS	Malaysia external trade statistics
MSC	Multimedia Super Corridor
OLS	Ordinary least square
PCSE	Panel-corrected standard errors
RE	Random effect

ROA	Return on assets
ROE	Return on equity
R&D	Research and development
SIZE	Firm size
STD	Short-term debt
TANG	Tangibility
TD	Total debt
UNIMAS	Universiti Malaysia Sarawak
VIF	Variance Inflation Factor

CHAPTER 1

INTRODUCTION

1.0 Introduction

Technology sector has become a cornerstone for modern economic growth. Its' contribution not only to the creation of innovation but also employment, revenue generation, and globalization. Technology companies, from digital services, software, semiconductors to technology equipment, are in the frontline position concerning driving industrial revolutions and societal transformation. Financial structures and performances essential to the survival of technology companies depend on many factors, including capital structure decisions, market volatility, and external shocks related to the COVID-19 pandemic. The capital structure of a firm reveals the proportionate mix of both debt and equity financing, which afterward curates the financial performance of that firm. The capital structure decisions undertaken by a firm influence factors like profitability, risk, and growth potential. Technology firms, firms with high intangible asset reliance, considerable R&D investments, and changing market conditions, especially face an uphill challenge in optimizing their capital structures. These challenges have risen nowadays, as there are many disruptions happening globally due to the COVID-19 pandemic.

The pandemic brought about unmatched uncertainty to the world's markets and sledgehammered the technology company much more than industry peers. Supply chain disruptions, changing consumer behaviour, and shifting demand patterns have redrawn operational and financial priorities. Technology firms, usually capital-intensive and innovation-driven, had to revisit their financial play in view of the issues at hand. The pandemic also presented new opportunities for growth in digital services and

semiconductors, as the reliance on technology globally began to increase visibly. But this interplay of pandemic-driven challenges and opportunities beckons to more fundamental questions: what is the optimum capital structure, and how does it relate to firm performance? Indeed, the case of Malaysia's technology sector is relevant in this scenario. Since the country has vowed for economic transformation, an imperative need, simultaneously, emerged for a technology sector serving as an important driver of growth. Hence, MyDIGITAL aims at accelerating digitalization and technological adoption. Policies like these places the technology industry at the heart of Malaysia's economic journey. Notwithstanding these developments, the financial dynamics of technology firms remain understudied, particularly with regard to their capital structure and how they would respond to exogenous shocks such as COVID-19.

This study examines how the COVID-19 pandemic has affected the capital structure-performance nexus of technology firms listed in Malaysia. As a yardstick of firm performance, this study focused on the return on assets (ROA), capital structure variables included the total debt to total assets ratio (DTA) and the long-term debt to total assets ratio (LTDA), while tangibility, growth, and size of firm are the control variables. The paper contributes to the literature on how capital structure decisions impact firm performance through an investigation into the unique financial dynamics in the context of technology firms during the pandemic.

1.1 Background of the Study

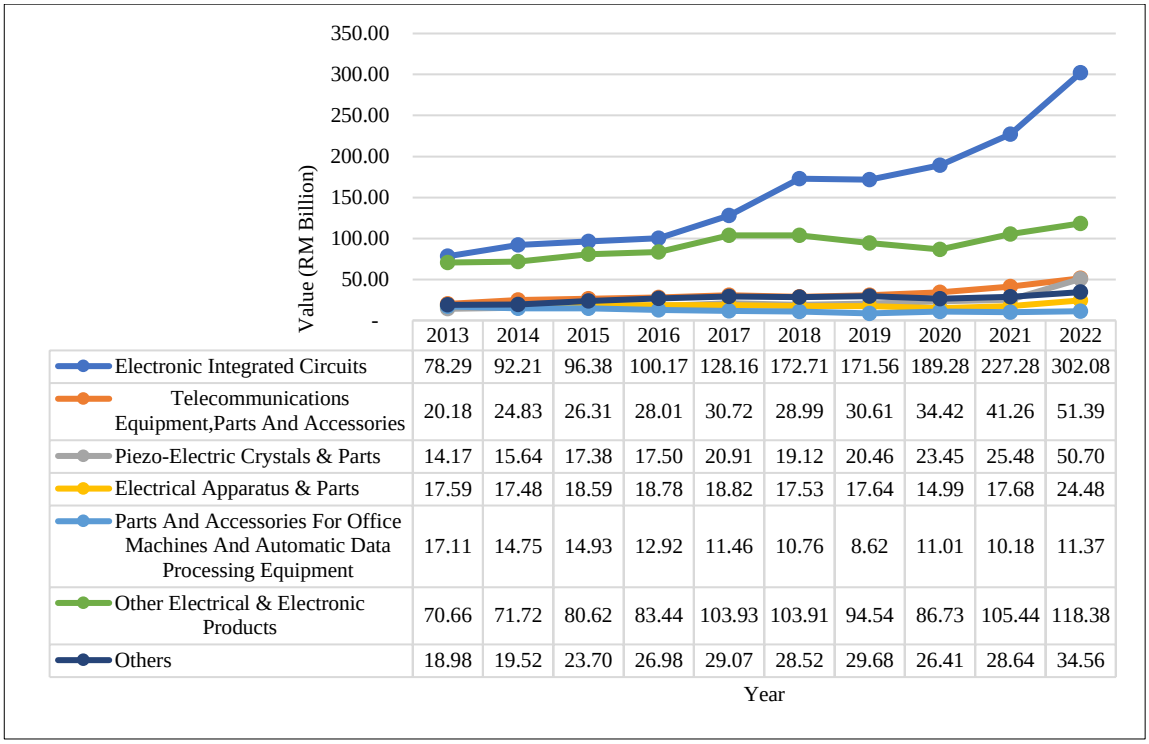
1.1.1 Economic Transformation of Malaysia

During the past few decades, Malaysia has undergone rapid economic transformation from an agriculture-based economy to one that is increasingly diversified toward industry

and services sectors. Innovation and technology have always formed the bedrock of economic growth, continuously pursued through policies such as the Eleventh Malaysia Plan and the National Policy on Industry 4.0. These policies emphasize digitalization, technology innovation and sustainable development to position Malaysia as a regional technological and innovative hub. The technology sector is critical in Malaysia's journey toward becoming a high-income economy. The government has helped to articulate this vision, leading to the issuance of policy initiatives such as the Malaysia Digital Economy Blueprint, popularly known as MyDIGITAL, with the year 2030 as a guide for attainment of a digitally driven economy (Economic Planning Unit, 2021). This has served as a catalyst for huge investments into infrastructural development, R&D and education in support of an enabling technology ecosystem. Along the way, technology companies have turned major contributors to Malaysia's gross domestic product and export earnings.

Based on the statistics published by Department of Statistics Malaysia (DOSM) (2023), electrical and electronic (E&E) products exports in 2022 was valued at RM593.0 billion, surged 150.2% as compared to 2013, with cumulative annual growth rate (CAGR) of 9.6%. Subsequently, semiconductor products (i.e. electronic integrated products, piezo-electric crystals & parts and others), which is the major contributor to E&E exports also increased intensely from RM111.4 billion in 2013 to RM387.3 billion in 2022, with CAGR 13.3% (Figure 1.1). Meanwhile, for the contribution towards gross domestic product (GDP), E&E products also contribute significantly towards manufacturing sector. Electronic components and boards, communication equipment and consumer electronics were the major contributor, which constituted 23.8% of manufacturing sector’s GDP (Figure 1.2). Hence, this shows that the growth of technology industry has important and direct

association with Malaysia's economic growth and therefore it is important for government or relevant authorities to put attention on the technology industry in Malaysia.

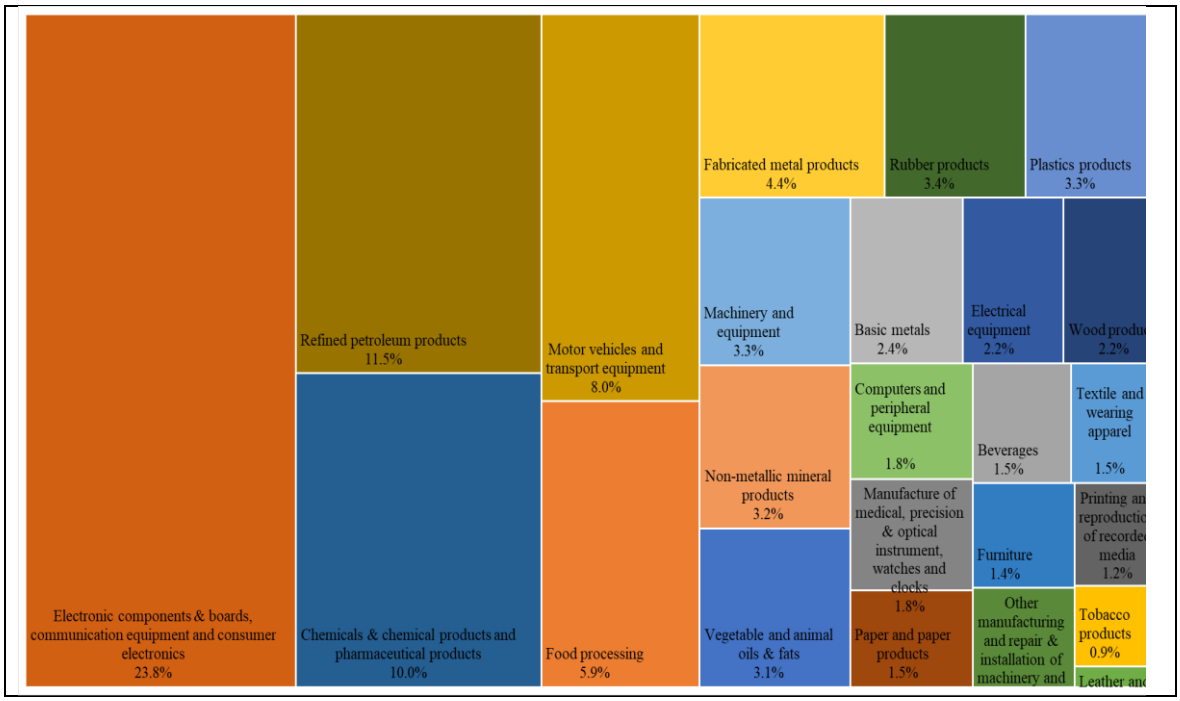


	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Electronic Integrated Circuits	78.29	92.21	96.38	100.17	128.16	172.71	171.56	189.28	227.28	302.08
Telecommunications Equipment,Parts And Accessories	20.18	24.83	26.31	28.01	30.72	28.99	30.61	34.42	41.26	51.39
Piezo-Electric Crystals & Parts	14.17	15.64	17.38	17.50	20.91	19.12	20.46	23.45	25.48	50.70
Electrical Apparatus & Parts	17.59	17.48	18.59	18.78	18.82	17.53	17.64	14.99	17.68	24.48
Parts And Accessories For Office Machines And Automatic Data Processing Equipment	17.11	14.75	14.93	12.92	11.46	10.76	8.62	11.01	10.18	11.37
Other Electrical & Electronic Products	70.66	71.72	80.62	83.44	103.93	103.91	94.54	86.73	105.44	118.38
Others	18.98	19.52	23.70	26.98	29.07	28.52	29.68	26.41	28.64	34.56

Year

Note: Malaysia External Trade Statistics (METS) Online, Department of Statistics Malaysia.

Figure 1.1: Malaysia E&E Products Exports, 2013-2022



Note: Annual Gross Domestic Products 2015-2022, Department of Statistics Malaysia.

Figure 1.2: GDP by Kind of Economic Activity for Manufacturing Sector, 2022

1.1.2 Emergence of the Technology Industry in Malaysia and Relevant Policies

Over the past two decades, Malaysia's technology industry has been expanding rapidly, driven through a series of incentives introduced by the government and foreign direct investments meant to meet the increased global demand for technology. Many notable policy initiatives, such as Multimedia Super Corridor (MSC) Malaysia, have thus offered incentives for technology companies to set up shop in the country. It therefore attracted international players and fostered the growth of domestic firms that contributed toward sector diversification and competitiveness. Malaysia's technology sector broadly develops in four main sub-sectors comprising digital services, software, semiconductors, and technology equipment. These sub-sectors put together form the backbone of the nation's technology ecosystem for both their domestic and international markets. Take, for instance, semiconductor manufacturing, where Malaysia is counted among the world's largest

exporters. The country manufactures key products that are used by fabrication industries worldwide to make goods such as automobiles and consumer electronics. Moreover, it also recentralized digital services and software development, especially in e-commerce, fintech, cloud computing, among other areas, impelled by the ever-increasing digital adoption by businesses and consumers.

1.1.3 Developments in Technology Key Sub-Sectors

(a) Digital Services

The sub-sector of digital services encompasses, among other things, e-commerce, cloud computing, fintech, and digital marketing. Usage has grown in this sub-sector due to gigantic leaps in the use of the internet and especially mobile devices. According to Malaysian Communications and Multimedia Commission (MCMC), internet usage in Malaysia reached 96.8% in 2022 and has thus enabled the rapid expansion of digital services. This was further accelerated by the COVID-19 pandemic, which saw businesses and consumers increasingly rely on digital solutions for communications, transactions, and operations.

(b) Software

Malaysia's software industry has evolved significantly, with huge support for investment in human talent development and R&D. Some of the local companies include MYEG Services and TimeTec that have emerged in the front rank for their innovative solutions around enterprise software, cyber security, and AI. Initiatives at the governmental level also include the Digital Tech Industry Talent Development Program to help address the skill gaps and facilitate a continuous supply of talents that this sub-sector requires.

(c) Semiconductors

This semiconductor sub-sector has been one of the pillars of the technology industry in Malaysia, with more than 13% contribution to the world's semiconductor assembly and test capacity. Powerful players such as Infineon Technologies and Intel have set up bases in Malaysia, benefiting from the strategic location, skilled labor, and quality infrastructure that the country has been offered. This sub-sector has seen very strong and fast growth arising from increasing global demand for semiconductors, steered by the trends adopted such as 5G, electric vehicles, and IoT applications.

(d) Technology Equipment

The sub-sector manufacture of hardware components, equipment for telecommunications, and electronic devices makes up this sub-sector. Companies in this segment are also critically needed to help the more general industrial base in Malaysia by providing vital inputs into other manufacturing industries, healthcare, and logistics. It is here where modernization, driven by innovations and the promotion of Industry 4.0 by the government, radically impacts on this sub-sector, locating firms at the cutting edge of advanced manufacturing technologies and competitiveness.

(e) Quintile Segmentation of Technology Key Sub-Sector

Table 1.1 presents the quintile segmentation for the average value of ROA, DTA, and LTDA in the technology sector. By segregating it into four sub-sectors (i.e. digital services, semiconductors, software, and technology equipment), it enables us to explore a range of capital structures and firm performance across different levels of quintiles.

Table 1.1: Quintiles Segmentation of Technology Key Sub-Sector

Sub-Sector	Quintile	ROA	DTA	LTDA
Digital Services	20%	-0.01	0.39	0.07
	40%	0.02	0.42	0.08
	60%	0.04	0.45	0.10
	80%	0.05	0.67	0.15
Semiconductor	20%	0.02	0.29	0.09
	40%	0.05	0.32	0.10
	60%	0.08	0.33	0.11
	80%	0.11	0.45	0.16
Software	20%	-0.10	0.23	0.04
	40%	-0.04	0.24	0.05
	60%	-0.00	0.26	0.05
	80%	0.09	0.29	0.06
Technology Equipment	20%	-0.00	0.29	0.04
	40%	0.01	0.32	0.06
	60%	0.03	0.35	0.07
	80%	0.07	0.40	0.08
Sector	**Quintile**	**ROA**	**DTA**	**LTDA**
Technology	20%	-0.02	0.31	0.07
	40%	0.02	0.33	0.08
	60%	0.04	0.35	0.11
	80%	0.06	0.51	0.12

Note: Author's calculation based on average value of ROA, DTA, and LTDA.

ROA ratio for the digital services sector shows substantial growth across all quintiles from -0.01 (quintile 20%) to 0.05 (quintile 80%). This performance leads to dramatic debt accumulation since the DTA ratio moves from 0.39 (quintile 20%) to 0.67 (quintile 80%). The LTDA ratio shows substantial growth between 0.07 and 0.15, which demonstrates increasing usage of long-term debt. This indicates that digital services companies fuel growth through substantial debt utilization; therefore, investors consider them as high-impact yet risky investments.

The semiconductor sub-sector stands out as the most performing segment in the technology sector because its' average ROA ratio has grown from 0.02 (quintiles 20%) to more than 0.11 (quintiles above 80%), which represents the highest firm performance level among all technology sub-sectors. The financial structure of DTA also shows a positive association with ROA as the ratio increased from 0.29 at quintiles 20% to 0.45 at quintiles 80%. However, the average LTDA ratio remains stable, shifting from 0.09 (quintiles 20%) to 0.16 (quintiles 80%). However, the ratio is higher as compared to other sub-sectors in the technology sector. This implies the semiconductor sub-sector depends highly on long-term debt finance to secure stronger financial stability.

For the software sub-sector, it shows improving momentum, whereby the average ROA ratio improves from -0.10 at quintiles 20% to 0.09 at quintiles 80%. This reflects higher demand in the market, especially during the pandemic and the era of digitalization that boosted utilization of software tools. Yet, the DTA ratio remains stable, going from 0.23 (quintiles 20%) to 0.29 (quintiles 80%), and the LTDA ratio shifts from 0.04 (quintiles 20%) to 0.06 (quintiles 80%), which is relatively lower than digital services and the semiconductor sub-sector. This indicates the software sub-sector is in growing financial stability as it uses less debt; therefore, it represents a lower-risk investment option.

The technology equipment sub-sector obtains the lowest firm performance growth among sub-sectors because the ROA ratio rises from a negative value to 0.07 (quintiles 80%). The DTA ratio is quite high, increased from 0.29 (quintiles 20%) to more than 0.40 (quintiles above 80%). The LTDA ratio demonstrates moderate yet balanced long-term debt exposure after it increased from 0.04 (quintiles 20%) to 0.08 (quintiles 80%). Technology

equipment firms demonstrate restricted financial efficiency because they operate under high operational expenses and competitive market challenges, which will affect their ROA.

Overall, the technology sector demonstrates continuous firm performance grow through its rising average ROA ratio from -0.02 to more than 0.06 (quintiles above 80%) at the sector-wide level. The DTA and LTDA ratios also surge from 0.31 to above 0.51 and 0.07 to above 0.12, respectively. Research indicates that higher ROA ratios in firms signify effective operational efficiencies and optimal asset utilization (Bodie et al., 2018). This supports the notion of the resource-based view theory since firms that excel in resource management and financial management achieve superior performance (Barney, 1991).

1.1.4 Emergence of COVID-19 Pandemic

The COVID-19 pandemic marked a point beyond which life, industries, and consumer behaviours would never again be the same in the global economy. For the technology industry, the pandemic brought both challenges that needed overflow and new opportunities. On one hand, supply chain disruptions, workforce shortages, and economic uncertainty were huge obstacles to firms. But on the other hand, accelerating digital transformation across many industries increased demand for technology solutions during the crisis.

In Malaysia, the technology sector proved resilient during the pandemic, with sub-sectors such as digital services and semiconductors registering growth. Increased work-from-home arrangements and other applications, e-commerce, and electronic payments fueled demand for digital solutions, while worldwide semiconductor chip shortages made it clear how critical Malaysia's semiconductor industry was to total global supply. Technology

equipment and software companies faced great challenges in continuing operations, securing finance, and navigating uncertainties.

1.1.5 The Relationship between Capital Structure and Firm Performance: An Empirical View in the Context of COVID-19 Pandemic

Capital structure, which relates to the mix of debt and equity financing, has traditionally been viewed as a factor affecting performance. In this respect, theories such as the trade-off theory and pecking order theory provide details that firms make their financing decisions based on parameters like tax advantages, costs concerning bankruptcy, and asymmetry in information. The high dependence on intangible assets and R&D investments complicates capital structure decisions for technology firms because such assets are usually less attractive to lenders than tangible assets. The COVID-19 pandemic, therefore, amplified the challenges associated with capital structure decisions. Highly indebted companies suffered more due to increasing financial distress following sinking revenues and heightened uncertainty, while conservative ones were in a better place to resist the crisis-shock waves. In the Malaysian technology industry, the impacts of the ongoing pandemic on their financing and performance differ across sub-sectors, which needs closer attention.

This paper explores the effect of the COVID-19 pandemic as a moderator on the relationship between capital structure and the performance of firms in Malaysia's technology sector. Focusing on return on assets as a firm's performance indicator and analysing the key capital structure indicators such as total debt to total assets and long-term debt to total assets, the present study tries to shed some light on the technology firms that optimize their financial strategies within a rapidly changing environment. These findings have great implications for

policies, investors, and most importantly industry stakeholders in view of post-pandemic recovery and pursuit of sustainable growth in technology sector.

