MODERATING ROLE OF INTELLECTUAL CAPITAL ON CAPITAL STRUCTURE AND CORPORATE PERFORMANCE OF HIGH TECHNOLOGY INDUSTRY IN CHINA AND UNITED STATES

By

LI SHIYU

Thesis Submitted to the School of Graduate Studies, Universiti Putra Malaysia, in Fulfillment of the Requirements for the Degree of Doctor of Philosophy

January 2023

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DEDICATION

To My Beloved Family

Li Suzhen
Zhang Jihua
Li Sinuo

To My Precious Husband
Zeng Jia

&

To My Treasured Supervisor

Ong Tze San

...With you, hopes are always there...

Abstract of thesis presented to the Senate of Universiti Putra Malaysia in fulfillment of the requirement for the degree of Doctor of Philosophy

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January 2023

Chair : Professor Ong Tze San, PhD
School : Business and Economics

As one of the knowledge-intensive industries in today's knowledge-based economy, the high technology industry is becoming increasingly competitive. How to improve corporate performance is a key concern for most companies. Since the Modigliani-Miller (MM) Theorem was proposed, research on the relationship between capital structure and corporate performance has been a popular academic topic.

At the same time, intellectual capital is the core resource of knowledge considered as one of the core capital forms of high-tech companies. Its importance in creating value and maintaining long-term competitive advantage for corporate becomes abundantly obvious. Therefore, it is of great practical significance to explore the relationship between capital structure and corporate performance of high-tech companies from the perspective of intellectual capital.

The research background is based on the US-China trade war. Since high-tech industry is the most affected industry in this trade war, the sample is selected from the top 200 listed companies in high-tech industry with the highest market capitalization in two countries, totaling 400 companies. The balanced dataset employed in the study covers a period from the year 2017 to 2019 and semi-annuals were used as a study period, so a total of six study periods. The data analysis consisted of two stages. The first stage is to calculate firm efficiency as a measure of corporate performance using the Data Envelopment Analysis (DEA). The second analysis step is to use the static panel regression analysis by Pooled Ordinary Least Square (POLS), Fixed Effect (FE), and Random Effect (RE) models. Subsequently, the Generalized Method of Moments (GMM) is adopted as a further robustness check test for the possibility of endogeneity in the models.

The results of the study reveal a significant relationship between debt to asset and long-term debt to equity as important measures of capital structure and corporate performance. Furthermore, human capital efficiency and value added intellectual coefficient can both have a positive and significant impact on corporate performance. Moreover, the statistics indicate that intellectual capital has a significant moderating effect between capital structure and corporate performance.

The study concludes that the capital structure and intellectual capital have significant impact on corporate performance. Furthermore, the study presents evidence on the moderating role of intellectual capital on the link between capital structure and corporate performance. The study contributes to the existing body of knowledge, empirical and practice. Firstly, this comparative research contributes in enlarging the existing literature on the relationship among capital structure and corporate performance of the high-tech industry in the economic context of the US-China trade war. Secondly, the using of Value Added Intellectual Coefficient (VAIC) to measure intellectual capital establishes a performance and intellectual capital evaluation index system that meets the characteristics of this type of enterprise, further laying the foundation of a certain knowledge system for the development of high-tech industry. Finally, the findings suggest that high-tech company managers should pay more attention to intellectual capital, so that intellectual capital can be employed efficiently and effectively and that the impact of capital structure on the company can be adjusted to better contribute to business operations.

Abstrak tesis yang dikemukakan kepada Senat Universiti Putra Malaysia
sebagai memenuhi keperluan untuk ijazah Doktor Falsafah

PERANAN MODERASI MODAL INTELEKTUAL TERHADAP STRUKTUR MODAL DAN PRESTASI KORPORAT INDUSTRI TEKNOLOGI TINGGI DI CHINA DAN AMERIKA SYARIKAT

Oleh

LI SHIYU

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Pengerusi : Profesor Ong Tze San, PhD
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Sebagai salah satu industri berintensifkan pengetahuan dalam ekonomi berasaskan pengetahuan hari ini, industri berteknologi tinggi menjadi semakin kompetitif. Masalah utama bagi kebanyakan firma adalah berkenaan dengan cara meningkatkan prestasi korporat. Sejak Teorem Modigliani-Miller (MM) dicadangkan, penyelidikan tentang hubungan antara struktur modal dan prestasi korporat telah menjadi topik akademik yang popular.