1.2 Problem Statement

The major chunk of the literature has explained the impact of capital structure on firm performance with a focus on traditional industries and general economic conditions. Considering the rapid change that happens within the technology sector, especially given the heights it has reached and its importance during the COVID-19 pandemic, the need exists to focus more closely on that area and study updated aspects. However, the technology sector in Malaysia has been transformed into a vital driver of economic growth, innovation, and global competitiveness. However, there is a lack of complete understanding regarding how the capital structure factor induces the financial performance of companies in this sector, more specifically under the unprecedented external shocks such as the COVID-19 pandemic. As leaders in technological innovation globally, the financial performance of technology firms around the world is crucial not only for survival but also for overall economic progress. Having emerged as an important part of the overall economy in Malaysia, the technology sector has made a huge contribution to the country's GDP, foreign exports, and jobs. Indeed, the industry has grown variously and dynamically for digital services, semiconductors, software, or even technology equipment serving local and international markets. Despite this all, the financial performance of such companies still seems to show volatility factors due to rapidly fluctuating market conditions, high competition, and inherent risks associated with innovation in technology.

The importance of this sector was even better recognized during the COVID-19 pandemic. Even though most industries were experiencing declines, segments in the

technology sector, such as semiconductors and digital services, witnessed high demand due to changes in consumer behavior and due to acceleration in digital transformation. This growth has not happened all over the technology sector; other sub-sectors have to face supply change disruptions and increased operational costs. These divergences highlight the need to understand the various financial determinants, which eventually enable the firms to emerge successfully or collapse in front of such disruption. Capital structure of the firm is one of the major aspects of financial management within the firm and, hence, it plays an utmost role in determining the performance of the firm during this period. The technology firm is inherently complex in their capital structure decisions due to their reliance on intangible assets-that is, intellectual property and R&D investments. Unlike tangible assets, which are easily collateralized, many intangible assets-carry higher perceived risks for the lender and therefore lead to constrained access to debt financing. Besides, technology companies work in extremely dynamic markets marked by a short life cycle of their products, extreme competition, and unpredictable results from innovations. This makes their environment volatile, increasing the risks of doing business, therefore making the trade-offs between debt and equity financing even more complex (Myers, 1984).

Besides, technological companies in Malaysia are struggling with bigger complications than their worldwide technological hubs in the United States or Europe because Malaysia has regulatory environments, changed market demands, and lack of access to venture capital. This complicates decisions about the capital structure even further, and therefore it is relevant to provide a closer insight with regard to how these factors influence the performance of a firm. These suggestions are further supported by several studies such as that by Modigliani and Miller (1958) and the pecking order theory, where it was found that companies select their capital structure based on the cost of financing and risk factors.

However, these theories alone are insufficient to explain the particularities of technology firms during an era of exogenous shock faced in the case of the COVID-19 pandemic.

The outbreak of COVID-19 brought unprecedented disruptions in the global economy, with more significant consequences for the capital structure and firm performance. In such a scenario, technology firms faced challenges occasioned by supply chain disruption and shortages of the workforce, balanced with opportunities related to heightened demand for digital solutions. In such a context, the increase in the intricacy of this environment was even more elevated, as decisions about the capital structure weighed much on a firm's ability to adapt and thrive. Highly indebted firms may have struggled to meet their financial obligations in the context of falling revenues, while firms with more conservative financing strategies may prove more resilient. The pandemic thus had the effect of magnifying the impact of capital structure on the performance of the firms and was, therefore, an important area of inquiry. For instance, the firms with high levels of long-term debt may suffer liquidity constraints, while those with judicious mix of equity and short-term debt are better positioned to see out the crisis. In a nutshell, the enhanced knowledge of how the pandemic interacts with different capital structures in order to impact financial outcomes is vital for devising effective financial strategies for the technology sector.

Despite this fact, much research has been conducted about the capital structure and firm performance, there are still some major gaps, especially regarding the context of Malaysia's technology sector. Most of the studies previously conducted relate to conventional industries or generalized market conditions and, therefore, provide limited insights regarding the specific nature of technology firms. Moreover, very few studies have investigated the moderating role of COVID-19 in this relationship, which keeps many

important questions still unanswered. For example, how did capital structure choices before the pandemic impact the ability of firms to adapt during the crisis? Did some financing strategies reveal their weaknesses, which were exposed by the pandemic, or did the pandemic show that they were resilient? Although a number of previous literatures has been instrumental in highlighting the general principles of the capital structure, such as the trade-off theory and the pecking order theory, these are not very likely to completely capture the peculiar risks and opportunities that technology firms face. For example, R&D investments, usually equity-financed rather than debt-financed, are by nature very risky and uncertain in the form of returns that this investment may yield. This is a dynamic that may be further complicated by the pandemic, which has altered market conditions and investor preferences.

Technology firms represent a unique and interesting domain of study due to dependency on innovation, high market volatility, and also because of their contributory role in economic development. The fact that intangibles and R&D investments have such great prominence in the sector differentiates it from earlier sectors and thus has actually made the case an interesting one while looking into the relation of capital structure with performance. Besides, the rapid speed at which technology is changing, combined with the global nature of this industry, offers both opportunities and risks not commonly seen in other industries.

The capital structure-related decisions of technology firms are interesting from the financial point of view. High risk, associated both with innovation and uncertainty in the market, often results in these firms adopting singular financing strategies. The foundations for such strategies will be important in order for investors, policymakers, and industry stakeholders to foster growth and build resilience in the sector. Moreover, because of the

pandemic's influence on the technology sector, there is a need to update this research to new realities and challenges faced by the firms.

1.3 Research Questions

This study is guided by the following research questions:

RQ1: How does capital structures (DTA and LTDA) influence the firm performance (ROA) of technology listed companies in Malaysia?

RQ2: How does capital structures (DTA and LTDA) influence the firm performance (ROA) of technology listed companies in Malaysia during the COVID-19 pandemic?

RQ3: What is the moderating effect of the COVID-19 pandemic on the relationship between capital structure and firm performance in technology listed companies in Malaysia?

1.4 Research Objectives

1.4.1 General Objective

Generally, this study aims to investigate the relationship between capital structure and firm performance of technology listed companies in Malaysia and examine the moderating effect of the COVID-19 pandemic on this relationship.

1.4.2 Specific Objectives

RO1: To analyze the relationship between capital structures (DTA and LTDA) and firm performance (ROA) of technology listed companies in Malaysia.

RO2: To examine the relationship between capital structures (DTA and LTDA) and firm performance (ROA) of technology listed companies in Malaysia during COVID-19 pandemic.

RO3: To assess the moderating effect of the COVID-19 pandemic on the relationship between capital structure (DTA and LTDA) and firm performance (ROA) in technology listed companies in Malaysia.

1.5 Significance of the Study

This has been a very valued study for various stakeholders, including businesses, policymakers, academics, and society in general. Based on the moderating effect of the COVID-19 pandemic on the association between capital structure and firm performance in the Malaysian technology sector, this study provides actionable insights that enhance decision-making capabilities to help attain sustainable growth.

1.5.1 Significance to Businesses

The present study consequently presents practical insights into capital structure optimization for performance improvement in technology sector businesses and, in particular, those listed in Malaysia. Technology firms by nature often operate in a turbulent environment characterized by high risks and substantial investment in intangible assets such as R&D. This research identifies how capital structure decisions, including total debt to total assets and long-term debt to total assets, influence firm performance during periods of external shocks such as the COVID-19 pandemic. By understanding these dynamics, firms can make informed financial decisions to improve resilience and maintain profitability in uncertain times. These findings are particularly necessary for firms that focus on finding a

balance between growth goals and the management of risks. For instance, it draws on how firms should make use of debt financing vis-à-vis their financial stability. Second, with regard to flexible strategies for disrupted markets, the paper points out that such firms need to show competitiveness in an ever-evolving industry environment at all times.

1.5.2 Significance to Policymakers

Policymakers are yet one of the leading players in determining both the regulative and financial environment in which businesses operate. The research, therefore, contributes to policy decision-making through the provision of evidence regarding the effects that the COVID-19 outbreak has had on the financial performance of technology firms in Malaysia. Through such findings, they thus stand in a better position where they can execute interventions that are appropriate for nurturing the sector through the use of financial incentives, grants, and tax benefits that drive resilience and innovation.

This study further develops the enabling environment that will enable the technology sector to be much more sustainable. This shall come with policies that take into consideration the uniqueness of the needs of technology firms with regard to financing of intangible assets, backstopping of research and development, among others, and even reduction of volatility in markets. It will provide further insight on how policy makers can make more valuable adjustments to the strategies aimed at a balanced and inclusive recovery of the economic impacts of the pandemic.

1.5.3 Significance to Academics

This paper, therefore, holds academic significance in adding to the recently growing literature on capital structure and firm performance, in addition to the impact of external

shocks. There have been many studies on the relationship between capital structure and performance, but few of them incorporate the moderating effect of the COVID-19 pandemic. Such a perspective furthers theoretical understanding of how firms navigate financial challenges across unprecedented crises. The study also sets a base in respect of the relationship between financial management and crisis response; thus, it opens wide avenues for similar research in other contexts and industries. Academics can use this as a means to explore variations across different industries, geographic regions, or economic conditions that come up when there is an expansion of knowledge in this field.

1.5.4 Significance to Society

First, the wider societal relevance of this study is sustained by the fact that it deals with the technology sector, which has been one of the most crucial drivers of innovation, employment, and economic growth. Moreover, the COVID-19 pandemic underlined the critical role that technology has played and continues to play in enabling enterprises, governments, and society as a whole to adapt to new realities such as remote work, digital commerce, and virtual communication. The research at hand specifically identifies those aspects of technology firms that helped them in attaining resilience and sustainability, especially with respect to their financial performance during the pandemic. Technology firms that are strong and resilient serve the greater good by driving innovation, jobs, and economic stability. The insights of this study will go a long way to help these firms continue towards their thriving so that their deliverables can serve in improving the quality of life and foster progress on a long-term basis. Secondly, discovering means of mitigating financial risks contributes to fostering a resilient and inclusive economy that shall be more resistant to possible disruptions in the future.

1.6 Scope of the Study

The paper investigates the effect of the COVID-19 pandemic on the association between capital structure and firm performance in Malaysia technology listed companies. This analysis confines trading to companies belonging to the technology sector, comprising the four mains sub-sectors, which were digital services, software, semiconductors, and technology equipment. This was a strategic selection of sub-sectors, which was done to ensure that the research encompasses various levels of diversity and dynamism in the technology industry of Malaysia. This is because each different technological nature will have its peculiarities in financial structure, market challenges, and so on. In this way, the research gained subtle information about how the capital structure decisions influence performance across changing situations in these subsectors. ROA, used in the study, is generally regarded as a dependent variable for firm performance. For that matter, ROA is considered an appropriate proxy for the effective use of assets by a firm in realizing earnings. The nature of this proxy has made it imperative for consideration of financial performance across different alternative sub-sectors of the technology industries. The independent variables will be DTA and LTDA, representing total debt to total assets and long-term debt to total assets, respectively. Both are integral part of capital structure of the firm. It also controls for tangibility, growth, and firm size in the determination of ROA. The moderating variable in this regard is the COVID-19 pandemic, which is represented as a dummy variable in order to capture the impact on the relationship existing between capital structure and firm performance.

This present study realizes the importance of revisiting the capital structure-firm performance relationship in view of the COVID-19 pandemic. Previous research on this area

is bounded mostly to conventional industries or conditions prior to the pandemic. Few of the available studies consider the moderating effect of external shocks like the COVID-19 pandemic, which has fundamentally shifted market dynamics and financial decision-making. This literature gap underlines the need for updated and sector-specific research that reflects the current realities faced within Malaysia technology industry.

The focus is justified by its increasingly high position in Malaysia's economic scenery, besides being an important driver in innovation and digital transformation. Moreover, the COVID-19 pandemic has underlined further the resilience and adaptability of this sector, making it an ideal case to look at how firms navigate financial challenges during uncertainty. By taking the study scope to listed companies only, the paper has ensured that there would be access to reliable financial data which can be soundly analyzed and compared from one firm and sub-sector to another.

This study shall be defined in scope and targeted on vital critical variables: its focus is on the technology sector in Malaysia, it includes critical financial variables within the sector, and COVID-19 as a pandemic factor which moderates. In this regard, an attempt shall be made to institute an extensive and context-specific analysis that addresses the gaps in literature and also provides actionable insights for stakeholders.

1.7 Chapter Summary

Chapter one introduced the study and laid the foundation for the investigation into the effect of the COVID-19 pandemic within the relationship of the capital structure on the firms' performance in technology listed companies in Malaysia. The chapter began with an overview of the topic; it outlined the rationale of the importance of the technology sector in Malaysia's economic transformation and its increasing importance during the COVID-19

pandemic. Particular attention was given to the unique financial challenges and opportunities related to technology firms, especially with regards to capital structure decisions.

The background highlighted the economic policies of Malaysia in developing the industry of technology and the peculiar features of the four main sub-sectors, including digital services, software, semiconductors, and technology equipment. It also discussed how the pandemic has so far affected the financial and operational nature of these companies, setting a background that necessitates a specific look at the nature of the relationship between capital structure and performance under pandemic conditions.

The problem statement identified the lacuna in the existing literature and justified the need for updated research that reflects current challenges of the technology sector and the pandemic's effects. The research questions and objectives laid down an explicit framework for the study, while the significance of the study identifies its relevance to businesses, policymakers, academics, and society. The scope of the study outlined its focus on technology listed companies, variables of interest, and comparative analysis across sub-sectors.

CHAPTER 2

LITERATURE REVIEW

2.0 Introduction

The capital structure has been one of the major subjects of interest in corporate finance, while its impact on performance remains one of the broad areas of inquiry. The COVID-19 pandemic brought unparalleled challenges by disrupting global economies and shifting industry dynamics across the globe, including that of technology. The technology firms in Malaysia stood at the front in terms of ensuring continuity of businesses and digital transformation during this period. Yet, the pandemic has also exposed them to higher risks, financial constraints, and changing performance metrics that test both the resilience and effectiveness of their capital structures.

This chapter presents a critical review of related literature relevant to setting up the theoretical and empirical grounding of the study. Particularly, it investigates how the capital structure as represented by total debt to total asset ratio (DTA) and the long-term debt to total asset ratio (LTDA) relates to firm performance through its proxy return on assets (ROA). The control variables are tangibility, growth, and firm size combined in the discussion for firm-specific characteristics affecting performance. This chapter also evaluates the moderating role of the COVID-19 pandemic, putting great emphasis on its potential to change the relationship between capital structure and firm performance.

This literature review focuses on the identification of the most appropriate theories underlying the study, such as Trade-Off Theory and Pecking Order Theory, in capital structure. The empirical review summarizes the findings from past studies, especially in

Malaysia and other countries in the technology sector. The chapter concludes by highlighting the gaps in existing literature and develops the hypotheses for this study.

2.1 Theoretical Framework

2.1.1 Trade-Off Theory

Trade-Off Theory is one of the key concepts in capital structure of the firms, and basically it tries to say the benefits derived from a certain amount of debt held against its costs. The Trade-Off Theory was given by Kraus and Litzenberger (1973); they claim that an optimal level for a firm exists where benefits on account of tax shield provided outweigh the marginal costs linked to financial distress and risks associated with bankruptcy. The reason is that this balance is crucial for achieving sustainable financial performance, especially during disruptions caused by the COVID-19 pandemic. Among the most significant debt financing advantages, according to the Trade-Off Theory, is the reduction of a firm's taxable income due to the tax shield and hence increased profitability of its operations. On the other hand, over involvement in debt will increase the possibility of financial distress, especially during periods of economic uncertainty. This is particularly true for technology firms, which often operate in rapidly changing environments and which need heavy investment in innovation and research. High debt ratios can choke these investments and consequently hurt firm performance.

It also focuses on the role of firm-specific characteristics, such as asset tangibility, growth prospects, and liquidity, in determining the optimal capital structure. For instance, high tangibility provides collateral for securing debt and lowers borrowing costs (Frank and Goyal, 2009). In contrast, firms with high growth potential may prefer equity financing to avoid the constraints of fixed debt obligations. These trade-offs aggravate the economic

crises when the capital market is turbulent and not amenable to access to capital. The COVID-19 pandemic has underlined the imperative of achieving an optimal capital structure, as firms with a high indebtedness level have had to face significant challenges, given the shortfalls in cash flow and heightened risks of bankruptcy. For technology firms in Malaysia, the pandemic had a dual edge: although demand for digital solutions surged, operational disruption and supply chain constraints created risks from a financial perspective. The studies by Demmou *et al.* (2021) affirm that firms with balanced leverage have a higher capability for crisis survival, hence showing signs of practical applicability of the Trade-Off Theory.

2.1.2 Pecking Order Theory

Myers and Majluf (1984) developed the Pecking Order Theory to provide another perspective on capital structure decisions, emphasizing information asymmetry. The Pecking Order Theory is based on the premise of a hierarchy of financing preferences for firms, as opposed to the optimal debt-to-equity ratio hypothesized by the Trade-Off Theory. Consequently, they do internal financing first, then debt, followed by equity, in decreasing order, because of these higher costs and information asymmetry risks. This gives much insight into how firms might have been making financing decisions amidst such economic uncertainty and at such an unprecedented time like the COVID-19 pandemic. The Pecking Order Theory postulates that internal financing is the least risky and least costly for firms since it avoids the signalling problems associated with external financing. Debt, while more available than equity, adds fixed obligations and raises the probability of financial distress, especially for firms whose cash flows are not stable. The cost of equity financing is

the most expensive as investors who are uninformed of a firm's prospect can cause its undervaluation (Myers, 1984).

The implications of the theory are immense for technology firms, which often have high growth potential with limited tangible assets. This may make it more difficult to secure debt, and hence, these firms may rely heavily on retained earnings or strategic debt to fund investments in innovation and expansion. This preference for internal financing confirms the predictions of the theory, especially concerning the study variables DTA and LTDA. Firms considered internal financing of capital especially important during the time of the pandemic because there is a liquidity constraint that heightens uncertainty. Wang *et al.* (2022) find that firms with a strong internal reserve position were better prepared to deal with cash-flow disruptions during the crisis, whereas firms reliant on heavy levels of debt struggled to meet fixed obligations, resulting in low profitability and a heightened risk of default. This condition is particularly true for Malaysian technology firms, which, due to their reliance on innovation and high operation leverage, have exemplified this dynamism. This fact highlights that during the pandemic, retained earnings were more preferable than external financing, and therefore, the Pecking Order Theory has been practical.

2.2 Empirical Review

2.2.1 Capital Structure and Firm Performance

The capital structure has been one of the fundamental bases of corporate finance research in view of its link to firm performance. It simply refers to the mix of debt and equity applied by a firm in financing its operations, with influence on such major aspects of performance as profitability, efficiency, and shareholder value. ROA is considered the dependent variable of this study and is one of the most widely used measures of firm

performance because it reveals how well a company uses its assets to generate profit. For instant, Mohammad and Bujang (2020) examined this topic on the three selected industries in Malaysia (i.e. construction, finance, and plantation). This study based on sample period from 2011 to 2015 and employed panel regression method. Like most of the study, this research adopted ROA and ROE as dependent variables, while short-term debt (STD), long-term debt (LTD), and total debt (TD) as independent variables. The outcome of the study is rather mixed and depends on the industries involved. For construction industry, STD and LTD is found to has negative and positive association with ROE, respectively. Meanwhile, for finance industry, TD has negative association with ROA but positive association with ROE. For plantation industry, STD and LTD has positive and negative relationship with ROA and ROE, respectively. As such, this study enables the firms' manager to develop different strategies that suit to their business goal. If the business purpose is to maximise ROA, then the Pecking Order Theory is more suitable. Vice versa, if the purpose is to maximise ROE, then the Trade-Off Theory will be more suitable.

Meanwhile, Jee *et al*. (2021) had studied the relationship between capital structure and firm performance on 39 Malaysian public listed companies which involved in the plantation industry for the 11-year period from 2009 to 2019. The dependent variables involved are ROA and ROE while the four independent variables used which are short-term debt, long-term debt, total debt, and firm growth. Based on the fixed effect panel regression analysis, the findings shown that only total debt and firm growth have significant negative relationship with ROA while there was only firm growth which has significant positive relationship with ROE. The researchers recommended that before companies make the decision on the type of financing chosen, the company should thoroughly understand on the influence of debt financing on the firm performance. And if possible, companies are

recommended to attain optimal capital structure so that lowest cost of capital will be incurred, and the company will have the lowest probability of facing financial insolvency.

According to the research by Anozie *et al*. (2023) which is to measure the impact of capital structure on financial performance of oil and gas firms in Nigeria. The sample period for the study spanned from 2011-2020. The three independent variables used were short-term debt to total assets, long-term debt total assets, total debt to equity and the financial performance is represented by ROA. Based on the outcome generated from pooled OLS, it shows that the short-term debt to total assets and total debt to equity has the positive insignificant relationship with the ROA of the oil and gas firms in Nigeria while the long-term debt to total asset has the negative relationship with company's ROA. The researchers suggested that when making the decision on the capital structure, the company should consider the cost of capital and the benefit that can be derived and should always make sure that the benefit is always greater than cost.

Meanwhile, based on the research from Zhang (2020) which attempt to study the relationship between capital structure and profitability of the 673 Chinese firms in A-share market from the period from 2009 to 2018. The capital structure is represented by short-term debt to total assets, long-term debt to total assets, and total debt to total assets while the profitability is represented by ROE, ROA and profit margin. Based on the result from Pearson correlation analysis and OLS regression, it shows all three independent variables have the negative relationship with the profitability of the business. Besides, the outcome also shows Chinese listed companies prefer equity financing over the debt financing in managing business operation. Since there are some limitations to cover all industries in this study, the researcher therefore suggested to compare each industry separately in future.

To investigate this issue on developed country, Tretiakova *et al*. (2021) choose United Kingdom as their country of study. This study focused mainly on pharmaceutical industry with the sample size of 185 companies. The capital structure variables consist of equity, short, and long-term debt. Besides than ROA, ROIC, change in market capitalization (DMC) and price-to-book (PB) ratio are included as dependent variables. The results from panel regression and Wald test indicated that equity has inverse relationship with PB ratio and ROA but have positive relationship with DMC. In addition, long-term debt is positively related to PB ratio and DMC, while short-term debt negatively related to DMC, ROA and ROIC. Thus, this study supported partly of Pecking Order Theory. Few suggestions also being propose for future study, including enlarge the samples size of company, consider elements of firm size and leverage in sampling, extend more financial indicators and more analysis on developed countries. So that this will be able to give a more precise result.

For the study by Fekadu (2020), which specifically investigate the relationship between capital structure and financial performance of 30 Ethiopia grade one construction companies. This analysis is based on sample data from 2011 to 2015. The results from random effect multiple regression analysis shows that debt to equity and long-term debt has positive relationship with ROA and ROE. Vice versa, debt to assets has negative relationship with ROA and ROE.

Fatima and Mohiuddin (2020) investigate the impact of capital structure on profitability and corporate value of five ceramic listed companies in Dhaka stock exchange, Bangladesh for the period from 2012 to 2018. In this research, the profitability is measured by using return on assets, return on sales, return on equity, net profit margin, and earnings per share while the corporate value was measured by market to equity's book value and

Tobin's Q. Then, the capital structure was represented by short-term debt to asset ratio, long-term debt to asset ratio, total debt ratio, and debt-to-equity ratio. Based on the pooled OLS, fixed effect, random effect model test from R software, the outcome showed that debt-to-equity ratio has the positive relationship with profitability and corporate value while long-term debt to asset ratio has the negative relationship with the both dependent variables. While the capital structure does not have any significant impact on net profit margin.

For Robert *et al*. (2020), a study has been conducted for the companies listed in Nairobi Securities Exchange, Kenya. The objectives of the study are to determine the relationship between firm's financial performance with equity financing, long-term debt financing, and short-term debt financing. By using the secondary data span from 2008-2013, the multiple regression analysis results found that ROA is positively and significantly affected by long-term debt and equity financing, and negatively and significantly by short-term debt.

Meah *et al*. (2020) stated that they studied the correlation between capital structure and the success of Bangladeshi businesses. A total of 39 family businesses and 39 non-family firms made up the sample. Firms listed on the Dhaka Stock Exchange between 2013 and 2017 come from eight different sectors: textiles, cement, engineering, leather, food, ceramics, pharmaceuticals, and fuel and power. The findings from pooled OLS estimation indicated a strong negative correlation between ROA and all leverage ratios, that are short-term debt ratio, long-term debt ratio and total debt ratio. The study strongly agrees the Pecking Order Theory.

To some extent, Aulia and Gandakusuma (2020) looked at the manufacturing companies in ASEAN five nations (i.e. Indonesia, Malaysia, the Philippines, Singapore, and

Thailand), to see how capital structure affected their performance. Their investigation, which included panel data spanning from 2014–2018 and a linear regression model, revealed that TDTA significantly reduce ROA. Although TDTE's negative effect on Tobin's Q is negligible, both TDTA and TDTE dramatically reduce ROE. Sales growth and size also have a favourable impact on a company's performance. The tangibility of assets has a small but unfavourable impact on business results.

Additionally, Minh *et al*. (2019) relied on 17 different listed cement firms in Vietnam to study the relationship between capital structure and firm performance. This study utilizing the data from year 2010 to 2018. The outcome from the quantitative regression model indicated that capital structure exerts a detrimental influence on firm's performance. Furthermore, several control variables demonstrated varying impacts on performance. Specifically, the SIZE variable exhibits a consistently positive association with performance across all models with high reliability. Conversely, the TANG variable shows a negative correlation. However, the impact of the GROW and LIQ variables on business performance remains inconclusive.

Differ from most of the study, Ahmed and Afza (2017) adopt moderating effect of business strategy in the relationship between capital structure and firm performance of the non-financial firms in Pakistan. The results from panel regression estimation showed that high debt ratio is detrimental to the firm's performance. Therefore, suggest to the policy makers does not highly depend on debt financing when the market competition is strong.

Furthermore, using data from the Nigerian Stock Exchange, Ganiyu *et al*. (2019) studied 115 companies to determine how capital structure affected their performance between 1998 and 2015. The yearly reports of publicly listed companies in Nigeria provided

the secondary data utilized for this study. By estimates using the generalised method of moments (GMM), which is a two-step process, the results show that capital structure and company success are positively related. The capital structure, including total and short-term leverage ratios, is associated with return on equity, a measure of a company's profitability. There is a negative correlation between return on equity and the square term of the short-term leverage ratio and the long-term debt to total capital, according to the study.

From 2013-2018, Nguyen and Nguyen (2020) studied Vietnam to see how capital structure affected performance. 448 non-financial enterprises trading on the Vietnam Stock Exchange make up the research sample panel. The study employed the generalised least square (GLS) technique for this investigation. To estimate capital structure, one looks at the ratios of total liabilities, short-term liabilities and long-term liabilities to total assets. To analyse business performance, one looks at return on equity, return on assets, and earnings per share. Factors such as company size, growth rate, liquidity, and fixed-to-total-assets ratio serve as control variables in this analysis. The empirical results show that capital structure significantly hinders company performance. The results showed that overall debt to total assets, long-term debt to total assets, and return on equity are all adversely correlated with one another.

Sahari *et al*. (2019) examined the Malayan food processing industry's capital structure and business efficiency in a similar study. All of the variables significantly affect the success of the firm, according to the results. For this analysis, researchers combed through 450 data points from 45 food processing firms traded on the Bursa Malaysia between 2007 and 2016. The data analysis included descriptive statistics, correlation, and regression. Return on assets is a measure of a company's efficiency, whereas financial leverage, size,

and age are indicators of its capital structure. Furthermore, their research establishes a set, random effect, and pooling model. Research shows that there is a positive correlation between firm performance and age and size, and a negative correlation between leverage and company performance.

Following the discussion above, we synthesize the literature on how capital structure, particularly total debt to total asset and long-term debt to total asset, affects firm performance, with a particular emphasis on the mediating effects of control variables such as tangibility, growth, and firm size.

2.2.1.1 Capital Structure and ROA

The literature shows mixed evidence on the direction and strength of the relationship between capital structure and firm performance. For example, Nazir *et al.* (2021) investigated the Pakistani firms and found a significant negative relationship between debt levels, both short-term and long-term against ROA, which indicates that higher leverage increases financial risk, hence reducing profitability. Abor's (2020) findings contrast that moderate levels of debt are positively associated with ROA for firms operating in stable economic conditions because of the debt tax shield and disciplinary benefits to managerial behaviour. The findings are also nuanced in the Malaysian context. Mohd Shaari and Nik Kamarudin (2024) investigated Malaysian firms, finding a negative association of DTA with ROA and emphasizing the role of high debt in reducing financial flexibility. However, they found a positive relationship between LTDA and ROA, indicating that, if used strategically, long-term debt can support capital-intensive investments, hence improving performance.

2.2.1.2 Role of DTA and LTDA

The two independent variables used in this research are DTA and LTDA. These two factors represent two different dimensions of debt use and its implications for performance. The first one, DTA, refers to a measure of total leverage and is likely to influence ROA negatively due to the compounding effects of high interest expenses and financial risk. As reported in previous researches by Demmou *et al.* (2021), firms with high levels of DTA have a higher tendency to experience financial distress during economic slowdowns. However, LTDA has always presented a far more conflicting relation with performance. Generally speaking, long-term debt is usually considered strategic in nature and is issued to buy particular assets. Such a match of growth opportunities will, in general, amplify ROA. As also highlighted from the empirical work of Bhatia and Mahapatra (2019), those firms which reported higher LTDA ratios had outperformed their peers, provided cash flow generation was sufficient enough for servicing such debt obligations. Again, it goes on proving that the debt maturity structure may also lead to performance changes within firms.

2.2.1.3 Impact of Control Variables on Firm Performance

Control variables such as tangibility, growth, and firm size significantly influence the relationship between capital structure and firm performance. These variables not only provide context to the leverage-performance dynamic but also act as critical moderating or mediating factors, shaping the extent to which debt impacts profitability. This section delves into the individual roles of these variables and their combined effect on firm performance.

(a) Tangibility

Tangibility refers to the proportion of fixed assets to total assets within a firm. It represents the extent to which a firm can utilize its tangible assets as collateral to secure external financing. Firms with higher tangibility ratios generally have greater access to debt at favourable terms, as lenders perceive tangible assets as lower risk due to their ability to be liquidated in case of default. This characteristic significantly enhances a firm's financial stability and performance.

Empirical research underscores the positive impact of tangibility on firm performance. García-Teruel and Martínez-Solano (2021) highlighted that firms with higher tangibility ratios tend to achieve improved ROA because they benefit from reduced borrowing costs. These reduced costs stem from the enhanced creditworthiness provided by tangible assets, which minimizes the risk premium demanded by lenders. Additionally, such firms can negotiate longer repayment terms, further lowering the financial burden and enhancing profitability. Moreover, tangibility contributes to better financial decision-making. Firms with substantial tangible assets can take calculated risks by leveraging their resources to undertake capital-intensive projects that yield higher returns. This behaviour contrasts with firms having lower tangibility, which are constrained by limited collateral and are often compelled to rely on expensive equity financing, thereby diluting shareholder value. However, the benefits of tangibility are not uniform across industries. For instance, in asset-light sectors such as technology, tangibility might have a less pronounced effect on the leverage-performance relationship. Nonetheless, in capital-intensive industries like manufacturing, construction, and real estate, tangibility serves as a critical determinant of both capital structure and financial performance.

(b) Growth

Growth opportunities are a vital determinant of a firm's financing needs and influence its capital structure. Firms in high-growth phases often require substantial external financing to capitalize on emerging market opportunities, expand operations, or invest in research and development. This reliance on external capital, particularly debt, creates a nuanced relationship between growth and firm performance.

While debt financing can fuel growth, it also carries inherent risks. Excessive leveraging can strain a firm's financial resources, especially when growth projections fail to materialize. At the same time, growth opportunities can act as a signalling mechanism to investors and creditors. Firms with robust growth prospects are often perceived as more creditworthy, enabling them to access debt at lower interest rates. These firms can use the borrowed capital to invest in projects with high returns, thereby enhancing their ROA. However, this dynamic is contingent on effective growth management. Mismanagement or over-leveraging during growth phases can lead to inefficiencies, eroding both profitability and shareholder value. Another critical aspect of the growth-performance relationship is the role of industry-specific factors. In fast-growing sectors such as technology or renewable energy, firms might experience rapid value appreciation, which offsets the risks associated with high debt levels. Conversely, in more mature industries, the returns from growth investments might be slower, increasing the financial strain from leverage.

(c) Firm Size

Firm size is another pivotal control variable that affects the leverage-performance relationship. Larger firms typically enjoy several advantages over smaller firms, including economies of scale, greater market influence, and diversified income streams. These factors

enable large firms to better absorb financial shocks and maintain stable profitability levels even under high leverage conditions. Economies of scale are particularly advantageous for larger firms. By spreading fixed costs over a larger revenue base, they can achieve cost efficiencies that smaller firms cannot. These cost savings translate into improved operating margins, which bolster ROA. Additionally, large firms often have superior bargaining power within financial markets, allowing them to secure debt at more favourable terms. Al-Najjar and Hussainey (2019) documented that larger firms are better equipped to manage financial risks and maintain stable capital structures, further solidifying their performance metrics.

Diversification is another critical advantage of large firms. By operating in multiple markets or product lines, these firms can mitigate risks associated with sector-specific downturns. This diversification provides a financial cushion, enabling large firms to sustain their operations and profitability even during adverse market conditions. However, firm size also introduces complexity. Larger firms often face bureaucratic inefficiencies and slower decision-making processes, which can hinder their ability to respond to dynamic market conditions. Therefore, while size offers several advantages, its impact on the leverage-performance relationship is not universally positive. Effective management practices are essential to fully leverage the benefits of size and minimize its drawbacks.

2.2.2 Capital Structure and Firm Performance in the Technology Sector

With fast changes and innovations, high growth, and tremendous competition, the technology sector shows unique challenges and opportunities toward capital structure and performance relationship. This section outlines some of the empirical findings related to capital structure, specifically DTA and LTDA, impacts on firms' performance in the context

of the technology sector and covers both Malaysia and worldwide contexts for a whole rounded view of sectoral specifics.

Technology firms often require external finance for R&D, product innovation, and market expansion. Their growth potential and heavy reliance on intangible assets, however, make them quite different from firms operating in traditional industries. According to Alexeeva-Alexeev (2023) the asset-light nature of technology companies limits the use of tangible assets as collateral, hence increasing reliance on equity financing or unsecured debt. This reliance influences their debt to asset ratios and performance outcomes differently than in capital-intensive sectors.

2.2.2.1 Empirical Evidence from Malaysia

In relation to technology sector, Ahmad *et al.* (2021) conducted an analysis for the relationship between capital structure and firm's performance by focusing on the technological sector in Malaysia. This study adopted 11 technology companies listed in Bursa Malaysia, covering the period from 2012 to 2017. From the panel analysis that including pooled OLS, Random Effect (RE) and Fixed Effect (FE) model, the results showed that short-term debt, long-term debt, and tangibility do not have significant relationship with firm performance. This implies that the examines companies do not rely on debt to finance its' business operation, so does use of assets to secure its' debt. However, the firm size is found has significant positive relationship with firm performance. This mirroring the examine companies able to use firm's assets to generate income. This study is line with the pecking order theory that emphasis internal source of fund. For future study, it is suggested to explore on a specific country for the technology education as this service has been evolved after COVID-19 pandemic.

According to research from En and Malek (2021), the researcher performed examination on 27 Malaysia listed software companies for an 8-year period from 2012 to 2019 where the firm performance is measured by ROA and ROE. The outcome showed long-term debt to total asset and short-term debt to total assets have negative relationship with ROE while total debt to total assets has positive relationship with ROE. Meanwhile for ROA, only short-term debt to total assets has negative relationship with it, while long-term debt to total assets and total debt to total assets have positive relationship with ROA, but insignificant. Yet, the presence of growth variable is found to have the positive impact on company performance. Those profitable software companies have the preference in financing the company via equity financing instead of debt financing. When the long-term debt to total assets increases, the ROE will decline due to the cost incurred from long-term debts. As a result, the company profit will reduce and eventually it will affect the retained earnings of the company.

2.2.2.2 Empirical Evidence from Other Countries

Worldwide, research on technology sector capital structure provides useful fact-finding. A research study by Bradley *et al*. (2020), in the United States, documents that technology firms with relatively higher LTDA ratios achieve better ROA compared to matched firms whose major source of debt is short-term loans. According to the authors, this was because long-term debt obligations are more stable and predictable and thus allow management to focus on innovation and strategic growth without the stresses of frequent refinancing. In contrast, emergent market studies, such as those of India and China, show a different story. For instance, Rajan and Kumar (2019) reported that Indian technology firms with a high DTA ratio underperformed their peers due to increased financial distress and

higher borrowing costs. Alarussi and Gao (2023) also found evidence of a negative relationship between DTA and ROA among Chinese technology firms mainly during economic downturns when leverage amplified financial vulnerabilities.

While the overall trends in the technology industry across countries broadly align, there are some points to note wherein differences can be seen. In Malaysia, regulatory frameworks and government incentives, such as tax breaks for R&D, play an important role in determining the capital structure-performance relationship. En and Malek (2021) have noted that favourable financing conditions in Malaysian technology firms can use long-term debt efficiently without affecting ROA negatively. In contrast, companies in developed markets, such as the United States and Europe, enjoy more varied financing options, like venture capital and private equity. This reduces their reliance on debt and results in lower DTA ratios. However, firms in these markets still employ long-term debt as an important strategic means of improving performance, according to Bradley *et al.* (2020).

2.2.3 Capital Structure, Firm Performance, and COVID-19 Pandemic

The COVID-19 pandemic brought in huge disruptions of economic activities internationally. This set the kind of uncertainty unparalleled in human history, and such that is critically impacting corporate financial strategies and overall performance. In this sense, considering that technology companies normally largely depend on external financing to sustain innovation and growth, for the technology companies, this pandemic dramatically amplified the challenges in sustaining capital structure choices. This section explores how the pandemic has moderated the relationship between capital structure, proxied by total debt to total assets and long-term debt to total assets, respectively, and firm performance measured by ROA. The pandemic created new risks for highly indebted firms, especially

those dependent on short-term debt. Empirical studies during the pandemic still provide evidence of how excessive leverage negatively impacts firm performance, where firms experience revenue losses and greater financial burdens. For instance, Mohd Shaari and Nik Kamarudin (2024) investigate the moderating effect of the pandemic on capital structure and firm performance. The results showed that ROA has decreased substantially for the Malaysian firms that had a high DTA ratio during the pandemic. The uncertainty of economic recovery and supply chain disruptions constrained the revenue generation capacity of firms, making them more vulnerable to financial distress.

By contrast, companies with a higher share of long-term debt were in a comparatively better position to resist the crisis. Long-term debt is generally considered to provide greater financial stability and allows companies to focus on long-term strategies without the immediate pressure of short-term repayment obligations. Evidence from Nik Kamarudin *et al*. (2022) showed that Malaysian technology firms with higher LTDA ratios had been more resilient during the pandemic. It provided a continuous opportunity for these firms to continue their R&D and innovative investments-what is key to sustaining the competitive advantage in technology firms. Similar results were found by Bradley *et al*. (2021), an investigation of U.S. technology firms during the COVID-19 pandemic, showing long-term debt to be positively related to improved firm performance amidst this economic uncertainty. In the pandemic period, liquidity became a significant determinant in the capital structure-performance relationship. A firm with superior liquidity could fulfil its debt obligations and operational expenses more effectively, therefore reducing the detrimental effect of leverage on performance. Khan and Khan (2021) reported that the balance between liquidity and leverage within firms faced minimum financial stress in the pandemic period.

By contrast, highly leveraged firms with low liquidity suffered very badly as their ability to service the debt was impaired, amidst tumbling revenues.

Market conditions during the pandemic also played a moderating role in the effects of capital structure on firm performance. In the case of technology companies, for instance, the sudden shift to digitalization and increased demand for online services provided a unique growth opportunity. However, firms with higher levels of debt were often unable to capitalize on these opportunities due to financial constraints. Dodoo *et al.* (2024) remarked that only the technology firms who had moderate levels of LTDA showed improved agility in matching up the changes in the market situations since their financial resource base was good enough to invest in digital infrastructures and the development and improvement of products. This further sets the performance-capital structure relationship during the COVID-19 pandemic, with several government policies and support mechanisms. Initiatives in Malaysia that included moratoriums for loans and financial assistance during the COVID-19 outbreak reduced the financial pressure faced by firms-especially those with higher levels of debt. Mohd Shaari and Nik Kamarudin (2024) have mentioned that such moves temporarily eased the adverse impact that high DTA ratios have on ROA and enabled firms to stabilize their operations. These interventions are nonetheless long-term uncertain, since firms may suffer further setbacks once these support measures are lifted.