Pada masa yang sama, modal intelek merupakan sumber teras pengetahuan yang dianggap sebagai salah satu bentuk modal teras bagi firma berteknologi tinggi. Kepentingannya dalam mencipta nilai dan mengekalkan kelebihan daya saing jangka panjang untuk korporat menjadi lebih ketara. Oleh itu, objektif pertama adalah untuk menerokai hubungan antara struktur modal dan prestasi korporat bagi industri berteknologi tinggi dari perspektif modal intelek.

Latar belakang penyelidikan adalah berdasarkan perang perdagangan di antara Amerika Syarikat (AS)-China. Memandangkan industri berteknologi tinggi adalah industri yang paling terjejas dalam perang perdagangan ini, sampel dipilih daripada 200 firma tersenarai teratas dalam industri berteknologi tinggi dengan permodalan pasaran tertinggi di kedua-dua negara, iaitu berjumlah 400 firma. Set data seimbang yang digunakan dalam kajian ini meliputi tempoh dari tahun 2017 hingga 2019 dan data setengah tahunan digunakan sebagai tempoh kajian, jadi sejumlah tempoh kajian yang terlibat adalah enam. Analisis data terbahagi kepada dua peringkat. Peringkat pertama adalah untuk mengira kecekapan firma sebagai ukuran prestasi korporat dengan menggunakan kaedah Analisis Penyampulan Data (DEA). Langkah kedua adalah analisis menggunakan regresi panel statik melalui Kaedah pengumpulan Kuasadua Terkecil (POLS), Model Kesan Tahap (FE) dan Model Kesan Rawak (RE).

Setelah itu, Kaedah Umum Momen (GMM) dijalankan sebagai ujian semakan kekukuhan serta mengesan kebalangkalian isu endogeneiti dalam model.

Hasil kajian mendedahkan hubungan yang signifikan antara hutang atas aset dan hutang jangka panjang atas ekuiti sebagai ukuran penting struktur modal dan prestasi firma. Tambahan pula, kecekapan modal insan dan pekali intelek nilai tambah boleh memberi kesan positif dan signifikan terhadap prestasi firma. Selain itu, statistik menunjukkan bahawa modal intelek mempunyai kesan moderasi yang ketara antara struktur modal dan prestasi firma.

Kajian ini merumuskan bahawa struktur modal dan modal intelek mempunyai kesan yang signifikan terhadap prestasi korporat. Tambahan pula, kajian ini membentangkan bukti tentang peranan moderasi modal intelek terhadap hubungan antara struktur modal dan prestasi korporat. Akhir sekali, kajian ini menyumbang kepada bidang pengetahuan, empirikal dan amalan yang sedia ada. Pertama, kajian perbandingan ini menyumbang dalam memperluaskan literatur yang sedia ada tentang hubungan antara struktur modal dan prestasi korporat industri berteknologi tinggi dalam konteks ekonomi perang perdagangan AS-China. Kedua, penggunaan Nilai Ditambah Intellectual Coefficient (VAIC) untuk mengukur modal intelektual mewujudkan sistem indeks penilaian prestasi dan modal intelektual yang memenuhi ciri-ciri jenis perusahaan ini, seterusnya meletakkan asas sistem pengetahuan tertentu untuk pembangunan industri berteknologi tinggi. Akhir sekali, penemuan mencadangkan bahawa pengurus firma berteknologi tinggi harus memberi lebih perhatian kepada modal intelek, supaya modal intelek dapat digunakan dengan lebih cekap dan berkesan, serta kesan struktur modal ke atas firma boleh diselaraskan untuk menyumbang kepada operasi perniagaan dengan lebih baik.

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Over the course of my researching and writing this study, I would like to show my thanks to all those who have helped me.

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This thesis was submitted to the Senate of Universiti Putra Malaysia and has been accepted as fulfillment of the requirement for the degree of Doctor of Philosophy. The members of the Supervisory Committee were as follows:

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Declaration by Members of Supervisory Committee

This is to confirm that:

- the research conducted and the writing of this thesis was under our supervision;
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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF ABBREVIATIONS

CE	Capital Employed
CEE	Capital Employed Efficiency
CHN	China
CP	Corporate Performance
CS	Capital structure
DEA	Data Envelopment Analysis
FE	Frim Efficiency
FEM	Fixed Effect Model
GDP	Gross Domestic Product
GMM	Generalized Method of Moments
HC	Human Capital
HCE	Human Capital Efficiency
IC	Intellectual Capital
MM	Modigliani-Miller
OLS	Ordinary Least Square
POLS	Pooled Ordinary Least Square
R&D	Research and Development
REM	Random Effect Model
ROA	Return on Assets
ROE	Return on Equity
SC	Structural Capital
SCE	Structural Capital Efficiency
TE	Technical Efficiency

US	United States
VA	Value Added
VAIC	Value Added Intellectual Coefficient

CHAPTER 1

INTRODUCTION

1.1 Background of the study

Capital structure is a company's financial framework which includes the structure and percentage relationship of funds (debt and equity) that is raised by an enterprise to finance the company. This may include some or a combination of the following: issuance of bonds; stocks; bank borrowings; and strategic investors' equity financing (Parsons and Titman, 2009; Mohamad and Saad, 2010；Abeywardhana, 2017). The capital structure is the internal structure of the funds that an enterprise uses to maintain its operations and to promote its development (Strebulaev, 2007; Ardalan, 2017; Li and Niskanen, 2019). However, owners of funds with different attributes have different goals. Consequently, a company's capital structure decision plays a critical role in influencing corporate decisions and boosting corporate evolution (Cohn, Mills and Towery, 2014). In other words, a company's ability to effectively achieve stakeholder needs is closely tied to its capital structure decision (Zuraidah, Norhasniza and Shashazrina, 2012; Aziz and Abbas, 2019). Looking deeper, Tirumalsety and Gurtoo (2021) stressed that capital structure is crucial to how a company utilizes various sources of funding to provide it with funding guarantees and to maintain a company's overall operations and performance growth.

In the 1950s, with the rise and development of international capital markets, the study of capital structure has become a greatly substantial research area, with scholars conducting in-depth research on this issue. In 1985, the classic work named "Capital Cost, Corporate Finance and Investment Theory" by Modigliani and Miller pioneered the study of modern capital structure theory, and "Modigliani-Miller (MM) Theorem" became the foundation of modern capital structure hypotheses. According to the MM Theorem, it is assumed that the capital structure that an enterprise chooses is completely independent of its market performance in a capital market with complete information, without considering income tax. It is necessary to clarify that the MM Theorem operates under the condition of perfect market with various assumptions, such as no taxes, rational investors, perfect competition, no bankruptcy costs and most efficient market (Ganiyu et al., 2019; Shoaib and Siddiqui, 2022).

Therefore, most previous studies on the relationship between capital structure and corporate performance under the MM Theorem hypothesis are mostly constrained by the perfect market assumption (Detthamrong et al., 2017). The premise of Modigliani-Miller (MM) Theorem is a perfect market including the absolute free flow of capital, both of which are almost certain not to exist in reality. Moreover, there are other factors existing in the economic market that impede capital flows, for instance income taxes that exist for almost every company.

Often, because of information asymmetry, it is not possible for people outside the company to know how a company chooses and manages its securities, thus making it difficult to understand their capital structure clearly (Li, 2019). Since then, many scholars (Narayanan,1988; Huang, 2006; Saeedi and Mahmoodi, 2011) have attempted to strengthen the MM Theorem's persuasiveness and flexibility by enlarging the model's assumptions or by defining the assumptions of the model more exclusively; and struggled to make the assumptions of the theorem closer to the real world. With the continuous improvement of the MM Theorem, scholars have successively proposed a wealth of theories such as Agency theory (Jensen & Meckling, 1976) and Information Transmission Theory (Scott & Keith,1996).

Although many scholars have made substantial in-depth research on capital structure, it is still a widely held view that the "mystery of capital structure" still exists today, just like the "Black Box" of enterprises in traditional economics; that is, how its internal mechanism works has not been fundamentally explained, given the complexity of the real economic playing field and the special characteristics of particular industries (Ahmad et al., 2012). There is some evidence to suggest that the effect of capital structure on corporate performance is different under different macroeconomic environments (Tirumalsety and Gurtoo, 2021; Yang, Lee and Lim, 2022). Thus, it is believed that there is no fixed relationship between capital structure and company performance across all economic environments (Ardalan, 2017; Li, Niskanen, 2019). In other words, an analysis of the relationship between capital structure and company performance is always specific to the economic background and target industry.