The pandemic also underlined the fact that firm-specific variables, including size and growth potential, might become significant in determining how capital structure affects performance. The larger firms with established market positions and diversified streams of revenues were better positioned to absorb the pandemic shocks even at higher levels of debt. By the opposite, small firms, lacking financial resources and with larger DTA ratios, became

even more seriously affected, in the words of Wei *et al.* (2022). Growth potential played a paramount important part in the technology sector - thus, firms with high levels of innovative capacity and long-term financing provided by debt demonstrated higher even out-of-crisis-performance. From an international perspective, the pandemic underlined sharp contrasts in how capital structure impacted firm performance across different regions. While firms operating in more developed markets like the United States and Europe had higher LTDA ratios, they enjoyed more stable financial systems with access to low-cost financing. These advantages allowed them to maintain their strategic focus and outperform their peers with higher DTA ratios. While this provided emerging market firms, such as Malaysia, with high bank credit growth, these economies were relatively disadvantaged by not being able to access the relatively lower-priced long-term debt, with a higher cost of borrowing. According to Rajan and Kumar (2020), the discrepancy thus alludes that there are contextual factors, and these come into play to review the capital structure-performance relationship for any COVID-19 pandemic period.

The COVID-19 pandemic has already brought about a very novel and broad change in critical dynamics of capital structure concerning firm performance within the technology-related sector. Firms wherein DTA is high are those reporting greater devastation of financial risks and shrinkage of revenues, particularly when the LTDA ratios tended to show resilience. Variations in liquidity, large or small size of firms, respectively, and timely interventions by governments across countries were crucial factors influencing respective results. The findings underscore how strategic debt management contributes to firm performance, with emphasis on its long-term sustainability in times of economic turmoil.

2.3 Hypotheses Development

2.3.1 The Relationship between DTA and Firm Performance

The relationship between DTA and firm performance has been debated among researchers. DTA measures the degree to which a firm depends on overall debt as a source of finance. From the theoretical point of view, the Trade-Off Theory suggests that at a moderate level, debt will improve firm performance by reaping the benefit of tax shields. However, when the firm over-relies on debt, financial distress costs outweigh their benefits, hence a negative effect on performance.

Empirical studies present inconclusive sets of results. For instance, En and Malek (2021) evidenced that with an increased ratio of DTA, there is a decrease in ROA on the grounds of increased interest burdens and risks of insolvency. In this respect, Khalid *et al*. (2022) noticed that highly indebted Malaysian firms exhibited falling profitability during the economic turmoil because they could not be responsive to the constantly changing market conditions quickly. On the other hand, some scholars present views that debt drives managerial disciplines; through debt, the cash flow becomes restricted and this subsequently constrains managers to realize the better investment decisions (Jensen, 1986).

Companies involved in the technology industry exhibit relatively high capital requirements for R&D and innovation. While DTA can provide the necessary finances, high dependence on debt would adversely impact performance resulting from volatile cash flows and heightened risk of financial distress. Hence, it is hypothesized:

Hypothesis 1a: DTA is negatively related to firm performance.

2.3.2 The Relationship between LTDA and Firm Performance

Long-term debt to total asset measures the dependence of a firm on long-term borrowing. In contrast to short-term debt, long-term debt offers financial stability to firms by making strategic investments possible without pressure for immediate repayment. It posits that firms benefit from long-term debt due to its lower refinancing risk and greater alignment with asset life spans. However, Pecking Order Theory argues that business firms still prefer internal finance for their fund requirements than external debts, including even long-run debts as they are considered cost and riskier funds. En and Malek (2021) established that companies with high LTDA ratios outperformed due to better financing of growth projects long-term. That also had been even more productive for technology industries where long-term debts allowed a firm to take the leading positions due to continuous innovating. Yet, not all evidence confirms the above benefits of over-leveraging. Considering the above, LTDA and firm performance should be positively related, provided the levels of debt remain within manageable limits. It is hereby hypothesized:

Hypothesis 1b: LTDA is positively and significantly associated with firm performance.

2.3.3 Capital Structure and Firm Performance in Response to the COVID-19 Pandemic

The pandemic caused challenges that firms have never faced, and thus, it altered the intrinsic relationship between the capital structure and performance of the firms. During the pandemic, high DTA ratios increased the possibility of financial distress because firms faced huge revenue losses with increasing costs of operations. According to Khan and Khan (2021), because of the use of excessive short-term debt, the inability to meet obligations resulted in falling ROA. This was most pronounced in the technology sector, as supply chain

disruptions and delays in project execution furthered the financial strain of high DTA ratios. On the other side, firms with a high LTDA ratio were resilient through the pandemic. In this scenario, long-term debt supplied the financial stability for these firms to stand firm with strategic priorities rather than pressures of immediate finance. Ahmad *et al.* (2021) identified that higher LTDA ratio helped the technology firms in Malaysia maintain R&D activities and adjust to changing market demand throughout the crisis. The pandemic highlighted long-term risks that such indebtedness poses to firms' operations in high uncertainty times.

With these dynamics, for example, the COVID-19 pandemic is likely to act as a moderator with respect to the capital structure-firm performance relationship in a particular way. It is reasonable to argue that the pandemic worsened the negative effects of DTA on firm performance while strengthening the positive performance impact of LTDA correspondingly. Therefore, with regard to the two kinds of debt, or DTA and LTDA in particular, the following hypothesis can be put forward:

Hypothesis 2a: DTA is significantly negatively related to firm performance during the COVID-19 pandemic.

Hypothesis 2b: LTDA would be positively related to firm performance and vice versa during a pandemic crisis.

2.3.4 The COVID-19 Pandemic as a Moderator

The moderating effect of the COVID-19 pandemic on the relationship between the capital structure and performance of firms could be understood in perspective to exogenous shocks and changing financial decision-making. Precisely, during the pandemic, high DTA ratio firms especially suffered more due to their dependence on costly and hardly refinanced

short-term debt against declining revenues. With high LTDA ratios, firms had a buffer against financial shocks since long-term debt does not press for immediate liquidity. For example, studies like Dodoo *et al.* (2024) indicate that this pandemic accelerated financial flexibility's emergence to prominence in firm-performance assessment. Firms who maintained an optimum capital structure, focusing largely on long-term debt while discouraging short-term borrowing, turned out better in performance in recent years of economic turmoil. Hence, it supports the views presented in resource-based view that long-run competitive advantage has sources from fundamental resource allocation.

The firm-specific factors affecting this interaction include liquidity, size, and growth potential. During the crisis, firms that had diversified sources of revenue proved to be larger and could manage their debt obligations much better. Similarly, firms with high levels of liquidity and growth potential also showed more resistance to the adverse impact of the pandemic. The immediate feeling, therefore, is that the above insights would indicate that the pandemic acted as a kind of stress test on the capital structure of firms, amplifying the impact of DTA and LTDA on performance. According to the discussed, the following hypotheses have been suggested:

Hypothesis 3a: The COVID-19 pandemic moderates the relationship between DTA and firm performance.

Hypothesis 3b: The COVID-19 pandemic conditions moderate the relationship between LTDA

2.4 Literature Gap

Although there have been past studies relating capital structure and firm performance, the literature still portrays certain significant gaps relative to the technology sector and the moderating role of the COVID-19 pandemic. This section identifies and evaluates such gaps in order to establish the unique contribution of the present study. First, a number of studies have focused on how debt ratios, such as DTA and LTDA, can affect the performance of the firm. However, most of these studies have taken aggregated measures or generalized contexts for these measures, which are rather sector-agnostic. Being highly innovative, with high changes in the market and hence volatile cash flows, the financial and operational challenges are highly different in the technology sector. Despite these distinctive features, few studies have focused on how capital structure decisions affect the performance of technology firms. Moreover, studies targeting a Malaysian context have been very scanty, despite that country rapidly advancing in terms of its technological capabilities and infrastructure. The characteristics mean that the sector requires focused analysis; the relationship between debt and performance can be fundamentally very different from that in other sectors.

Another gap exists in the temporal context of research. Very few studies have tackled how capital structure affects firm performance during external shocks, such as the COVID-19 pandemic in Malaysia. This pandemic disrupted global markets and created a unique setting that could be used to analyse firm performance. While some few scholars, like Mohd Shaari and Nik Kamarudin (2024), have touched on the implications of the pandemic, these discussions are often generic, focusing on the aggregate economic impacts rather than the sector-specific effects. The technology sector thus provides fertile ground for

investigation, with both challenges, such as supply chain disruptions, and opportunities, including increased reliance on digital solutions. In this connection, the moderating role of the pandemic remains inadequately discussed insofar as it altered the dynamic between debt and performance; the critical questions remain open.

2.5 Chapter Summary

This chapter presented a comprehensive literature review on the relationship between capital structure and firm performance, with a particular focus on technology firms in Malaysia during the COVID-19 pandemic. The chapter began with an exploration of the key theoretical foundations, highlighting the Trade-Off Theory and Pecking Order Theory, which provide contrasting perspectives on how firms should structure their capital to balance risk, debt, and performance. The discussion then transitioned to empirical studies, illustrating the general consensus on the negative or positive effects of capital structure on firm performance, depending on various factors such as the level of debt, industry, and economic environment. The review of the capital structure-performance relationship specifically within the technology sector revealed notable gaps in the literature, particularly regarding the Malaysian context. Further, the review addressed the moderating role of the COVID-19 pandemic, which has reshaped business operations globally, including in the technology sector. While there is a growing body of research on the pandemic's impact on firm performance, the sector-specific nuances and the distinct effects of short-term versus long-term debt on performance during a crisis remain inadequately explored. The chapter underscored the need for research that bridges these gaps and offers insights into how external shocks like COVID-19 impact financial decision-making in the technology sector.

Finally, the chapter laid the groundwork for the development of hypotheses. It proposed several relationships between capital structure variables (DTA and LTDA) and firm performance (ROA), while also positing that the COVID-19 pandemic may moderate these relationships.

CHAPTER 3

METHODOLOGY

3.0 Introduction

This chapter outlines the methodology for analysing the impact of capital structure on firm performance in Malaysian technology-listed companies, focusing on the moderating role of the COVID-19 pandemic. A quantitative approach using panel data from 117 companies listed in Bursa Malaysia across the Leap, Main, and ACE markets (1992–2022) is applied. Section 3.1 describes the study variables, including the dependent variable: return on assets (ROA), explanatory variables: total debt to total assets (DTA), long-term debt to total assets (LTDA), control variables: tangibility (TANG), firm size (SIZE), firm growth (GROWTH), dummy variable: COVID-19 pandemic, and the moderating variables of COVID-19 pandemic (COVID*DTA, COVID*LTDA). Section 3.2 details the econometric models based on proposed hypotheses, while Section 3.3 covers data analysis, model selection, and diagnostic checks to ensure robustness. STATA 17 is utilized for its advanced panel data analysis capabilities, ensuring a rigorous and comprehensive examination of the research objectives.

3.1 Variable Description

3.1.1 Dependent Variable

Return on assets (ROA) is the dependent variable in this study, chosen as a measure of firm performance. It evaluates a company's ability to generate profit relative to its total assets, reflecting the efficiency of management in utilizing the company's resources. ROA is calculated using the formula:

ROA = Profit after Tax / Total Assets Equation 3.1

A ROA greater than 1% indicates that the firm is efficiently utilizing its assets to generate profits, suggesting strong operational performance. Conversely, a ROA below 1% may highlight inefficiencies, signalling the need for management to reevaluate asset utilization strategies. Negative ROA values, often seen during economic downturns or crises, point to losses relative to assets and reflect financial distress. ROA is a critical performance metric because it incorporates the effects of both operational efficiency and capital structure decisions. It aligns well with the research objective of examining how debt levels influence firm performance, especially during times of uncertainty like the COVID-19 pandemic. By focusing on ROA, this study provides insights into how technology firms in Malaysia manage their assets to remain profitable in a dynamic economic environment.

The data for ROA is sourced from audited financial statements of 117 technology listed companies in Bursa Malaysia over a 30-year period (1992–2022). This extended timeframe ensures that the analysis captures long-term trends and variations in performance, offering a robust basis for evaluating the impact of capital structure on firm profitability. The use of ROA aligns with prior studies on capital structure and firm performance, further validating its relevance for this research.

3.1.2 Explanatory Variables

The explanatory variables in this study are total debt to total assets (DTA) and long-term debt to assets (LTDA). These measures are essential for understanding how a firm's capital structure influences its performance (Adamu, 2018). In examining these variables, the study aims to determine the extent to which technology listed companies in Malaysia

rely on debt financing and how this reliance impacts their operational efficiency and profitability, especially during a disruptive event like the COVID-19 pandemic.

(a) Total Debt to Total Assets (DTA)

The total debt to total assets (DTA) measures the proportion of a firm's total liabilities relative to its total assets (Shikumo *et al*., 2020). It is calculated as:

DTA = Total liabilities / Total assets Equation 3.2

This ratio is a comprehensive indicator of financial leverage, reflecting the degree to which a firm relies on debt financing to fund its assets. A higher DTA ratio suggests a greater reliance on debt, which can be a double-edged sword. On one hand, debt allows firms to finance growth, invest in innovative projects, and scale operations without diluting ownership. On the other hand, excessive debt can lead to increased financial risk, particularly during periods of economic uncertainty, as it amplifies the burden of interest payments and repayment obligations (Lea, 2020). For technology listed companies, DTA is particularly significant. This sector often requires substantial capital for research, development, and technological advancements. Firms with a balanced DTA ratio can leverage their debt effectively to enhance innovation and competitiveness. However, during periods of disruption, such as the COVID-19 pandemic, high DTA ratios may indicate financial fragility, as firms with higher debt levels may struggle to meet their obligations due to disrupted cash flows and declining revenues.

(b) Long-term Debt to Total Assets (LTDA)

The LTDA represents the proportion of a firm's total assets financed by long-term debt (Hajisaaid, 2020). It is calculated as:

LTDA = Long-term liabilities / Total assets Equation 3.3

This ratio is crucial in assessing a company's reliance on long-term financing and its ability to sustain financial obligations over extended periods. A higher LTDA suggests greater financial leverage, which can provide capital for growth but also increases financial risk due to prolonged interest obligations (Hajisaaid, 2020). In technology firms, where innovation cycles are lengthy and capital-intensive, long-term debt can support strategic investments, enhancing firm performance. However, excessive long-term debt may reduce financial flexibility, especially during economic downturns like the COVID-19 pandemic.

3.1.3 Control Variables

Control variables are essential in econometric models to isolate the relationship between the explanatory variables and the dependent variable. By accounting for other factors that may influence the dependent variable, these controls enhance the robustness and reliability of the findings. In this study, three control variables are included: Tangibility (TANG), firm size (SIZE), and firm growth (GROWTH). These variables provide a holistic understanding of the factors that affect the financial performance of technology listed companies in Malaysia, particularly within the context of their capital structure decisions.

(a) Tangibility (TANG)

Tangibility measures the proportion of fixed assets to total assets. It is calculated as:

TANG = Fixed Assets / Total Assets Equation 3.4

Tangible assets, such as property, plant, and equipment, are physical assets that firms use to collateralize debt. High tangibility levels often indicate strong financial health, as

tangible assets provide lenders with greater security, potentially lowering borrowing costs (Lea, 2020). Firms with a high TANG ratio may find it easier to access credit markets, as tangible assets act as a safeguard for creditors against default risks. For technology firms, tangibility plays a unique role. Unlike manufacturing or real estate companies, where tangible assets dominate the balance sheet, technology firms often have significant intangible assets, such as patents, trademarks, and software. This difference can affect their ability to secure financing. Nevertheless, a balanced proportion of tangible assets is crucial for ensuring financial stability, especially during economic disruptions like the COVID-19 pandemic.

A higher tangibility ratio typically reflects a firm's stability and ability to leverage its physical assets for operational and strategic needs. Conversely, a lower ratio might indicate limited collateral, making debt financing more expensive or challenging to secure. Understanding the role of tangibility in firm performance provides insights into how technology firms navigate financing constraints in a capital-intensive and innovation-driven industry.

(b) Firm Size (SIZE)

Firm size, often proxied by the natural logarithm of total assets, is another critical control variable. It is calculated as:

$$SIZE = \ln(\text{Total Assets}) \qquad \text{Equation 3.5}$$

The inclusion of SIZE in this study accounts for the structural differences between small and large firms in terms of resources, market power, and financial strategies (Shikumo *et al.*, 2020). Larger firms typically enjoy several advantages, such as economies

of scale, greater access to capital markets, and higher bargaining power with suppliers and customers. These factors can significantly influence their financial performance. In the technology sector, firm size often correlates with R&D capabilities, global reach, and innovation potential. Larger technology firms may have the capacity to invest heavily in R&D, leading to the development of cutting-edge products and services. Additionally, their established market presence can provide a buffer against economic shocks, such as those experienced during the pandemic.

However, larger size does not always equate to better performance. Over-expansion can lead to inefficiencies, bureaucratic delays, and higher fixed costs, which may negatively impact profitability. On the other hand, smaller firms, while potentially more agile and innovative, may face greater challenges in securing financing and scaling operations. By including SIZE as a control variable, this study aims to capture the nuanced effects of firm size on performance, particularly in a rapidly evolving and competitive industry like technology.

(c) Growth (GROWTH)

Growth reflects the changes in total sales over a given period, calculated as:

GROWTH = (Current year sales – Last year sales) / Last year sales

Equation 3.6

High growth rates indicate that a firm is expanding its sales over the year, which can signal strong market demand, successful strategies, and potential for future profitability (Zafar and Siddiqui, 2023). In the technology sector, growth is often driven by innovation, market expansion, and investments in R&D. Rapidly growing firms may also attract investor

confidence, leading to higher market valuations. However, growth comes with challenges. Rapid expansion often requires significant capital to grow, which may increase a firm's reliance on debt financing. If growth is not managed effectively, it can strain resources, disrupt operational efficiency, and lead to financial distress. Additionally, external factors such as economic conditions, regulatory changes, and competitive pressures can impact a firm's growth trajectory. In this study, GROWTH is included as a control variable to account for the varying growth dynamics across technology listed firms. For example, firms with higher growth during the pre-pandemic period may have faced unique challenges during the pandemic, such as supply chain disruptions and declining consumer demand. By controlling for growth, the analysis provides a more accurate assessment of the relationship between capital structure and firm performance.

The three control variables of tangibility, firm size, and growth are carefully chosen to provide a comprehensive understanding of the factors influencing firm performance. Each variable addresses a specific aspect of a firm's financial and operational dynamics, allowing the study to isolate the effects of the explanatory variables (DTA and LTDA) on performance. Moreover, these controls are particularly relevant in the context of the technology sector, where firms operate in a highly dynamic and competitive environment. By accounting for these variables, the study ensures that the findings are robust, reliable, and reflective of the unique characteristics of technology listed companies in Malaysia. The inclusion of these controls also enhances the study's ability to draw meaningful conclusions about the capital structure-performance relationship during the unprecedented challenges of the COVID-19 pandemic.

3.1.4 Dummy Variable

The COVID-19 dummy variable captures the structural impact of the pandemic on firm performance. It is assigned a value of 1 for pandemic years (2020–2022) and 0 otherwise. This variable helps assess how the crisis influenced financial performance by disrupting supply chains, increasing costs, and shifting market dynamics.

3.1.5 Moderating Variable

The interaction terms COVID*TDA and COVID*LTDA evaluate whether the pandemic amplified or mitigated the effects of total and long-term debt on firm performance. These terms help determine whether firms with different capital structures experienced varying financial outcomes due to the pandemic. A significant interaction effect would suggest that debt-financed firms either struggled more or adapted better during COVID-19.

3.2 Model Estimation

Model estimation serves as the cornerstone of this study, enabling the analysis of the relationship between capital structure and firm performance while considering the moderating effects of the COVID-19 pandemic. Econometric models form the foundation for understanding the interplay between the independent, dependent, control, and moderating variables, providing a structured framework for empirical analysis. By employing panel data regression, this study capitalizes on the time-series and cross-sectional nature of the dataset, ensuring a robust and nuanced evaluation of the research objectives. Model estimation in this context involves identifying and specifying the relationships between variables based on theoretical underpinnings and empirical evidence. The primary focus is on analysing how DTA and LTDA impact firm performance, as measured by ROA,

a widely accepted proxy for financial performance. Additionally, the study explores the role of the COVID-19 pandemic as a dummy variable that potentially alters these relationships. The moderating variables which interact between the pandemic and the capital structure variables (i.e. COVID*DTA and COVID*LTDA) enable a deeper examination of how external shocks influence the financial dynamics of firms.

Panel regression techniques are well-suited for this study due to their ability to account for unobserved heterogeneity across firms and over time. These techniques also help mitigate issues such as multicollinearity and omitted variable bias, which are common in cross-sectional and time-series analyses. The study employs three main types of panel regression models: the Pooled Ordinary Least Squares (OLS) model, the Random Effects (RE) model, and the Fixed Effects (FE) model. Each of these models offers unique advantages, allowing for a comprehensive evaluation of the data. To determine the most appropriate model, the Breusch-Pagan LM test is used to compare Pooled OLS and RE model, while the Hausman test is applied to decide between FE and RE model. This systematic approach ensures that the model selection process is both rigorous and theoretically justified. The inclusion of control variables such as tangibility, firm size, and growth further strengthens the model by isolating the specific effects of DTA and LTDA on ROA. These variables are carefully selected based on their relevance to the capital structure-performance relationship, as established in prior literature. By controlling for these factors, the models aim to provide a clearer picture of how capital structure decisions influence firm performance under different conditions.