Against the backdrop of its industry and economic specificity, capital is critical to the existence of any organization because of its direct relation to operating continuity, and its influence on the ability of a company to pursue maximization of shareholder wealth and societal wealth (Akani and Ifechi, 2017). Thus, determining the capital structure decision of an enterprise is critical and challenging. In reality, to balance the relationship between capital structure and corporate performance, financial managers often find it difficult to exactly determine the ideal capital structure in continuously changing business and economic environments (Dao and Ta, 2020; Wang and Sun, 2021). Each enterprise has its own unique attributes and the goals they pursue in each specific period may change; thus, causing enterprises to have differing considerations when choosing a financing method (Yang, Lee and Lim, 2022). Only the capital structure that supports the corporate development goals is in a reasonable position in its relationship with corporate performance. Therefore, the capital structure of a company may need frequent micro and macro adjustment if the company desires a consistently profitable, or improved, performance in the complex economic environments (Saeedi and Mahmoodi, 2011; Ganiyu, Adelopo, Rodionova and Samuel, 2019). Furthermore, a company has to issue and manage various securities to achieve the particular combinations that can maximize its overall value i.e., optimize its capital structure (Nwude and Anyalechi, 2018); where optimal capital structure means maximizing the value of a company at a minimum weighted-average cost of capital. Despite the fact that optimal capital structure has been widely researched, Antill and Grenadier,

(2019) hold the view that it is not possible to find any formula or theory that decisively provide optimal capital structure for a company. Besides, according to He et al. (2020), different capital structure will affect the financing cost, financing risk tax level and other aspects of the company; and, of course, affect the performance of the company. Even though many researchers insist that there is no optimal capital structure, a capital structure that contributes to better corporate performance is reasonable for the company (Jouida and Hellara, 2018; Hirdinis, 2019). Hence, a clear understanding of the relationship between capital structure and company performance is of great help in determining capital structure. To sum up, it is of great significance to study the effect of capital structure and its influence on company performance.

In traditional economics, it is believed that the main sources of corporate value creation are monetary funds, machinery and equipment, raw materials, labor, and other factors of production. This view was generally accepted in the industrial economy period, promoting the development of social technology and economies of that time (Allameh, 2018). However, with the increasing dependence of world economic growth on the emergence, growth and application of knowledge, the knowledge economy has gradually replaced the industrial economy—i.e., the knowledge economy has become the main economic form of the 21st century (Xu, Haris and Yao, 2019). In the era of the knowledge economy, human knowledge has also undergone innovative changes. Against this background, Intellectual Capital Theory has been proposed and widely used in research fields such as management. Since the 1980s, experts and scholars have increasingly conducted research on intellectual capital and regarded it as a significant factor that has an impact on corporate value creation (Allameh, 2018).

As an important resource of knowledge, intellectual capital plays an especially important role in the value-adding and long-term development of a company (Lu, Wang and Kweh, 2014; Farah and Abouzeid, 2017). Today, knowledge, like tangible assets such as currency, equipment, and raw materials, is regarded as an essential strategic resource for enterprises. The strategic role of intellectual capital is becoming increasingly apparent; for instance, the experience and ability of employees in the enterprise, the internal organizational structure of the enterprise, as well as the relationship between the enterprise and customers (Sarwenda, 2020). Further, with the rapid development of science and technology and the increasing economic globalization, knowledge and high-tech—as unique strategic resources—will replace the traditional material resources in the development of enterprises (Chen, Liu and Zhu, 2018; Feng, Sun, Chen and Gao, 2020). Hence, with the continuous acceleration of the process of technological information, intellectual capital is becoming increasingly prominent in the development of enterprises (Xu and Liu., 2020).

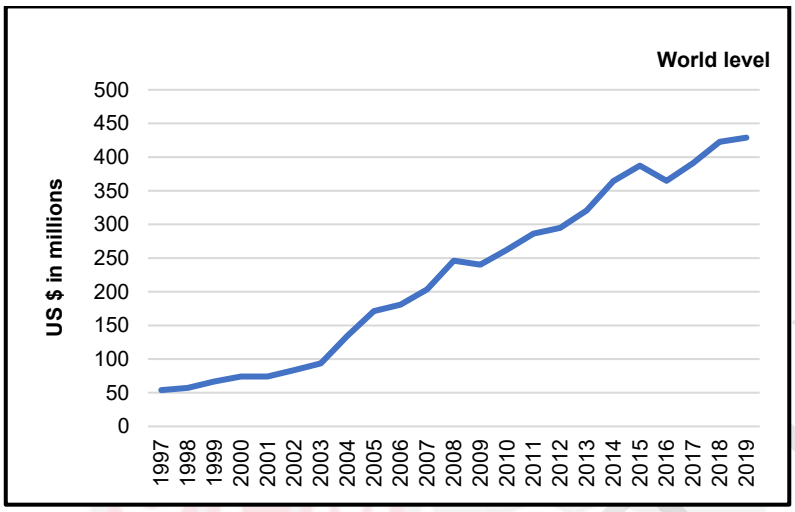

Figure 1.1: Charges for the use of intellectual property, payments, at the world level (Current US$)
(Source: International Monetary Fund, Balance of Payments Statistics Yearbook, 2019)

Figure 1.1 indicates charges for the use of intellectual property at the world level from 1997to 2019. It can be seen that there has been a sharp rise in charges for the use of intellectual property especially from the first few years of the 21st century. It is evident that from 2005 to 2019, the use of intellectual property had increase drastically which was four time higher than the decade before. This indicates that capital markets are increasingly skewed towards greater use of intellectual property. Additionally, from a macro perspective, intellectual property plays an increasingly influential role in the world economy augmentation, attracting more and more attention (Eppinger et al., 2021; Grimaldi, Greco and Cricelli, 2021).

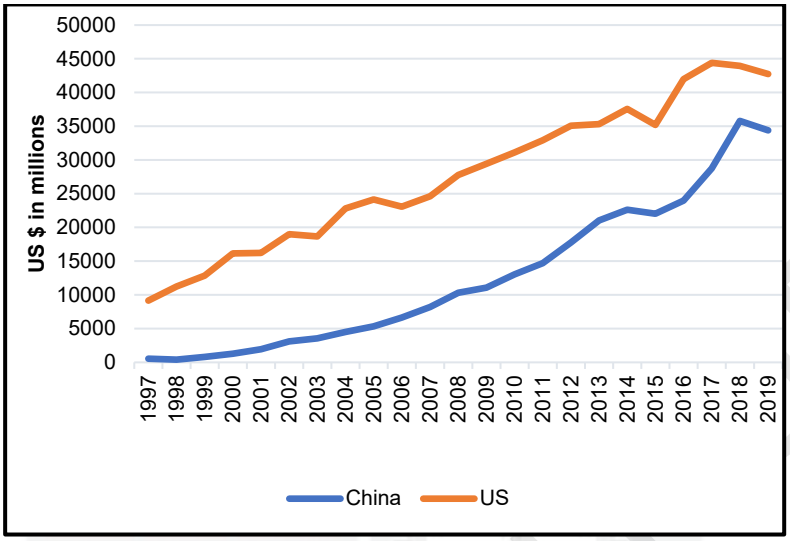

Figure 1.2: Charges for the use of intellectual property, payments, China and US (Current US$)
(Source: International Monetary Fund, Balance of Payments Statistics Yearbook, 2019)

Looking into the two biggest economics in the world i.e., US and China as shown in Figure 1.2. It can be seen that both countries have clear upward trend and more and more attention is paid to the application of intellectual property. There is a big gap between China and US, especially before 2012, the charges for the use of intellectual property of US was about twice as high as that of China. After that, charges for the use of intellectual property in China has a fast-growing then the gap between two countries is narrowing although the charges for the use of intellectual property of US is about 1.24 times that of China at 2019. Based on the report from The World Intellectual Property Organization, which oversees a system for countries to share recognition of patents, said 58,990 applications were filed from China last year, beating out the United States which filed 57,840. This gap makes the comparative study of intellectual capital between the two countries of practical significance.