3.2.1 Econometric Models

The following panel regression models (Equation 3.7 to Equation 3.12) are formulated to test the six hypotheses in this study.

(a) Model 1: Examining the relationship between DTA and ROA

$$ROA_{i,t} = \alpha + \beta_1(DTA)_{i,t} + \beta_2(TANG)_{i,t} + \beta_3(SIZE)_{i,t} + \beta_4(GROWTH)_{i,t} + \varepsilon_{i,t}$$

Equation 3.7

This model evaluates the direct relationship between DTA and firm performance, measured by ROA. It incorporates DTA as the primary explanatory variable, capturing the impact of a firm's overall debt level relative to its total assets. The model includes key control variables: Tangibility, firm size, and growth that are widely recognized as significant determinants of firm performance. Tangibility accounts for the proportion of tangible assets, reflecting the firm's ability to leverage fixed assets for securing financing. Firm size, expressed as the natural log of total assets, offers insights into the economies of scale and market influence. Growth, calculated as changes in sales, indicates the firm's expansion trajectory. Together, these controls isolate the specific effect of DTA on ROA. This model addresses Hypothesis 1a by testing the theoretical assertion that higher total debt levels negatively impact financial performance due to increased financial risk and interest obligations.

(b) Model 2: Examining the relationship between LTDA and ROA

$$ROA_{i,t} = \alpha + \beta_1(LTDA)_{i,t} + \beta_2(TANG)_{i,t} + \beta_3(SIZE)_{i,t} + \beta_4(GROWTH)_{i,t} + \varepsilon_{i,t}$$

Equation 3.8

This model focuses on the relationship between LTDA and ROA. Unlike TDA, LTDA reflects the proportion of long-term financial obligations in the firm's capital structure, emphasizing the role of stable, long-term financing. By including the same control variables as Model 1, this model ensures consistency and comparability while isolating the influence of long-term debt. Tangibility remains crucial, as firms with significant fixed assets are better positioned to secure long-term financing. Firm size and growth offer insights into scalability and future potential. Hypothesis 1b is tested in this model, which posits a positive relationship between LTDA and ROA. The underlying rationale is that long-term debt allows firms to invest in growth-oriented projects without the immediate financial strain of short-term liabilities, potentially leading to improved financial performance over time.

(c) Model 3: Testing the impact of COVID-19 on DTA and ROA

$$ROA_{i,t} = \alpha + \beta_1(DTA)_{i,t} + \beta_2(TANG)_{i,t} + \beta_3(SIZE)_{i,t} + \beta_4(GROWTH)_{i,t}$$

$$+ \beta_5(COVID)_{i,t} + \varepsilon_{i,t}$$ Equation 3.9

Model 3 introduces the COVID-19 variable as an additional factor, examining its impact on the DTA-ROA relationship. By including a dummy variable for the pandemic (0 for pre-pandemic years and 1 for post-pandemic years), this model explores whether the global economic disruption caused by COVID-19 altered the effect of total debt on firm performance. The interaction between DTA and COVID-19 is not explicitly tested here but

sets the groundwork for subsequent models. Hypothesis 2a is central to this analysis, proposing that the pandemic exacerbated the negative impact of total debt due to heightened financial uncertainties and operational disruptions. The control variables remain consistent with previous models to ensure comparability and reliability in the findings.

(d) Model 4: Testing the Impact of COVID-19 on LTDA and ROA

$$ROA_{i,t} = \alpha + \beta_1(LTDA)_{i,t} + \beta_2(TANG)_{i,t} + \beta_3(SIZE)_{i,t} + \beta_4(GROWTH)_{i,t} + \beta_5(COVID)_{i,t} + \varepsilon_{i,t} \quad \text{Equation 3.10}$$

In this model, the influence of the COVID-19 pandemic on the LTDA-ROA relationship is explored. By introducing the same pandemic dummy variable, the model evaluates whether long-term debt provided a buffer during the pandemic by enabling firms to maintain financial stability and continuity. This analysis addresses Hypothesis 2b, which suggests a positive association between long-term debt and firm performance during the pandemic. The reasoning stems from the expectation that firms with stable, long-term financing were better equipped to navigate the unprecedented challenges posed by COVID-19. Control variables such as tangibility, firm size, and growth continue to play a pivotal role in isolating the unique effects of LTDA.

(e) Model 5: Moderating effect of COVID-19 on DTA and ROA

$$ROA_{i,t} = \alpha + \beta_1(DTA)_{i,t} + \beta_2(TANG)_{i,t} + \beta_3(SIZE)_{i,t} + \beta_4(GROWTH)_{i,t} + \beta_5(COVID)_{i,t} + \beta_6(COVID*DTA)_{i,t} + \varepsilon_{i,t} \quad \text{Equation 3.11}$$

This model evaluates whether the COVID-19 pandemic moderated the relationship between DTA and firm performance (ROA). Model 5 explicitly tests how COVID-19 altered the magnitude or direction of DTA's effect on ROA. The interaction term COVID*DTA captures the incremental effect of DTA during the pandemic period, isolating whether the financial risks or benefits of debt financing were amplified or mitigated under crisis conditions. Control variables remain consistent with earlier models to maintain comparability and isolate the moderating role of COVID-19. Hypothesis 3a is tested here, positing that the pandemic strengthened the negative relationship between DTA and ROA. The theoretical basis lies in the heightened financial fragility caused by COVID-19, whereby firms likely faced intensified pressure from uncertainties, exacerbating the adverse effects of leverage. By testing the interaction term, this model reveals whether the pandemic acted as a "crisis multiplier," amplifying the financial risks associated with high debt levels.

(f) Model 6: Moderating Effect of COVID-19 on LTDA and ROA

$$ROA_{i,t} = \alpha + \beta_1(LTDA)_{i,t} + \beta_2(TANG)_{i,t} + \beta_3(SIZE)_{i,t} + \beta_4(GROWTH)_{i,t}$$

$$+ \beta_5(COVID)_{i,t} + \beta_6(COVID*LTDA)_{i,t} + \varepsilon_{i,t} \qquad \text{Equation 3.12}$$

The final model includes an interaction term between LTDA and COVID-19, focusing on the pandemic's moderating effect on the long-term debt-performance relationship. Hypothesis 3b is examined here, proposing that long-term debt acted as a stabilizing factor during the pandemic, mitigating adverse financial impacts. This model extends the analysis of Model 4 by explicitly testing the interaction effects, offering insights into how firms with long-term financial obligations navigated the pandemic's challenges. The inclusion of control variables ensures that the findings are robust and reliable.

3.3 Data Analysis

3.3.1 Data Description

The dataset consists of financial and operational data for 117 technology listed companies on Bursa Malaysia, spanning three decades from 1992 to 2022. It covers the pre-pandemic period of 2019 and earlier to the pandemic period between 2020 to 2022. Such a period enables a strong analysis of the moderating effects of the pandemic on the relationship between capital structure and firm performance. The panel data approach helps in capturing the cross-section and time-series dimensions of data in this study. Panel data allowed the possibility of controlling for unobservable heterogeneity and provide more trustworthy estimates. For this, the dataset used contains firms listed on Main, Leap, and ACE markets to ensure that all three market segments are represented. The financial data are sourced from Orbis Online Databases published in Petary UNIMAS website. Data analysis is done using STATA 17, which has robust statistical modelling capabilities, including panel data techniques. The rich dataset allows the study to evaluate the nuanced effects that capital structure has on firm performance, considering COVID-19 as an important moderating factor.

3.3.2 Panel Data Model

Panel data combines both cross-sectional and time-series data, allowing for more robust analysis by accounting for variations across firms (cross-sectional) and over time (temporal). This approach is ideal for capturing dynamic changes in firm performance while controlling for unobserved heterogeneity, i.e. the individual characteristics of firms that may influence both the independent and dependent variables. The selection of an appropriate regression model is crucial to ensure the validity of the results. To identify the most suitable

model, several steps are undertaken, including testing for model assumptions, comparing different model specifications, and selecting the model that best suits the nature of the data.

The first approach is the Pooled Ordinary Least Squares (OLS) method, which treats all observations as if they come from a single pool of data. This model assumes that there is no variation across firms and over time in the relationship between the independent and dependent variables, thus ignoring any potential heterogeneity. Pooled OLS is the simplest and most basic method, where it assumes that all companies in the sample behave in the same way without considering the possibility that individual firms may have unique characteristics that affect the outcome. While this model serves as a good starting point for analysing the data, its assumption of no heterogeneity across entities makes it less appropriate if unobserved firm-specific effects are present. A potential limitation of Pooled OLS is its inability to control for individual firm characteristics that could influence both the dependent variable (ROA) and the explanatory variables (e.g. DTA, LTDA, etc.). For example, unobserved factors like company culture, managerial expertise, and historical performance could impact a firm's financial outcomes. These firm-specific effects might lead to biased estimates of the relationship between capital structure and firm performance, particularly when there are substantial differences between firms in the dataset. As a result, Pooled OLS might not be able to capture the true dynamics of the capital structure-performance relationship, especially in the context of the COVID-19 pandemic, which introduced unique challenges across industries. The specified Pooled OLS regression model is as below:

$$ROA_{i,t} = \alpha + \beta_1(LTDA)_{i,t} + \beta_2(TANG)_{i,t} + \beta_3(SIZE)_{i,t} + \beta_4(GROWTH)_{i,t} + \beta_5(COVID)_{i,t} + \beta_6(COVID*LTDA)_{i,t} + \varepsilon_{i,t} \quad \text{Equation 3.13}$$

where

i = company

t = time

$\beta_1, \beta_2, \ldots, \beta_6$ = parameter

$\varepsilon_{i,t}$ = error term, that is assumed to be white noise and varies over both company and time

To some extent, the RE model assumes that the unobserved heterogeneity across firms is uncorrelated with the explanatory variables, meaning that the individual differences between firms (e.g. management practices, strategies, etc.) are random and do not systematically affect the key variables of interest. RE model takes into account the possibility that each firm has its own unique set of characteristics that influence the dependent variable. However, it assumes that these characteristics do not correlate with the variables included in the regression model, such as DTA, LTDA, and COVID-19. One of the advantages of RE model is its ability to model firm-specific effects without introducing the complexities of firm-specific intercepts as in the FE model. However, its validity depends on the assumption that the firm-specific effects are uncorrelated with the regressors. If this assumption holds true, RE model can provide more efficient estimates compared to Pooled OLS, as it accounts for some of the individual firm-specific variation without requiring firm-specific intercepts. The Breusch-Pagan LM test is used to determine whether the RE model is appropriate for the dataset by comparing the likelihood of RE model to that of Pooled OLS. A significant result from the LM test indicates that RE model is preferable to Pooled OLS.

While RE model offers improvements over Pooled OLS, it still assumes that unobserved heterogeneity does not correlate with the model's explanatory variables. In the

context of this study, where variables like DTA and LTDA are central to understanding capital structure, it is crucial to assess whether firm-specific factors (e.g. company policies, debt strategies) might influence these relationships. If such correlations exist, RE model may lead to biased estimates. Therefore, RE model is suitable only if the assumption of no correlation between firm-specific effects and explanatory variables holds, making the results more reliable than those from Pooled OLS. The specified RE model that was proposed is as shown below:

$$ROA_{i,t} = \alpha + \beta_1(LTDA)_{i,t} + \beta_2(TANG)_{i,t} + \beta_3(SIZE)_{i,t} + \beta_4(GROWTH)_{i,t} + \beta_5(COVID)_{i,t} + \beta_6(COVID*LTDA)_{i,t} + w_{i,t} \quad \text{Equation 3.14}$$

where $w_{i,t} = \mu_i + E_{i,t}$, with μ_i is the unobservable individual effects of a company that has zero mean property, independent of individual observation error term $\varepsilon_{i,t}$, has constant variances σ_ε^2 and independent from explanatory variables.

Again, if the correlation issue does exist in the RE model, then the FE model will carry out. The FE model takes a more conservative approach than RE model by controlling for unobserved heterogeneity through the inclusion of firm-specific intercepts. This model allows for different intercepts for each firm, which helps account for any individual characteristics that may affect the outcome variable (ROA). FE model is particularly useful when the assumption of no correlation between firm-specific effects and explanatory variables in RE model is not tenable. By including fixed intercepts for each firm, FE model controls for the influence of time-invariant factors, such as management practices or corporate culture, which may be important for understanding firm performance. The major advantage of FE model over RE model is that it does not rely on the assumption that unobserved firm-specific effects are uncorrelated with the independent variables. As a result,

FE model produces more reliable estimates when there is a concern that such correlations exist. For example, in the context of this study, certain firm-level factors like governance structures or industry-specific risks may influence both the capital structure (DTA, LTDA) and firm performance (ROA). FE model addresses this potential issue by ensuring that the analysis controls for these unobserved heterogeneities. To determine whether FE model is more appropriate than RE model, the Hausman test is used. The Hausman test evaluates whether the individual effects are correlated with the regressors, and if the test shows significant differences between the FE model and RE model estimates, FE model is preferred. The key advantage of FE model is its ability to provide unbiased estimates even when unobserved heterogeneity is correlated with the explanatory variables, making it a more robust method for analysing the relationship between capital structure and firm performance. However, the main limitation of FE model is its inability to account for time-invariant variables that do not change across the time period of the study. For instance, firm-specific characteristics such as location or industry might remain constant during the study period but still influence the firm's capital structure decisions. While FE model controls for this type of heterogeneity, it does not allow for the examination of the impact of variables that do not vary within firms over time.

Overall, the selection of the appropriate model (i.e. Pooled OLS, RE, or FE model) is based on a series of tests aimed at ensuring the robustness and reliability of the results. First, Pooled OLS serves as the baseline model, assuming no variation across firms and periods. However, as mentioned earlier, this assumption may not hold, especially in the presence of firm-specific characteristics that influence both the dependent and independent variables. Second, the Breusch-Pagan LM test is conducted to decide between Pooled OLS and RE model. If the test shows that RE model is more appropriate, the next step is to use

the Hausman test to compare FE model and RE model. If the Hausman test reveals significant differences between the two, the FE model is chosen. In following this model selection procedure, the study ensures that the final choice of regression model appropriately captures the relationships between capital structure, firm performance, and the moderating impact of the COVID-19 pandemic. The methodology ensures that unobserved heterogeneity, potential endogeneity, and other issues are properly addressed, leading to more accurate and reliable findings.

3.3.3 Diagnostic Checking

Besides than choosing an appropriate model, diagnostic checking plays a crucial role in panel data analysis, ensuring the robustness and validity of regression results (Ismaeel *et al.*, 2021). In this section, we focus on diagnosing key issues that could impact the accuracy of the regression model, namely multicollinearity, autocorrelation, and heteroskedasticity. The detection of these issues is vital, as they can distort the estimation process and lead to unreliable conclusions. If any of these problems are detected, corrective measures such as applying robust standard errors will be considered. These steps are crucial to maintaining the integrity of the model and ensuring the validity of the findings.

Multicollinearity occurs when independent variables in a regression model are highly correlated with one another, making it difficult to isolate the individual effects of each variable on the dependent variable (Ismaeel *et al.*, 2021). When multicollinearity is present, it inflates the standard errors of the regression coefficients, making hypothesis testing unreliable. This can lead to the incorrect conclusion that certain variables are not significant when they may, in fact, be important. In panel data analysis, multicollinearity can obscure the true relationships between variables, impacting the model's ability to generate

meaningful results. To detect multicollinearity, the Variance Inflation Factor (VIF) is commonly used (Zhou, 2013). The VIF for each independent variable is calculated using the formula:

$$VIF_i = 1/(1 - R_i^2) \quad \text{Equation 3.15}$$

where R_i^2 represents the coefficient of determination for the regression of the $_i$-th variable against all other predictors. A VIF value exceeding 10 typically indicates significant multicollinearity, although in practice, a threshold of 5 is often considered acceptable. To address multicollinearity, the first step is to compute the VIF values for all independent variables, such as DTA, LTDA, TING, SIZE, and GROWTH. In addition, examining pairwise correlations among these variables can help identify any potential collinearity issues. If multicollinearity is detected, several remedies can be applied. These include dropping highly correlated variables if there is a sound theoretical justification for doing so, or combining correlated variables into a single composite index. Other methods, such as ridge regression or principal component analysis, can also be employed to mitigate the effects of multicollinearity on the regression results. Variables with high VIFs will be carefully reassessed to ensure that multicollinearity does not undermine the analysis, thereby improving the reliability of the results.

Furthermore, autocorrelation refers to the correlation of residuals across successive periods of time, which violates the independence assumption in regression analysis (Astivia *et al.*, 2019). In the context of panel data, autocorrelation can result in inefficient estimates, leading to biased and unreliable statistical inferences. Specifically, the presence of autocorrelation suggests that the model does not fully capture the temporal dynamics of the data, which can distort the estimation of the relationships between the independent and

dependent variables. To detect autocorrelation in the residuals, the Wooldridge test for autocorrelation in panel data is commonly used (Zhou, 2013). The null hypothesis of this test is that there is no first-order autocorrelation in the residuals. The test involves estimating the panel regression model, followed by performing a regression of the residuals on their own lagged values. The test statistic is then evaluated, and if it is found to be significant, the null hypothesis can be rejected, indicating the presence of autocorrelation. If autocorrelation is detected, the next step is to correct the model by applying robust standard errors that account for serial correlation. For example, Driscoll-Kraay standard errors or clustered standard errors can be employed to address autocorrelation in the residuals, ensuring that the model produces efficient and unbiased estimates.

Ultimately, heteroskedasticity occurs when the variance of the residuals is not constant across all observations, violating one of the key assumptions of regression analysis (Zhou, 2013). In the presence of heteroskedasticity, the standard errors of the regression coefficients are biased, leading to incorrect statistical inferences. Heteroskedasticity can arise due to various factors, such as differences in firm size, industry characteristics, or macroeconomic conditions. This issue can cause the model to overstate or understate the significance of the explanatory variables, which undermines the validity of the regression results. To detect heteroskedasticity, the Breusch-Pagan and Modified Wald tests are typically applied in panel data regression (Astivia *et al.*, 2019). The Breusch-Pagan test evaluates whether the residual variance is a function of the independent variables, while the Modified Wald test is designed to detect groupwise heteroskedasticity in panel data. The first step involves estimating the panel regression model, followed by conducting the Breusch-Pagan test for heteroskedasticity. Additionally, the Modified Wald test can be applied to check for cross-sectional heteroskedasticity, which may be prevalent when

dealing with data from different firms or industries. If heteroskedasticity is identified, robust standard errors, such as White's robust standard errors, can be used to adjust for the heteroskedasticity in the model. In some cases, more advanced techniques, such as feasible generalized least squares (FGLS) or panel-corrected standard errors (PCSE), may be required if the issue persists despite applying robust standard errors.

In the event that any of the diagnostic test, such as those for multicollinearity, autocorrelation, or heteroskedasticity reveal violations of assumptions, the application of robust standard errors becomes essential. Robust standard errors adjust the variance-covariance matrix in a manner that allows for proper statistical inference, even in the presence of these violations. The use of robust standard errors helps to mitigate the impact of heteroskedasticity, autocorrelation, or multicollinearity, ensuring that the estimated standard errors are consistent and reliable. The steps for applying robust standard errors are straight forward. Once the diagnostic problem is identified, such as autocorrelation or heteroskedasticity, the model is re-estimated using robust standard errors that account for the specific violation. For instance, if autocorrelation is detected, Driscoll-Kraay standard errors can be used to correct the model. Similarly, if heteroskedasticity is found, White’s robust standard errors can be applied. After re-estimating the model with robust standard errors, the revised results are interpreted, ensuring that they align with theoretical expectations and make sense in the context of the study. This process enhances the validity of the regression analysis and ensures that the results are robust to potential issues in the data.

3.4 Chapter Summary

The section described the methodology that would be used in conducting analysis on the capital structure and firm performance among the listed technology companies in Bursa Malaysia. This ranged from a data description of dependent, independent, control, and moderating variables to a panel dataset covering 117 companies over 30 years (1992–2022). The variables were defined with care, and the measures were outlined to ensure all was clear and well-set for the objectives of the study. The panel data analysis methodology was explained, focusing on the selection of the most suitable regression model among pooled OLS, fixed effects, and random effects. The chapter elaborated on the Breusch-Pagan LM test and the Hausman test to make the selection process robust and justified on theoretical and statistical grounds. Furthermore, diagnostic checks were done in relation to possible violations of the regression assumptions: multicollinearity, autocorrelation, and heteroskedasticity. The processes to be followed in their detection and mitigation were described. The application of robust standard error was mentioned where needed as a way of ensuring these findings are reliable and valid and therefore increase the rigor of the analysis.

CHAPTER 4

EMPIRICAL RESULTS AND DISCUSSIONS

4.0 Introduction

This The fourth chapter offers the insights generated from investigating the capital structure and firm performance of technology listed companies in Malaysia. This section starts with the description of the data by using descriptive statistics to give a glimpse of the variables such as return on assets (ROA), Total debt to total assets ratio (DTA), and long-term debt to total assets ratio (LTDA). The split time series is obtained in order to include and separate periods before the pandemic, during the pandemic, and for the entirety of years, if possible, both pre- and post-pandemic so that any drastic changes can be identified.

Subsequently, the correlation analysis examines the links between the variables and determines whether there are valid relationships critical to the regression analysis. The chapter also looks at the findings from panel regression tests on the relationship between capital structure and firm performance alongside the moderating role of the pandemic. Such general comparisons by the aid of Pooled OLS, Random Effects (RE), and Fixed Effects (FE) are made to ascertain the soundness of general conclusions.

4.1 Descriptive Statistics

The descriptive analysis gives a primary measure of the variables investigated in the study, including mean, minimum, maximum, and standard deviation. As indicated in Table 4.1 above, this section looks at these statistics for the complete sample, for before pandemic period, and during the pandemic period to establish trends, variation, and any peculiarities.

Table 4.1: Summary of Descriptive Statistics

Variable	Observation	Mean	Minimum	Maximum	Standard Deviation
Full Sample					
ROA	1,732	0.0035	-4.0788	1.0290	0.2838
DTA	1,732	0.3339	0.0025	3.5253	0.2592
LTDA	1,732	0.0871	0.0000	4.3333	0.2335
TANG	1,732	0.2301	0.0000	9.5437	0.3675
SIZE	1,732	18.2252	13.0103	22.5596	1.4264
GROWTH	1,732	0.3041	-0.9208	31.4913	1.6578
COVID	1,732	0.2003	0.0000	1.0000	0.4004
COVID*DTA	1,732	0.0655	0.0000	2.2256	0.1667
COVID*LTDA	1,732	0.0219	0.0000	4.3333	0.1762
Before COVID-19 Pandemic					
ROA	1,385	0.0055	-4.0194	1.0000	0.2615
DTA	1,385	0.3356	0.0025	3.5353	0.2659
LTDA	1,385	0.0815	0.0000	4.2719	0.1778
TANG	1,385	0.2270	0.0000	5.0991	0.2378
SIZE	1,385	18.1550	13.0103	22.5596	1.4041
GROWTH	1,385	0.2801	-0.9208	29.6117	1.3590
COVID	1,385	0.0000	0.0000	0.0000	0.0000
COVID*DTA	1,385	0.0000	0.0000	0.0000	0.0000
COVID*LTDA	1,385	0.0000	0.0000	0.0000	0.0000
During COVID-19 Pandemic					
ROA	347	-0.0046	-4.0788	1.0290	0.3598
DTA	347	0.3268	0.0034	2.2256	0.2312
LTDA	347	0.1093	0.0000	4.3333	0.3818
TANG	347	0.2427	0.0000	9.5437	0.6702
SIZE	347	18.5051	14.5001	22.2549	1.4815
GROWTH	347	0.4003	-0.8910	31.4913	2.5200
COVID	347	1.0000	1.0000	1.0000	0.0000
COVID*DTA	347	0.3268	0.0034	2.2256	0.2312
COVID*LTDA	347	0.1093	0.0000	4.3333	0.3818

For the full sample period, it comprises of 1,732 observations. The mean ROA is 0.0035, with a standard deviation of 0.2838, indicating a low average firm performance and significant variability among firms. The minimum ROA of -4.0788 suggests instances of severe financial distress, while the maximum value of 1.0290 reflects firms that achieved robust operational efficiency.

The average DTA is 0.3339, highlighting that, on average, firms financed approximately 33.39% of their assets through debt. A standard deviation of 0.2592 suggests

moderate variability in debt reliance. LTDA shows a mean of 0.0871, with higher variability (standard deviation of 0.2335), reflecting varying long-term debt strategies across firms.

Tangibility (TANG) has an average of 0.2301, meaning approximately 23.01% of total assets are tangible. Firm size (SIZE), measured as the log of total assets, has a mean of 18.2252, indicating that most firms fall into a medium-to-large size category. Growth (GROWTH), capturing sales growth, averages at 0.3041 but shows high variability (standard deviation of 1.6578), suggesting significant differences in firms' expansion rates.

When the full sample period is separated into pre-pandemic period (1,385 observations), firms experienced a slightly higher average ROA of 0.0055, suggesting better firm performance relative to the full sample. The lower standard deviation of 0.2615 indicates more stable performance before the pandemic. Notably, DTA also increased slightly to a mean of 0.3356, reflecting consistent reliance on debt financing. LTDA declined to an average of 0.0815, with a reduced standard deviation (0.1778), indicating firms were less reliant on long-term debt compared to the full sample.

TANG remains consistent at 0.2270, with less variability compared to the full sample. SIZE averages 18.1550, slightly smaller than the overall dataset, while GROWTH shows a lower mean of 0.2801 and reduced variability. These trends suggest relatively stable financial performance and growth strategies in a predictable economic environment.

For during pandemic period, it covers 347 observations. ROA dropped to an average of -0.0046, with a higher standard deviation of 0.3598, highlighting increased financial stress and variability. This decline underscores the adverse effects of the pandemic on firm performance, as reflected in the minimum ROA of -4.0788.

DTA decreased slightly to a mean of 0.3268, and its variability (standard deviation of 0.2312) reduced compared to the full sample. This finding indicates that firms became more cautious about leveraging debt during the economic uncertainty of the pandemic. Conversely, LTDA increased to a mean of 0.1093, with a higher standard deviation of 0.3818, suggesting that firms turned to long-term financing to stabilize their operations.

TANG increased slightly to 0.2427, reflecting a possible reliance on tangible assets for collateral during the crisis. SIZE increased to an average of 18.5051, potentially indicating that larger firms were better equipped to withstand pandemic-induced challenges. Interestingly, GROWTH rose to 0.4003, with a standard deviation of 2.5200, showing that some firms managed to expand significantly despite the crisis, possibly due to industry-specific advantages or adaptive strategies.

For the COVID dummy variable, roughly 20% of the observations in full sample are from the during pandemic period. Meanwhile, COVID*DTA, representing the interaction between the pandemic and total debt, averages at 0.0655 for the full sample, with higher values during the pandemic (0.3268). This trend highlights the heightened interplay between debt and pandemic related challenges. COVID*LTDA, capturing the interaction of long-term debt with the pandemic, shows a mean of 0.0219 for the full sample but rises to 0.1093 during the pandemic, reflecting the strategic role of long-term financing during economic disruptions.

4.2 Correlation Analysis

Table 4.2: Results of Pearson's Correlation Analysis

Variable	ROA	DTA	LTDA	TANG	SIZE	GROWTH	COVID	COVID*DTA	COVID*LTDA
ROA	1.0000								
DTA	-0.1148*	1.0000							
LTDA	0.1291*	0.3658*	1.0000						
TANG	0.1517*	0.1208*	0.6846*	1.0000					
SIZE	0.1418*	0.0643*	-0.0096	0.0573*	1.0000				
GROWTH	0.0883*	0.0111	-0.0066	-0.0180	-0.0096	1.0000			
COVID	-0.0143	-0.0137	0.0476*	0.0172	0.0983*	0.0290	1.0000		
COVID*DTA	-0.0246	0.2364*	0.2147*	0.1579*	0.0273	0.0071	0.7847*	1.0000	
COVID*LTDA	0.1401*	0.1478*	0.7199*	0.6526*	-0.0659	0.0054	0.2483*	0.4298*	1.0000

Note: * Significant at 5% level.

The Pearson correlation analysis evaluates the strength and direction of linear relationships between the variables under study. Table 4.2 provides the correlation coefficients for ROA, DTA, LTDA, TANG, SIZE, GROWTH, COVID dummy variable, and COVID-19 related interaction terms (COVID*DTA and COVID*LTDA). These coefficients indicate whether variables are positively or negatively associated and highlight potential multicollinearity issues for further regression analysis.

The correlation coefficients, as presented in Table 4.2, reveal several significant relationships at the 5% level. ROA demonstrates negative and significant correlations with DTA (-0.1148), negative but insignificant correlations with COVID (-0.0143). While positive and significant correlations with LTDA (0.1291), TANG (0.1517), and SIZE (0.1418). COVID*DTA (-0.0246) shows a weak and non-significant negative correlation with ROA, while COVID*LTDA exhibits a positive correlation of 0.1401, with a significant relationship.

Other notable relationships include a positive and significant correlation between DTA and LTDA (0.3658) and a strong correlation between LTDA and TANG (0.6846). COVID*DTA and COVID*LTDA display moderate to strong correlations with COVID (0.7847 and 0.2483, respectively) and LTDA (0.2147 and 0.7199, respectively).

The significant negative correlation between ROA and DTA suggests that higher debt levels are associated with reduced firm performance. This finding aligns with the trade-off theory, which posits that excessive leverage increases financial risk and interest obligations, thereby reducing firm performance (Modigliani and Miller, 1958). In contrast, firms with low DTA likely maintain better financial flexibility, enabling higher firm performance.

Meanwhile, the positive correlation between ROA and LTDA indicates that long-term debt positively influences firm performance. This finding supports the notion that long-term financing provides stability and facilitates investments in growth-oriented projects, leading to enhanced performance (Titman and Wessels, 1988). However, the magnitude of this relationship suggests that long-term debt must be managed strategically to avoid potential financial distress.

Then, ROA's significant positive relationship with TANG highlights the role of tangible assets in boosting firm performance. Tangible assets can serve as collateral for debt, reducing borrowing costs and enhancing financial performance (Frank and Goyal, 2009). This result is particularly relevant for technology firms with tangible asset portfolios.

The positive correlation between ROA and SIZE underscores the advantages larger firms have in achieving economies of scale, accessing capital markets, and leveraging their market power to sustain firm performance. This finding corroborates existing literature suggesting that firm size positively influences financial performance (Zafar and Siddiqui, 2023).

Additionally, the significant positive correlation between ROA and GROWTH suggests that higher firm growth is associated with increased firm performance. Firms which have increased in operations trigger the level of firm performance.

For the correlation between ROA and COVID interaction variables, there is a weak and non-significant negative correlation between ROA and COVID. This suggests minimal direct influence of COVID-19 pandemic on firm performance. The weak and non-significant negative correlation between ROA and COVID*DTA also suggests minimal direct influence of total debt during the pandemic on firm performance. Conversely, the significant positive

correlation between ROA and COVID*LTDA implies that long-term debt played a stabilizing role during the pandemic. This result highlights the resilience of firms that strategically relied on long-term financing to navigate economic uncertainty (Liao *et al.*, 2023).

The strong positive correlation between DTA and LTDA indicates that firms relying on total debt are likely to utilize long-term debt. Similarly, the high correlation between LTDA and TANG underscores the role of tangible assets in securing long-term financing.

COVID-related variables, including COVID*DTA and COVID*LTDA, exhibit significant correlations with other variables, such as LTDA and COVID, suggesting their critical role in moderating the relationship between capital structure and performance during the pandemic. For instance, the correlation between COVID*LTDA and COVID reinforces the importance of long-term debt as a strategic tool for weathering economic disruptions.

Generally, the findings align with existing studies on capital structure and firm performance. For instance, Titman and Wessels (1988) support the positive impact of long-term debt on firm performance, as reflected in this study. Moreover, the positive correlation between firm size and firm performance corroborates Zafar and Siddiqui (2023), who highlight the advantages of scale and resource access. The role of tangible assets in securing financing is consistent with findings by Frank and Goyal (2009), underscoring the importance of collateralized debt in enhancing performance. The results also highlight the resilience strategies employed during the COVID-19 pandemic, aligning with Liao *et al.* (2023), who emphasize long-term debt's stabilizing role in crisis management.

The correlation analysis provides critical insights into the relationships among variables, forming the basis for subsequent regression analyses. The significant correlations align with theoretical expectations and past literature, reinforcing the importance of strategic capital structure decisions in enhancing firm performance. These findings emphasize the nuanced role of firm size, tangible assets, and long-term financing in driving firm performance, particularly during periods of economic uncertainty.

4.3 Panel Regression Results and Discussions

4.3.1 Capital Structure (DTA) and Firm Performance (Without COVID-19 Pandemic)

Table 4.3(a) provides the panel regression results for the relationship between DTA and ROA before the COVID-19 pandemic. Across all models, DTA shows a statistically significant negative relationship with ROA, indicating that higher levels of debt reduce firm performance. The coefficients range from -0.1584 in the Pooled OLS model to -0.2337 in the Fixed Effects (FE) model (with robust standard errors). The consistent negative direction suggests that an increase in debt levels imposes a financial burden, adversely affecting firm performance. This direction is commonly found in most of the studies, such as Jee *et al.* (2021), Zhang (2020), as well as Mohammad and Bujang (2020) that viewed excessive debt levels can increase financial risk and interest expenses, thereby deteriorate financial gain.

Table 4.3(a): Panel Regression Results (Without COVID-19 Pandemic)

Variables	Regression Model			
	Pooled OLS	**Random Effects Model**	**Fixed Effects Model**	**Fixed Effects Model with Robust Standard Errors**
	ROA	**ROA**	**ROA**	**ROA**
	Without COVID-19 Pandemic			
DTA	-0.1584*** (0.000)	-0.2091*** (0.000)	-0.2337*** (0.000)	-0.2337*** (0.006)
TANG	0.1257*** (0.000)	0.0863*** (0.000)	-0.0320 (0.319)	-0.0320 (0.387)
SIZE	0.0284*** (0.000)	0.0194*** (0.003)	0.0201** (0.011)	0.0201 (0.251)
GROWTH	0.0161*** (0.000)	0.0179*** (0.000)	0.0182*** (0.000)	0.0182*** (0.000)
Observation	1,732	1,732	1,732	1,732
R-squared	0.0699	0.0618	0.0262	0.0262
Adjusted R-squared	0.0677			
F-test	32.42***		24.31***	
Wald Chi-square		94.87***		
Breusch-Pagan LM Test				
Chi2	130.86			
Prob>chi2	0.0000			
Hausman Test				
Chi2(4)		36.03		
Prob>chi2		0.0000		
Diagnostic Test				
Multicollinearity Test				
Mean VIF			1.01	
Autocorrelation Test				
F (1, 115)			0.097	
Prob>F			0.7561	
Heteroskedasticity Test				
Chi2 (117)			5.8e+31	
Prob>chi2			0.0000	

Notes: (i) Figure in parentheses shows p-values.
(ii) * Significant at 10% level, ** Significant at 5% level and *** Significant at 1% level.

The FE model with robust standard errors, the most reliable estimate, shows a coefficient of -0.2337 (p-value<0.010), indicating that a 1% increase in DTA reduces ROA by approximately 0.23%. This finding aligns with the Pecking Order Theory, which argues

that firms prioritize internal financing and use debt as a last resort due to the risks associated with high leverage (Myers, 1984). Besides that, the observed negative relationship also aligns with the Trade-Off Theory, which suggests that while debt financing provides tax shields, excessive leverage increases financial distress costs, reducing overall firm performance (Modigliani and Miller, 1958). Firms in this sample may have reached or exceeded optimal debt levels, leading to diminishing returns on leverage.

For the role of control variables, TANG exhibits a significant positive relationship with ROA in the Pooled OLS and Random Effects (RE) models, respectively (i.e. 0.1257, p-value=0.000 and 0.0863, p-value=0.000). However, this relationship becomes insignificant in the FE model. Tangibility's diminishing role suggests that its impact is more prominent across firms rather than within a firm over time. For SIZE, it positively influences ROA in the Pooled OLS and RE models, but its significance diminishes in the FE model with robust errors. This result implies that larger firms may benefit from economies of scale, though this advantage may not be as pronounced within individual firms over time. GROWTH consistently shows a positive and significant relationship with ROA across all models. This finding highlights the importance of expansion strategies in boosting firm performance.

The results confirm prior research that indicates the relationship between debt and firm performance as being negative. For instance, Adamu (2018) noted that high level of debt erodes financial performance on account of higher interest expense and limited funds availability. Likewise, Frank and Goyal (2009) note that over-leveraging of firms clearly have inefficiencies especially in a competitively sensitive industry. The results also align with Shikumo *et al.* (2020), who suggested that due to the elevated cost of borrowing, firms

in developing markets such as Malaysia suffer additionally when leveraging impacts performance negatively.

The analysis implies that firms need to pay attention to their balance sheet and avoid incurring too much debt. Although debt leverages positively on growth, tax shield, and can be viewed as a source of finance, some problems such as financial risk, reduced efficiency arise with high level of debt usage. It finally realized negative correlation between DTA and ROA and therefore emphasizes the potential dangers of poor debt management to sustainable firm performance. These results complement the theoretical propositions and prior research highlighting the centrality of capital structure choices to firm outcomes especially during normal operation without external crises such as COVID-19.

4.3.2 Capital Structure (LTDA) and Firm Performance (Without COVID-19 Pandemic)

Table 4.3(b) examines the relationship between LTDA and ROA in the absence of COVID-19 pandemic effects. Across the models, LTDA demonstrates a negative and statistically significant relationship with ROA in the FE model (coefficient of -0.1154, p-value <0.050), while the Pooled OLS model displays positive yet weaker coefficient (0.0719, p-value <0.10) and the RE model show positive but insignificant result. The negative coefficient in the FE model suggests that an increase in LTDA leads to a decline in firm performance. A 1% rise in LTDA corresponds to a 0.115% reduction in ROA. This result reflects the cost burden associated with long-term debt, including interest expenses and restrictive covenants that may constrain operational flexibility.

Table 4.3(b): Panel Regression Results (Without COVID-19 Pandemic)

Variables	Regression Model			
	Pooled OLS	**Random Effects Model**	**Fixed Effects Model**	**Fixed Effects Model with Robust Standard Errors**
	ROA	**ROA**	**ROA**	**ROA**
	Without COVID-19 Pandemic			
LTDA	0.0719* (0.067)	0.0669 (0.114)	-0.1154** (0.036)	-0.1154** (0.015)
TANG	0.0811*** (0.001)	0.0407 (0.135)	-0.0564* (0.083)	-0.0564 (0.204)
SIZE	0.0273*** (0.000)	0.0208*** (0.001)	0.0242*** (0.003)	0.0242 (0.202)
GROWTH	0.0157*** (0.000)	0.0173*** (0.000)	0.0174*** (0.000)	0.0174*** (0.000)
Observation	1,732	1,732	1,732	1,732
R-squared	0.0511	0.0487	0.0002	0.0002
Adjusted R-squared	0.0489			
F-test	23.27***		10.17***	
Wald Chi-square		42.92***		
Breusch-Pagan LM Test				
Chi2	130.62			
Prob>chi2	0.0000			
Hausman Test				
Chi2(4)		29.86		
Prob>chi2		0.0000		
Diagnostic Test				
Multicollinearity Test				
Mean VIF			1.45	
Autocorrelation Test				
F (1, 115)			0.033	
Prob>F			0.8556	
Heteroskedasticity Test				
Chi2 (117)			1.5e+06	
Prob>chi2			0.0000	

Notes: (i) Figure in parentheses shows p-values.
(ii) * Significant at 10% level, ** Significant at 5% level and *** Significant at 1% level.

The findings resonate with Jensen and Meckling (1976) who proposed that high levels of long-term debt can exacerbate conflicts between debt holders and shareholders, leading to inefficiencies in resource allocation. This inefficiency may explain the observed negative impact of LTDA on firm performance in the FE model. The results also align with

Adamu (2018), who found that excessive reliance on long-term debt reduced firm performance in pharmaceutical manufacturing firms. High long-term debt obligations may restrict firms' ability to invest in growth opportunities, leading to a decline in operational efficiency and financial performance. In the Malaysian technology sector, firms with significant R&D expenses may find long-term debt particularly burdensome, as funds are diverted from innovation to debt servicing.

Conversely, the positive relationship observed in the Pooled OLS and RE models aligns with findings by Titman and Wessels (1988), who argue that long-term debt can support firms by providing stable financing for long-term projects. This stability can enhance performance, particularly for firms with tangible assets that facilitate secure borrowing. However, the FE model's ability to control for firm-specific heterogeneity offers a more nuanced and reliable perspective, indicating that the costs of long-term debt outweigh its benefits in this context.