Intellectual capital is literally "Intelligence" and "Capital". In other words, "Intelligence" is simply understood as the ability to solve problems and give expression to creativity (Garanina, Hussinki and Dumay, 2021). When the concept of intelligence is extended to the organizational level, intellectual capital represents the capability of the enterprise to create and integrate. Hence, the concept of "Capital" in intellectual capital can be understood as the company's collective value creation ability that is taken to be an asset of the company—it is a form of capital (Brennan and Connell, 2000). Obviously, intellectual capital has a richer connotation than a simple juxtaposition of these two concepts that is too simplistic. As a unique core resource of an enterprise, intellectual capital can be executed in a structured and standardized manner, as a form of asset, to

generate business benefits through reasonable management and exploitation (Salehi et al., 2021). A detailed description of intellectual capital will be presented in Chapter 2.

Since humankind entered the era of knowledge, knowledge and technology as special strategic resources, have gradually replaced traditional material assets to play a dominant role in the survival and development of enterprises (Maji and Goswami, 2017). Accordingly, traditional manufacturing and retail economies are rapidly being replaced with "knowledge–based, fast–changing and technologically intensive economies" (Kianto et al., 2017). Intellectual capital is a resource with knowledge as its core; as an indisputable fact, the significance of intellectual capital to creating value and maintaining long-term competitive advantage is obvious (Susanto, 2017; Yousaf, 2021).

Meanwhile, for many companies in the modern economy, intellectual—not physical—capital is their most important asset. Smriti et al., (2017) argue that a company's value is often partly based on the intangible intellectual capital that it possesses. In reality, traditional financial accounting cannot accurately measure the true value of a company because of the complexity in valuing intangible resources such as human capital and other intellectual capital. However, these intangible assets have tangible impact on the success of a company; and they are also key to the acquisition and maintenance of a company's competitive advantage. The traditional financial accounting information systems have been inclined to ignore the role of intellectual capital; and this can be misleading to decision makers and shareholders (Smriti and Das, 2017). In response, companies have begun accounting for these intangible assets, in recognition of its increasing importance in strategic competitive advantage (Seo, and Kim, 2020; Flatt and Kowalczyk, 2008).

Therefore, it is intuitively expected that the efficiency of intellectual capital utilization will have a direct influence on the performance of companies; thereby constituting an issue of practical interest to managers and shareholders as well as an important area for research (Liu, 2017). In fact, the development of the era of the knowledge economy depends mainly on the input of knowledge and intelligence, coupled with the inimitable and irreplaceable characteristics of intellectual capital itself, such as employees' professional knowledge, innovation ability, corporate culture, corporate management mechanism, and the relationship between the enterprise and the external environment. In essence, intellectual capital provides a reliable guarantee for enterprises to occupy an advantageous position among the competition (Kweh et al., 2019).

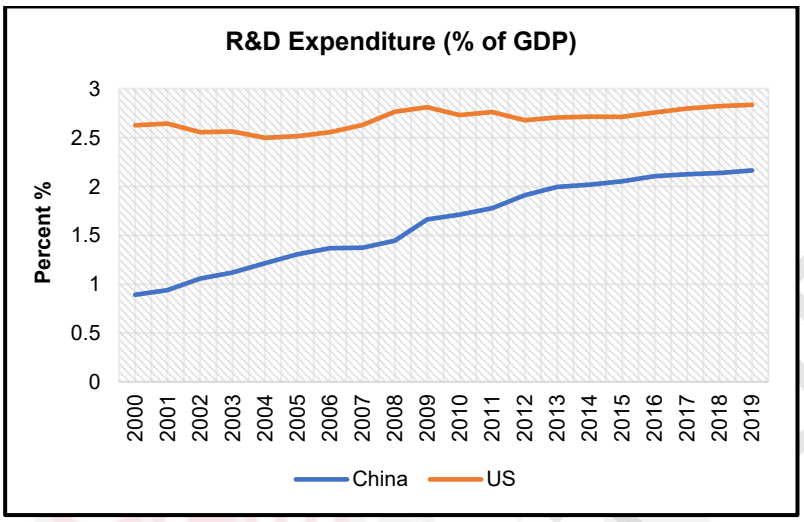

Figure 1.3: R&D Expenditure on Intellectual Capital as the Percentage of Gross Domestic Product
(Source: OECD Data,2020)

Some countries pay more attention progressively to scientific and technological innovation, increase investment in research and development costs and greatly improve the capacity of scientific and technological innovation with conforming to the development keynote of the era of knowledge economy (Bastalich, 2010; Ragulina, 2019; Liu, 2021).