In the control variables perspective**,** TANG exhibits a positive relationship with ROA in the Pooled OLS and RE models, suggesting that tangible assets enhance firm performance. However, this relationship becomes insignificant in the FE model, highlighting the diminished influence of tangibility within firms over time. Meanwhile, SIZE positively affects ROA across models. This result underscores the advantages of larger firms in achieving economies of scale and accessing resources to sustain firm performance. Also, GROWTH demonstrates positive and significant relationship with ROA across all models. This finding indicates that growth does increase firm performance.

The result of the analysis is that there is interplay between LTDA and ROA. On the positive aspect, long-term debt offers stability and funds for investment. However, based on

evidence and research, high level of debt seems to have its costs, which are borne out by deteriorating firm performance. This remains apparent in the context of the presented models that specific considerations about firm factors are crucial in order to arrive at robust conclusions on the capital structure-adjusted performance link.

4.3.3 Capital Structure (DTA) and Firm Performance (With COVID-19 Pandemic)

Table 4.4(a) presents the panel regression results analyzing the relationship between DTA ROA during the COVID-19 pandemic. The results across models indicate a consistently significant negative relationship between DTA and ROA, with the FE model providing the most robust estimate when corrected for heteroskedasticity. In the FE model with robust standard errors, the coefficient for DTA is -0.2421 (p-value < 0.010), indicating that a 1% increase in DTA corresponds to a 0.24% decrease in ROA during the pandemic. This finding is consistent across all models, with coefficients ranging from -0.1598 in Pooled OLS to -0.2421 in the robust FE model. The pandemic appears to have amplified the negative impact of debt on firm performance, likely due to heightened financial risks and disrupted cash flows.

As the dummy variable, the COVID variable has a negative coefficient (-0.1000, p-value=0.000) in the FE model with robust standard errors. This implies that, other things held constant, the pandemic had a negative impact on the performance of these firms. Analyzing the relationship shown between DTA and the pandemic demonstrates that the economic effects caused the already strained financial woes of leveraged companies.

The negative correlation between DTA and ROA during the pandemic confirms the work of Liao *et al.* (2023) who, stated that excessive debt amplified the financial risk of firms during crises. Certainly, the pandemic factors, such as disruptions of the supply chains,

decreased customer demand, and higher levels of volatility likely exacerbated the negative influence of debts on profits. The results are also consistent with the Trade-Off Theory that states that even though debt has tax benefits, it has costs in form of financial risk during periods of economic turmoil (Modigliani and Miller, 1958). Potentially, high levels of DTA during the pandemic might lead working firms fail to serve interest and other obligations because of the reduction in sales.

As for control variables, TANG displays a negative yet insignificant relationship with ROA in the FE models with robust standard errors, suggesting that tangible assets did not significantly buffer firms against the negative effects of debt during the pandemic. SIZE, anyway demonstrates a consistent positive and significant relationship with ROA (e.g. 0.0390 in the FE model with robust errors, p-value<0.100), highlighting the advantages larger firms had in weathering the pandemic through access to resources and diversified operations. GROWTH also shows a positive and significant relationship with ROA in all models (e.g. 0.0183 in the robust FE model, p-value=0.000). This suggests that firms that managed to maintain or grow their revenues during the pandemic achieved better performance despite adverse conditions.

The analysis underscores the exacerbation of the negative relationship between DTA and ROA during the pandemic. While debt remains a critical financing tool, its risks become more pronounced in periods of economic instability, as evidenced by the pandemic's influence. The robust FE model effectively captures these dynamics, providing a reliable framework for understanding how the pandemic shaped the debt-performance relationship.

Table 4.4(a): Panel Regression Results (With COVID-19 Pandemic)

Variables	Regression Model			
	Pooled OLS	**Random Effects Model**	**Fixed Effects Model**	**Fixed Effects Model with Robust Standard Errors**
	ROA	**ROA**	**ROA**	**ROA**
	With COVID-19 Pandemic			
DTA	-0.1598*** (0.000)	-0.2000*** (0.000)	-0.2421*** (0.000)	-0.2421*** (0.004)
TANG	0.1261*** (0.000)	0.1017*** (0.000)	-0.0366 (0.250)	-0.0366 (0.368)
SIZE	0.0291*** (0.000)	0.0250*** (0.000)	0.0390*** (0.000)	0.0390* (0.055)
GROWTH	0.0163*** (0.000)	0.0179*** (0.000)	0.0183*** (0.000)	0.0183*** (0.000)
COVID	-0.0257 (0.121)	-0.0500*** (0.002)	-0.1000*** (0.000)	-0.1000*** (0.000)
Observation	1,732	1,732	1,732	1,732
R-squared	0.0711	0.0666	0.0303	0.0303
Adjusted R-squared	0.0685			
F-test	26.44***		26.62***	
Wald Chi-square		108.22***		
Breusch-Pagan LM Test				
Chi2	136.82			
Prob>chi2	0.0000			
Hausman Test				
Chi2(4)		106.90		
Prob>chi2		0.0000		
Diagnostic Test				
Multicollinearity Test				
Mean VIF			1.01	
Autocorrelation Test				
F (1, 115)			0.059	
Prob>F			0.8092	
Heteroskedasticity Test				
Chi2 (117)			1.2e+05	
Prob>chi2			0.0000	

Notes: (i) Figure in parentheses shows p-values.
(ii) * Significant at 10% level, ** Significant at 5% level and *** Significant at 1% level.

4.3.4 Capital Structure (LTDA) and Firm Performance (With COVID-19 Pandemic)

Table 4.4(b): Panel Regression Results (With COVID-19 Pandemic)

Variables	Regression Model			
	Pooled OLS	**Random Effects Model**	**Fixed Effects Model**	**Fixed Effects Model with Robust Standard Errors**
	ROA	**ROA**	**ROA**	**ROA**
	With COVID-19 Pandemic			
LTDA	0.0752* (0.055)	0.0801* (0.053)	-0.1355** (0.013)	-0.1355*** (0.002)
TANG	0.0800*** (0.001)	0.0488* (0.068)	-0.0605* (0.061)	-0.0605 (0.206)
SIZE	0.0280*** (0.000)	0.0259*** (0.000)	0.0428*** (0.000)	0.0428* (0.051)
GROWTH	0.0159*** (0.000)	0.0174*** (0.000)	0.0174*** (0.000)	0.0174*** (0.000)
COVID	-0.0252 (0.132)	-0.0483*** (0.003)	-0.0963*** (0.000)	-0.0963*** (0.000)
Observation	1,732	1,732	1,732	1,732
R-squared	0.0524	0.0498	0.0023	0.0023
Adjusted R-squared	0.0496			
F-test	19.09***		14.33***	
Wald Chi-square		59.41***		
Breusch-Pagan LM Test				
Chi2	136.83			
Prob>chi2	0.0000			
Hausman Test				
Chi2(4)		92.82		
Prob>chi2		0.0000		
Diagnostic Test				
Multicollinearity Test				
Mean VIF			1.37	
Autocorrelation Test				
F (1, 115)			0.013	
Prob>F			0.9109	
Heteroskedasticity Test				
Chi2 (117)			2.4e+05	
Prob>chi2			0.0000	

Notes: (i) Figure in parentheses shows p-values.
(ii) * Significant at 10% level, ** Significant at 5% level and *** Significant at 1% level.

Table 4.4(b) presents the panel regression results exploring the relationship between LTDA and ROA during the COVID-19 pandemic. Across all models, LTDA exhibits a

significant and predominantly negative relationship with ROA, with the FE model providing the most reliable estimate when robust standard errors are applied.

In the FE model with robust standard errors, LTDA has a coefficient of -0.1355 (p-value<0.010), indicating that a 1% increase in LTDA results in a 0.1355% decrease in ROA during the pandemic. This result highlights the adverse effects of long-term debt on firm performance under the challenging conditions created by the pandemic. While the Pooled OLS and RE models suggest a positive relationship (e.g. 0.0752, p-value<0.10 in Pooled OLS), these estimates are less reliable due to their inability to account for unobserved heterogeneity.

The significant negative relationship between LTDA and ROA during the pandemic aligns with Liao *et al.* (2023), who observed that long-term debt magnified financial distress for firms during the pandemic, particularly those operating in volatile industries. The Malaysian technology sector, characterized by high capital requirements for research and development, may have been disproportionately affected by the rigidity of long-term debt during the pandemic. On the other hand, studies such as Titman and Wessels (1988) argue that long-term debt can provide financial stability by reducing the frequency of refinancing. This perspective aligns with the positive relationship observed in the Pooled OLS and RE models, though the FE model suggests that the costs of long-term debt outweighed its benefits during the pandemic.

As control variables, TANG demonstrates a positive relationship with ROA in the Pooled OLS and RE models (e.g. 0.0800, p-value<0.01) but becomes insignificant in the FE model. This suggests that while tangible assets support firm performance across firms, their impact diminishes when controlling for firm-specific factors over time. Meanwhile, SIZE

consistently shows a positive and significant relationship with ROA across models (e.g. 0.0428, p-value<0.10 in the robust FE model), indicating that larger firms were better positioned to sustain firm performance during the pandemic. GROWTH exhibits a strong and positive association with ROA across all models (e.g. 0.0174, p-value=0.000 in the FE model with robust errors), emphasizing the importance of revenue growth in maintaining firm performance during adverse conditions.

The COVID variable demonstrates a consistent and significant negative relationship with ROA across models, with a coefficient of -0.0963 (p-value=0.000) in the FE model with robust errors. This finding reinforces the notion that the pandemic independently exerted a negative impact on firm performance, likely due to disruptions in operations, supply chains, and market demand.

The panel regression results underscore the heightened negative impact of LTDA on firm performance during the COVID-19 pandemic, as captured by the FE model with robust standard errors. The pandemic's challenges appear to have amplified the constraints imposed by long-term debt, aligning with theoretical and empirical insights from the literature. The consistent positive influence of firm size and growth on ROA further highlights the importance of resilience and adaptability in navigating the economic disruptions caused by the pandemic.

4.3.5 Capital Structure (DTA) and Firm Performance (Moderating Effect of COVID-19 Pandemic)

Table 4.5(a): Panel Regression Results (Moderating Effect of COVID-19 Pandemic)

Variables	Regression Model			
	Pooled OLS	**Random Effects Model**	**Fixed Effects Model**	**Fixed Effects Model with Robust Standard Errors**
	ROA	**ROA**	**ROA**	**ROA**
	Moderating Effect of COVID-19 Pandemic			
DTA	-0.1659*** (0.000)	-0.2053*** (0.000)	-0.2450*** (0.000)	-0.2450*** (0.005)
TANG	0.1237*** (0.000)	0.1010*** (0.000)	-0.0376 (0.239)	-0.0376 (0.366)
SIZE	0.0295*** (0.000)	0.0255*** (0.000)	0.0392*** (0.000)	0.0392* (0.055)
GROWTH	0.0164*** (0.000)	0.0179*** (0.000)	0.0183*** (0.000)	0.0183*** (0.000)
COVID	-0.0400 (0.166)	-0.0662** (0.019)	-0.1076*** (0.000)	-0.1076* (0.075)
COVID*DTA	0.0433 (0.546)	0.0552 (0.432)	0.0238 (0.742)	0.0238 (0.894)
Observation	1,732	1,732	1,732	1,732
R-squared	0.0713	0.0674	0.0304	0.0304
Adjusted R-squared	0.0681			
F-test	22.09***		22.19***	
Wald Chi-square		109.07***		
Breusch-Pagan LM Test				
Chi2	137.20			
Prob>chi2	0.0000			
Hausman Test				
Chi2(4)		117.47		
Prob>chi2		0.0000		
Diagnostic Test				
Multicollinearity Test				
Mean VIF			1.78	
Autocorrelation Test				
F (1, 115)			0.081	
Prob>F			0.7763	
Heteroskedasticity Test				
Chi2 (117)			5.6e+31	
Prob>chi2			0.0000	

Notes: (i) Figure in parentheses shows p-values.
(ii) * Significant at 10% level, ** Significant at 5% level and *** Significant at 1% level.

Table 4.5(a) investigates the moderating effect of the COVID-19 pandemic on the relationship between DTA and ROA. Based on the results, it shows all models consistently show a significant and negative relationship between DTA and ROA, with the FE model with robust standard errors providing the most reliable estimate. DTA exhibits a coefficient of -0.2450 (p-value<0.010), indicating a strong negative relationship with ROA. The negative baseline coefficient of the DTA with ROA is supported by the Trade-Off Theory of capital structure by Modigliani and Miller (1958), where while debt has benefits on the grounds of tax shields, it initially connotes elevated risk from financial failure. The Trade-Off between high debt and low costs might have worsened during the pandemic due to a decline in revenues and increased uncertainty.

As for the control variables' perspective, TANG demonstrates an insignificant relationship with ROA in the FE model, indicating that tangible assets did not significantly influence firm performance during the pandemic. On the other hand, SIZE shows a positive and significant relationship with ROA (e.g. 0.0392, p-value<0.100 in the robust FE model), underscoring the resilience of larger firms during the pandemic. Then, GROWTH maintains a consistent positive relationship with ROA across models (e.g. 0.0183, p-value=0.000 in the FE model), emphasizing the importance of revenue growth in mitigating the adverse effects of high debt levels.

The COVID variable also demonstrates a significant negative impact on ROA, with a coefficient of -0.1076 (p-value<0.100). Notably, the interaction term COVID*DTA, representing the moderating effect of the pandemic, has a positive coefficient of 0.0238, but insignificant. Pandemic was found to amplify negative impact of DTA on ROA, yet the form of this association changed in such a way that could somewhat diminish the adverse effect

of high leverage in some settings. What stands out in this analysis is the interaction term COVID*DTA that both positive and negative impact of the pandemic. The negative baseline coefficient for DTA hints that for on average ROA was reduced but the coefficient of the interaction variable shows that something about the pandemic intensified this effect. Conversely, this implies that the negative impact of DTA on firm performance has been moderated for firms with high leverage by potentially adjusting for the pandemic, among other factors, including debt re-profiling or availing of government incentives.

The findings are consistent with the literature that pointed out that leverage cannot be an easy concept during economic crises. For instance, Liao *et al.* (2023) noted that firm's indebtedness, which is often on the rise, would deepen financial risk, but firms that restructured or sought external assistance during crises can partly mitigate these impacts. This fact corresponds to the positive coefficient of COVID*DTA, meaning that some companies managed to bring their capital structure configurations into compliance with pandemic-related disruptions.

The findings also confirm that the COVID-19 pandemic played a role in reducing the strength of the positivity and significance of the interaction term (COVID*DTA). This finding sheds the lighting on how capital structure changes during periods of economic instability and shows that one has to apply for external help in such crisis like situation. FE estimation with robust standard errors reveal more of these dynamics, thus giving a comprehensive view of the debt-performance relations in the backdrop of the pandemic.

4.3.6 Capital Structure (LTDA) and Firm Performance (Moderating Effect of COVID-19 Pandemic)

Table 4.5(b): Panel Regression Results (Moderating Effect of COVID-19 Pandemic)

Variables	Regression Model			
	Pooled OLS	**Random Effects Model**	**Fixed Effects Model**	**Fixed Effects Model with Robust Standard Errors**
	ROA	**ROA**	**ROA**	**ROA**
	Moderating Effect of COVID-19 Pandemic			
LTDA	0.0031 (0.946)	0.0137 (0.764)	-0.1398** (0.011)	-0.1398*** (0.001)
TANG	0.0500* (0.060)	0.0146 (0.608)	-0.0649** (0.047)	-0.0649 (0.198)
SIZE	0.0305*** (0.000)	0.0277*** (0.000)	0.0426*** (0.000)	0.0426* (0.052)
GROWTH	0.1577*** (0.000)	0.0172*** (0.000)	0.0174*** (0.000)	0.0174*** (0.000)
COVID	-0.0449** (0.012)	-0.0681*** (0.000)	-0.1019*** (0.000)	-0.1019*** (0.000)
COVID*LTDA	0.1955*** (0.001)	0.2055*** (0.000)	0.0651 (0.327)	0.0651 (0.190)
Observation	1,732	1,732	1,732	1,732
R-squared	0.0579	0.0553	0.0042	0.0042
Adjusted R-squared	0.0546			
F-test	17.68***		12.10***	
Wald Chi-square		72.06***		
Breusch-Pagan LM Test				
Chi2	140.85			
Prob>chi2	0.0000			
Hausman Test				
Chi2(4)		191.71		
Prob>chi2		0.0000		
Diagnostic Test				
Multicollinearity Test				
Mean VIF			1.76	
Autocorrelation Test				
F (1, 115)			0.012	
Prob>F			0.9133	
Heteroskedasticity Test				
Chi2 (117)			2.1e+05	
Prob>chi2			0.0000	

Notes: (i) Figure in parentheses shows p-values.
(ii) * Significant at 10% level, ** Significant at 5% level and *** Significant at 1% level.

Table 4.5(b) presents the panel regression results assessing the moderating effect of the COVID-19 pandemic on the relationship between LTDA and ROA. Across the models, LTDA demonstrates a significant and predominantly negative relationship with ROA. LTDA shows a coefficient of -0.1398 (p-value<0.010), indicating that an increase in LTDA reduces firm performance during the pandemic. The significant negative baseline relationship between LTDA and ROA is consistent with traditional capital structure theories, such as the trade-off theory (Modigliani and Miller, 1958), which highlights the financial distress costs associated with excessive long-term debt. During the pandemic, firms likely faced heightened difficulties in meeting long-term debt obligations due to declining revenues and operational disruptions. However, the interaction term COVID*LTDA, which captures the pandemic's moderating effect, has a positive coefficient of 0.0651. This interaction suggests that the pandemic altered the relationship between LTDA and ROA, partially mitigating the adverse effects of long-term debt in certain contexts.

As for control variables, TANG has an insignificant relationship with ROA in the FE model, suggesting that tangible assets did not play a significant role in influencing firm performance during the pandemic. Meanwhile, SIZE shows a positive and significant association with ROA across all models, with a coefficient of 0.0426 (p-value<0.100) in the robust FE model, highlighting the resilience of larger firms during the pandemic. Then, GROWTH consistently demonstrates a strong positive relationship with ROA (e.g. 0.0174, p-value=0.000 in the robust FE model), indicating that revenue growth contributed significantly to sustaining firm performance despite pandemic-related challenges.

The COVID variable also exhibits a strong and significant negative relationship with ROA, with a coefficient of -0.1019 (p-value=0.000). This finding reinforces the substantial

adverse impact of the pandemic on firm performance, independent of other factors. Meanwhile, the interaction term COVID*LTDA highlights the pandemic's nuanced role as a moderator in the debt-performance relationship. While LTDA's baseline effect remains negative, the positive interaction coefficient suggests that firms may have employed adaptive measures, such as debt restructuring or accessing pandemic-related support mechanisms, to reduce the burden of long-term debt on firm performance. The findings align with Liao *et al.* (2023), who observed that firms with higher long-term debt faced significant challenges during the pandemic but could mitigate these challenges through adaptive financial strategies. Similarly, Jensen and Meckling (1976) argue that agency costs associated with long-term debt may become more pronounced during periods of economic uncertainty, although effective managerial decisions can offset these costs.

4.4 Chapter Summary

This chapter analyzed the relationship between capital structure and firm performance, with a focus on the moderating role of the COVID-19 pandemic. Such variations before and during the pandemic were reflected in terms of firm performance, debt, and other financial factors comprehensively by means of descriptive statistics. In light of the correlation analysis, there appeared to be strong positive or negative correlations between the most important variables and more focus on debt management strategy and other firm factors.

Panel regression models - Pooled OLS, RE, and FE model were used to determine the effect of total and long-term debt on firm performance. Both DTA and LTDA are statistically significant negative predictors of ROA, which were intensified by the pandemic.

However, moderating interaction terms showed that some firms reduced these effects through dynamic measures.

CHAPTER 5

CONCLUSION AND RECOMMENDATIONS

5.0 Introduction

In this final chapter, conclusions of the study are outlined and suggestions for practical implications of the research are offered, as well as limitations of the study and recommendations for future research. The chapter forms the final part of the study where findings from the analysis and discussions made in the preceding chapters to respond to research objectives. The conclusions made in this chapter reflect the works completed in relation to the analysis of capital structure and firm performance, with focus placed on the impact of COVID-19 pandemic. The paper focuses on the important factors to firm and debt decisions during pandemic and makes important contributions for firms, governments, and funding institutions.

Furthermore, the chapter highlights limitations experienced when conducting the study whereby factors including data limitations, methodological issues and context factors may have contributed to the external validity of the findings. These limitations enable the formulation of an agenda for future research on how capital structure react towards external disturbances such as the current COVID-19 pandemic.

Analyzing the implications and offering tangible suggestions, the chapter is intended to advance both theory and practice while helping firms enhance financial execution and realize higher performance. The concluding thoughts in this chapter summarize the findings of the study and stress its importance in the context of the continuously changing economic landscape.

5.1 Research Findings

5.1.1 Findings on Capital Structure and Firm Performance Without COVID-19

The findings of the study for the capital structure and firm performance before the COVID-19 outbreak provide valuable lessons as to how financial leverage and performance function. The current study found that the total debt to total assets ratio (DTA) analysis maintained a significant incongruity with return on assets (ROA), with the Fixed Effect (FE) model proving the most precise fit. This negation is consistent with the Trade-Off Theory, whereby higher levels of total debt lower performance because of high financial distress costs. It is noteworthy that the results highlight the increased vulnerability of firms with high levels of gearing because the cost of interest and constrained credit facilities erode performance.

On the other hand, long-term debt to total assets ratio (LTDA) was not entirely consistent with ROA as the two share a moderate negative correlation with the coefficient of determination showing moderate variability. In the Pooled OLS and Random Effect (RE) models, the coefficients were slightly positive but barely statistical-significant, contrasting with the negative and significant coefficients of the FE model. Such a gap underlines the need of proper accounting for unmeasured heterogeneity when it comes to examining such financial measures. According to the results obtained from the FE model, long-term debt has a negative influence on performance and even though it offers creditors claims' structural stability, it forms stringent repayment schedules and relatively expensive credit.

Other control variables included firm size and growth rate offered further understanding to the results. The results showed that firm size was net positively related with performance measured by ROA and positively influenced the models across all. In the same

manner, growth had a positive impact on ROA proving that firms applying expansion strategies attained better financial results. Tangibility on the other hand was found to be significant in Pooled OLS but was not significant in FE model suggesting that the impact in tangible assets is more firm cross section rather than over time within firms.

In this regard, the pre-pandemic findings provide evidence that supports the importance of proper management of debt in enhancing the performance of the firm. Total debt and long-term debt are sources of high risk while firm size and growth are sources of high performance. These insights will offer a ground for comparison to the results that will be assessed in the context of COVID-19 impacts.

5.1.2 Findings on Capital Structure and Firm Performance During COVID-19

The outbreak of the COVID-19 pandemic brought unanticipated economic challenges, which had a great impact on the nature of capital structure and firm performance. During this period the DTA continued to sustain a strong negative correlation with ROA. This finding points to the increase in the financial risks in highly leveraged firms during the pandemic as revenues declined significantly, and firms faced a tough economic environment to service their debts.

Research findings show a negative relationship between LTDA and ROA during the pandemic. The result, therefore, indicates that assuring compliance with the inflexible covenants linked to long-term debt was even more daunting under the constrained economic environment that characterized the period of the pandemic. The firms with higher ratio of long-term debts could probably have had less operational freedom or flexibility in responding to quickly changing market environments.

COVID as the variable that measures the direct effect of the pandemic on firm performance was also significant and negative for ROA across all models. In the FE model, the COVID coefficient was -0.1000 (p-value=0.000), suggesting that the pandemic decrease performance irrespective of other factors. This impact can be attributed to the effects of the pandemic such as disruption of supply chains, decrease in consumers' spending, and increased expenses.

Leveraging control variables in the course of the pandemic offered more understanding of firm robustness. Size maintained its positive effect on performance, whereby the firms that were large and more capable of managing crises incurred from the pandemic were more profitable. To the FE model with robust standard errors, firm size was estimated by coefficient 0.0390 (p-value<0.010) representing diversified operation advantages, stronger resource, and greater market power. Growth also remained positively related to ROA with coefficient of 0.0183 (p-value=0.000) showing that firms who were able to sustain or generate more revenues during the pandemic performed better.

Surprisingly, the interaction terms that provided insights into the moderating role of the pandemic showcased complex trends. In the case of DTA, the coefficient of interaction term COVID*DTA was positive but insignificant, which means that some firms were able to contain the negative impact of leverage through some form of adjustment. Likewise, the COVID*LTDA indicating the interaction between LTDA and the pandemic also yielded a positive but insignificant relationship. This suggesting that, although long-term debt reduced ROA, the COVID-19 pandemic partly mitigated this effect.

Therefore, the evidence that emerged during the COVID-19 pandemic shows the increased danger of having a high amount of debt and emphasizing the significance of

change for clients in economic shocks. The negative correlations between both DTA and LTDA and ROA provide evidence on the poor debt management practices during crises while the moderation effect by the pandemic implies that firms that used strategic financial adjustments-maintained performance level better. These results contribute to the identification of how the pandemic influenced the development of capital structure and firm performance.

5.1.3 Moderating Effects of COVID-19 on Capital Structure and Performance

The COVID-19 pandemic affected the interaction between the capital structure and the firm's performance as a mediating factor in the interdependence of debt and performance. The inclusion of interaction terms in the panel regression models allowed for examining the conditional effects of the pandemic on long-term debt's relationship with ROA. COVID*DTA was the interaction term that measure the moderation effect of the pandemic on the relation between DTA and ROA. The results obtained when run the model into FE with robust standard errors showed that COVID*DTA indeed has significant and positive coefficient. This result indicates that DTA had a negative impact on the ROA, but the pandemic shifted the stability of this relationship and partially lessen the impact of total debt.

There are several factors that can help explain that moderating effect of the pandemic. Unfavorably, during the pandemic, leveraged firms may have made adjustments to debt to ensure it becomes more manageable through debt restructuring, payment deferment or through accessing the government relief programs. This intervention may have thus helped to reduce the negative effects of high leverage whereby firms have been able to continue to meet their expenses and pay for some necessary infrastructural undertakings despite low revenues.

Furthermore, some industries may have experienced an increase in demand due to the pandemic, which would allow firms with high debt levels to sustain or even enhance their operations. For instance, technology companies who figure higher on the leverage ratio scale witnessed a surge in demand during the pandemic; an effect which may help eliminate the traditional negative outcomes associated with a high debt ratio. Such dynamics reveal a close relationship between capital structure and the external factors affecting the business.

Additionally, COVID*LTDA showing the moderation of the pandemic on the LTDA also has a positive coefficient in the FE model with robust standard errors. This implies that the pandemic to some extent compensated for the negative correlation of long-term debt on the ROA. Despite the fact that it implies strict payment conditions, long-term debt may have helped to maintain the financial stability of the firm during the pandemic by granting financing for an extended period. The economic fluctuations that came with the pandemic probably forced firms to seek capital in long-term funding in order to avoid cash shortages. Furthermore, some government interventions like interest rates subsidies and government guarantees of some debts for business may have actually brought down the cost of utilizing long-term debts to a manageable level when the pandemic struck.

This moderating effect also explains the changes made to firms' capital structures as a result of the pandemic. Companies with higher long-term debt may have placed value on effective operating and cost control to ensure their earnings. Also, the possibility to use long-term debt as a security for the additional funds might have enhanced firms' liquidity, thus minimizing the impacts of the COVID-19 outbreak.

Even the COVID variable alone had an overall significant negative effect on the ROA in the FE model with robust standard errors, this result shows that the pandemic has a direct

negative effect on the performance of the firms irrespective of capital structure. The problem areas that the firm highlighted include the insufficient supply chain, decreased customers' demand, and therefore, the inefficiency as the major pressure on performance across industries.

The pandemic crisis acted as both a problem and a catalyst that made businesses change their financial tactics and seek innovative solutions. COVID-19 helped businesses modify their debt strategies and performance methods to overcome sudden economic uncertainties. Studies from earlier research confirm that external disruptions can reshape how businesses handle their finances. Gopalakrishnan *et al*. (2022) found that companies with financial adaptability succeeded at overcoming pandemic challenges. This research verifies that firms adapt their financing structure based on economic changes according to the Dynamic Trade-Off Theory. High debt firms used external help or planned ahead to reduce the negative effects of borrowing money.

Control variables demonstrate how the pandemic created unique effects that affected business operations differently. Our analysis showed firm size and growth directly impacted ROA at a confident statistical significance level. Large companies and firms with growth plans showed more success in handling pandemic-related difficulties. Tangible assets did not affect company performance during the pandemic period despite being measured.

Business performance during the COVID-19 pandemic broke down the traditional correlation between total and long-term debt levels and company results. The pandemic created severe financial problems for businesses but pushed them to create new plans that allowed them to handle their debt better. The interactions between economic disruptions and

business finance decisions reveal important patterns that help businesses prepare for future market changes.

5.2 Theoretical and Practical Implications of the Study

The research expands understanding of capital structure effects on firm performance through analysis of COVID-19 pandemic impacts. The research findings validate current financial theories with new understanding into debt management practices under economic uncertainty conditions. The research supports the Trade-Off Theory because debt offers tax shield benefits yet high leverage cause financial distress. Negative relationship between the DTA and ROA demonstrates the impact of higher firm leverage levels on profitability levels. The study expands the trade-off perspective through analysis of external pandemic events to stress the importance of proper debt management under these conditions.

Additionally, the research also supports the Pecking Order Theory through which companies should choose internal funding above debt because they must pay the costs of financial distress and asymmetric information. During the pandemic the negative influence on firm performance demonstrated that increased dependency on external debt produced substantial financial challenges for these firms. Research evidence demonstrates that organizations should focus on generating funds from internal sources especially during times of economic instability.

Thus, it is advisable the companies should improve understanding of Crisis Management and Financial Resilience Theories through evidence which shows that firms with flexible debt handling practices achieved superior performance during unexpected shocks. Some firms experienced improved capital structure-performance relationships because pandemic-related strategic financial actions including debt restructuring together

with cost optimization worked as a moderating effect. The results boost comprehension of economic continuity in emergency circumstances.

Under particle implication, this research generates multiple practical recommendations which serve businesses and both government authorities and financial institutions. The study demonstrates that firms need to maintain accurate debt management strategies. Organizations should limit their use of short-term debt since it reduces profitability when economic conditions deteriorate. The best strategy for firms should be to develop financial flexibility through strategic debt planning for long-term needs which maintains liquidity and minimizes financial distress. Organizations need to enhance their risk management procedures through stress testing and scenario analysis tools to deal with upcoming economic uncertainty.

The research underlines to policy makers that financial stability programs remain vital during economic emergency situations. To assist organizations financially handle debt obligations with minimal impact on performance. Governments should create specific programs that combine low-interest loan opportunities and tax incentive benefits. The implementation of capital structure disclosure requirements through regulatory framework should promote firms' effective reporting of their financial risks.

Financial institutions must develop adaptable financing programs that address unique sector requirements of their business clients. Financial sector stability is supported through business profitability when financial institutions implement loan restructuring measures that incorporate deferred payments and interest rate adjustments during economic downturns. Banks must improve their risk assessment systems through the addition of external shock variables that evaluate business financial stability effectively.

5.3 Research Recommendations

5.3.1 Recommendations for Firms in Managing Debt Levels

The study demonstrates that proper debt control enhances business success especially when markets face unpredictability. Firms must carefully determine their debt ratio to maximize benefits from borrowing without excessive risk. Firms must limit their dependence on short-term debt when research shows high total debt reduces performance before and throughout COVID-19 pandemic situations. Short-term borrowing tends to be available and adaptable but becomes limiting when businesses face revenue losses. During times of economic turmoil businesses should analyze their debt structure to convert short-term loans into longer-term financing because long-term debt provides better protection from frequent repayment requirements.

Companies need to enhance how they plan financial matters. Organizations that build strong prediction tools can see future cash issues and set limits on how much debt they should use. Stress testing financial models helps companies predict external risks and take early actions to handle debt responsibilities better. To handle high debt levels properly, firms need to reduce expenses and make their operations run better. Companies need to make their systems more efficient, spend wisely on essential needs, and use modern tools to boost output when the economy is unstable. Companies can protect their performance by increasing their income enough to handle debt payments.

Besides that, organizations must create long-term bonds with banking institutions to achieve better debt financing arrangements. Firms need to ask lenders for better interest rates plus longer loan durations and adjustable credit features. Clear financial reporting and good credit ratings help companies get more favorable debt terms from lenders.

The results demonstrate how a variety of methods can benefit companies. Organizations working in industries with unstable market conditions should bring in money from different sectors to minimize their reliance on markets that can suffer from economic disruptions or pandemic effects. A company can maintain its financial strength during uncertain times by spreading its income across different business areas even with high debt levels. Businesses can protect themselves from debt dangers while obtaining capital resources to drive business growth and creative development.

5.3.2 Recommendations for Policymakers in Economic Uncertainty

During uncertain times such as the COVID-19 pandemic policymakers must develop economic rules that allow businesses to remain steady and maintain sound financial operations. Public officials need to develop key strategies that support financially stressed firms with excessive debt. The government should build relief programs that enable businesses to get credit through reduced costs. Businesses can better handle crisis debt through low-rate loans, debt protection programs, and extended payment breaks while protecting their profit margins. The financial support should go first to industries that take the hardest hits from external events to strengthen overall economic performance. Policymakers should reward businesses with tax breaks when they show smart debt management practices. Tax programs with interest deductions and asset ratio bonuses push companies to use debt wisely in their financial planning.

Regulatory bodies must require businesses to openly show their debt practices and make sure managers handle debt properly. Financial institutions can better evaluate loan risks and trust borrowers more when companies share complete details about their debt

management and finances. The rules allow officials to watch how financial risks spread through the entire economic system.

Government leaders should work to grow many different parts of the economy to protect the nation from problems that affect only one sector. Supporting technology and health investments helps companies earn profits during crises and makes high debt levels less risky. Leaders who establish helpful regulations, show clear financial details, and build a stable economy will help businesses survive uncertain business conditions through good financial management.

5.3.3 Recommendations for Financial Institutions on Debt Financing

Financial institutions play a vital role in helping companies get loans and their lending decisions directly affect business results. Financial institutions must design special support methods to help firms maintain proper debt control especially when economic problems arise. Financial institutions must modify their loan requirements when crises occur to assist companies while they manage their debt obligations. Financial institutions can help companies stay afloat by letting them reschedule debt payments or lower interest rates. By implementing these solutions, businesses remain financially stable while preventing massive loan failures that hurt the entire financial market.

Lenders and banks must develop better systems to determine how well companies deal with their debt requirements. Stress testing and scenario analysis help banks find borrowers who perform well during tough times. This system allows lenders to make smart loan choices by reducing both risk and inefficiency. Besides that, financial institutions must create financial products that match specific industry requirements. Technology companies can focus on growth and innovation through low-rate long-term loans without exceeding

healthy debt limits. Specialized financial products can protect industries by reducing effects of unexpected events.

Financial institutions need to teach their customers about finance and provide professional advice. Financial institutions guide businesses on the right mix of funds and better manage cash to improve their financial health and debt performance during market challenges. Financial institutions need to create supportive debt management plans for businesses that maintain their own stability. When lenders partner with businesses, they help make the economy both strong and long-lasting.

5.4 Research Limitations

5.4.1 Data-Related Limitations

The study faced its biggest challenge due to limited and unreliable data sources. The research used data from public Malaysian technology companies' financial reports but these documents sometimes lacked full details. The absence of key performance indicators like employee satisfaction exists because the necessary data was not present. The study was not able to evaluate all factors that influence business success because key information was missing.

The available duration of the data created obstacles for our research. The COVID-19 pandemic brought unexpected economic changes that our available data records only partially. The limited time frame of available data reduced the study's ability to assess lasting effects of COVID-19 on capital structure and business performance. Differences in financial reporting methods by companies can reduce the validity of our findings.

Our research excluded businesses that operate below market visibility or under private ownership. The research design's emphasis on listed firms excluded small private companies which adopt distinct strategies to manage their finances. The findings would be more robust if the researchers extended their scope to include small businesses without public listings.

5.4.2 Methodological Limitations

The approach to research brought specific restrictions that affected the study. The panel regression approach offers strong results yet requires variables to evolve along a straight path to maintain accuracy. The study lacks complete accuracy because real financial relationships show changing and nonlinear behavior during events like the COVID-19 pandemic. Econometrics research would gain more detail if we used advanced methods like dynamic panel models and machine learning.

The Fixed Effects model handled hidden differences between companies well but missed important effects from industry sectors and regional locations which affect company success. By omitting these variables, the study fails to capture essential details about how business environments affect results.

Research studies often use ROA to measure performance but this approach fails to capture all performance aspects companies experience. Looking at financial market indicators, business success metrics, and organizational performance levels gives a more complete picture of firm results. Using DTA and LTDA to measure capital structure remains standard practice yet this approach does not account for other funding methods including equity and hybrid securities.

The research did not completely solve for variables that could affect outcomes because of missing factors. Although we used robustness testing, we could have improved our results by incorporating instrument variables or other established methods for causal inference.

5.4.3 Contextual and Generalizability Limitations

Limited application of research findings to other technology firms beyond Malaysian stock market listings. Technology companies spend heavily on research yet must adapt quickly to changing markets while keeping up with their fast-paced innovation cycles. The research findings specifically target technology firms and may not match the behavior of manufacturing or agricultural businesses.

The Malaysian business environment has distinct financial rules and economic conditions that do not match those of other countries. Malaysia runs its financial system under unique business rules, governance structures, and pandemic response policies that differ from both developed economies and other developing markets. The unique features of the Malaysian situation prevent us from directly applying these results to other regions.

The study examined economic conditions that emerged as a result of the COVID-19 pandemic during the selected period. Investigating capital structure and performance primarily through crises helps understand market responses but does not reveal stable market trends. The research results may not work well when tested beyond crisis situations.

The research's inclusion of only large public companies limits our ability to extend these results to smaller companies and private firms. Firms operate with unique money constraints and debt handling methods that produce different results when measuring capital

structure and business success. Further studies need to expand their research scope to overcome these challenges.

5.5 Future Research Recommendations

5.5.1 Expanding on the Role of External Shocks on Capital Structure

Researchers must study how external events like pandemics, recessions, world conflicts, and technological changes affect company funding and success. A thorough study of company financing strategies requires examining multiple economic disruptions over several years instead of limiting research to the COVID-19 pandemic alone. Academic teams must analyze how organizations adjust their methods for financial stability through cash flow management and outside financing while dealing with different economic challenges. Studies will develop practical solutions that enable organizations to better withstand market fluctuations.

Researchers can study the connection between business markets and macroeconomic policies on how external hurdles affect company financial planning. Studying how firms behave when facing crises in various sectors and regions before, during, and afterward helps researchers discover consistent patterns in their crisis management. Time-series analysis and structural equation modeling serve as advanced econometric tools that enable researchers to examine the lasting influence of external disruptions on debt handling and business viability.

5.5.2 Investigating Other Moderating Variables

Studies need to investigate additional elements that shape the connection between debt structure and business results beyond the COVID-19 pandemic. Economic indicators like inflation rates, interest rates, and exchange rates have strong impacts on how debt affects

performance. The effects of company governance systems and management talent on business results need more research attention as potential influences. A well-managed company with strong oversight can limit debt problems because leadership makes better choices and takes ownership. Executive leadership skills enable management to overcome financial problems through challenging crisis periods.

ESG concepts now act as significant factors that shape corporate behavior and performance. Research needs to investigate the effects of environmental social and governance activities on businesses' debt strategies and their performance stability during market downturns. Future work needs to study how companies perform alongside their business sector activity and broader market conditions in one analysis. This strategy would reveal the entire picture of the relationships that affect business financing decisions.

5.5.3 Incorporating Industry-Specific Effects in Future Studies

Future studies must analyze how industry types shape the link between company financing and business outcomes. The results apply specifically to the Malaysian technology market which shows high research spending while operating under quick product development and unpredictable market shifts. Researching additional sectors like manufacturing healthcare retail and agriculture enables us to compare results and make the results more widely applicable.

Each industry has unique preferences for how they structure their finances with regard to capital. Manufacturing and energy industries prefer long-term debt since they need substantial capital while service-based sectors tend to embrace equity financing. Analyzing sector differences in capital structure helps us better understand the factors that influence which financial structure works best in each industry.

Future studies should explore how specific industry conditions like competitive pressure, regulations, and technology use affect debt performance. Studies analyzing capital structure choices between developed nations and developing regions help explain how industry conditions influence financial decisions.

Analyzing each sector's financial situation will let policymakers and lenders build better support programs that match industry requirements. Future research that includes these elements will help create a better understanding of how capital structure affects business results.

5.6 Conclusion

This research looked at how capital structure affects business performance and how the COVID-19 pandemic modified these financial effects. The study showed that debt levels reduced company profits both during normal times and especially during COVID-19. Companies that adjusted their financial strategies experienced less harm from their debt load during the COVID-19 crisis. Performance benefits from larger businesses and better growth rates especially during uncertain times.

This research adds to existing literature by showing how debt affects business success under market disruptions while offering guidance to companies and financial regulators. Data and method barriers in the study present potential opportunities to extend this research and strengthen the current findings in future studies.

This study reveals that successful companies protect their performance by combining responsible borrowing with flexible operations in times of crisis. The study uses both theory

and real-world data to help businesses and investors understand how companies manage their debt while also providing practical guidance for current market conditions.

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