Figure 1.3 reveals that there has been a steady increase in the percent of research and development expenditure to develop intellectual capital on Gross Domestic Product (GDP) in the two countries. Especially, US tends to spend more money to research and develop into intangible assets such as intellectual capital rather than investing in fixed capital on a large scale as before. Not only enterprises, many countries began to transform into Innovative-country with technological innovation and advanced knowledge as the core driving force of economic and social improvement (Nadeem and Nguyen,2018).

1.2 Problem Statement

Financial markets are dynamic, and they affect the constant upgrading and transformation of various industries. Consequently, there is a delicate balancing act in the choice of a company's capital structure i.e., the proportion of debt financing and the proportion of shareholder investment; both of which are likely to affect company performance (Tirumalsety and Gurtoo, 2021). There are some companies of China and the United State with poor performance that resulted from the failure to manage their capital structure, especially during the trade war (Li, He and Lin, 2018). When faced with unstable capital markets, or depressed

economic markets—e.g., caused by the 2020 global Covid-19 pandemic—companies with unreasonable capital structure have greater likelihood of failure. As such, excessive debt financing would probably cause a company to default on its debt; and it is almost certain that companies with poor refinancing capabilities will experience financial crises resulting from inappropriate debt-asset ratios. Certainly, there is a high onus on companies to choose their capital structure appropriately.

On the other hand, as the knowledge economy continues to promote social progress, research has shown that the market value of enterprises frequently exceeds their book value. According to S&P 500 market value (2020), it is clearly seen that the proportion of tangible assets has tended to decrease drastically; and that of intangible assets, to increase greatly. The trend shows that intangible assets such as the intellectual capital of the enterprises have begun to outweigh their tangible assets (Farah and Abouzeid, 2017). The reason is that intellectual capital has become recognized and appreciated as a core component of a company's unique competitive advantage. Companies have moved from the traditional material capital of the past, to become dependent on intellectual capital (Maji and Goswami,2017; Ge and Xu, 2021). Consequently, many companies are suffering from the ignorance of intellectual capital and technology transformation. Many traditional businesses which have mainly focused on tangible assets have been losing competitiveness. Their performance is often inferior to those high technology companies which have focused greatly on intangible assets (Salehi, Fahimi, Zimon and Homayoun, 2021), e.g., Motorola and Kodak whose halos have faded because they failed to evolve. One of the biggest reasons for Motorola's fall is its failure to innovate, which ignored the indispensability of new technology ideas in the 3G era. Similarly, although Kodak invented the world's first digital camera, it had always been committed to the development and investment in tangible assets such as film, chemicals, and print shop equipment, thus crowding out investments in new patents and technology which were critical for success in the digital information age.

Companies with a higher ratio of intangible assets to total assets have higher earnings per share. In other words, the listed knowledge-based companies that emphasize importance on intangible assets generally have better share performances in the capital market. Especially for the technology companies, according to Duan (2023), high-tech companies are increasingly investing in intangible assets and disclosing information about intellectual capital when they publish their annual reports. It seems that emphasis on intellectual capital not only creates more profits for enterprises; but it also indirectly enhances the values of the enterprises through information disclosure. This reflects the importance of intangible assets such as intellectual capital, to the capital market of high-tech industries.

Since many corporations have realized the significant impact of intellectual capital on corporate performance, they have started to adopt methods to enhance the value of their intangible assets. For instance, high-tech companies, generally, have manifold investments on research and development (R&D) to

achieve the aim of improving corporate performance (Saether, 2019). Taking Dell Technologies' expenditure on R&D from 2000 to 2020 as example, in the 2020 financial year, Dell spent about five billion U.S. dollars on R&D, which is a substantial increase from 374 million U.S dollars in 2000. The company has especially increased its research and development spending between the 2018 and 2020 financial years because Dell Technologies is strongly pushing to remake its business model and emphasize intellectual capital, e.g., strengthening the research on core technology, patents, and training of employees. Dell is moving away from primarily being a hardware PC manufacturer to becoming an IT services and solutions provider in the midst of the digital transformation age. On the contrary, if a technology company does not emphasize R&D—that key measure to enhance intangible assets—it stands a greater likelihood of losing market competitiveness. For example, compared the percentage of R&D on operating income by Bears home appliance company to the industry average, Bears' percentage of R&D on operating income is lower than the industry average. And even when the percentage of the industry average was increasing, Bears' showed a downward trend. In fact, Bears did not pay attention to investment on technology and personnel training but invested most of its operating income fixed assets, resulting in an 80% increase, in 2020, of complaints about quality problems. From 2019 on, the operating profit and stock price of Bears had begun to fall sharply.

As a result of its diluted equity structure in 2017, Vanke's equity battle became one of the market's focal points. In the end, there was a serious decline in Vanke Union's market performance and stock prices. Vanke Union's equity battle was no accident: Vanke Union had problems with over-dilution of equity, and so, did Huike Technology—both these companies had been warned about this, by the CSRC (Han, 2019). The concentration of equity ownership has a significant positive effect on corporate performance (Wang and Zhang, 2016). However, some famous high-tech companies have diluted equity structures too—such as Facebook and HUAWEI—and still done well! HUAWEI Company, as one of the giants in new high-tech enterprises, has the characteristic of a diluted equity structure. The founder, Zhengfei Ren only owns 1% shareholding whilst most of the rest is owned by the numerous employees. Similarly, Facebook has a diluted equity structure with many owners, too. Yet the pre-eminent position of Facebook in social media is undisputed.

High-tech companies are highly dependent on core talent with professional knowledge. The equity incentive system that is often practiced by high-tech companies, tightly constrains the interests of individuals and companies, but this helps high-tech companies to optimize the equity structure, attract and retain talent, and reduce short-term behavior of management (Xu and Guo, 2019). Thus, is this a ubiquitous structure in particular industries, or a special structure just for some companies? Therefore, how this diluted shareholding structure affects the performance of high-tech industries in the current knowledge economy is worthy of further investigation. Therefore, this study will explore the relationship between capital structure and corporate performance from two aspects: equity structure and debt structure.

Furthermore, referring to the research on corporate performance, a large number of previous literature showed the tendency to use traditional financial ratios to measure the performance of enterprises. However, Cummins and Weiss (2013) have highlighted that the application of traditional financial ratio methods is unfavorable. Specifically, the ratio method does not consider the input price; As a result, ratios may not be a relevant indicator of corporate efficiency. Apart from that, traditional financial ratio methods are only one-dimensional, and this may limit the improvement of the decision-making process—considering that services, products or processes do involve multiple input and output combinations. Hence, this paper adopts the Data Envelopment Analysis (DEA) model to compute company efficiency for the purpose of measuring corporate performance. In short, this advanced frontier efficiency analysis method is potentially superior to the conventional ratios approach, i.e., for the purpose of obtaining meaningful, accurate and reliable proxies of efficiency, the weaknesses inherent in the traditional financial ratios method is overcome (Cummins and Xie, 2016).

On the one hand, in the rapidly developing high-tech industry where international competition is stiff, companies face vital issues such as, how to continuously maintain a reasonable capital structure, enhance the efficiency and use of capital, as well as corporate performance (Spitsin et al., 2022). On the other hand, the major challenge confronting companies in the 21st century is to obtain the finest out of its intellectual assets, and to view corporate knowledge as the only sustainable foundation for competitive gain in business (Nadeem, Gan and Nguyen, 2018). Hence, to succeed in the global village of today, it requires a paradigm shift from the manufacturing era to the knowledge economy where it necessitates corporations to capitalize on value creation from its intellectual capital (Smriti and Das, 2017). Therefore, in the era of the knowledge economy, the high-tech industry as a knowledge-intensive industry, must necessarily place higher requirements on the management of intangible assets that are represented by intellectual capital (Buenechea et al., 2018). Consequently, this study also aims to investigate the effect of capital structure and intellectual capital on corporate performance in the high-tech industry.

1.3 Research Questions and Objectives

How to continuously optimize the capital structure of an enterprise and improve the efficiency of capital use and its operating performance are important issues facing rapidly developing high-tech enterprises during fierce international competition.

Mainstream literature and research show that capital structure does affect the performance of the corporate performance; but for high-tech industries whether the impact is positive or negative, and the extent of the impact, are uncertain. Similarly, the positive role of intellectual capital in improving corporate financial performance is generally accompanied by the research results of scholars. In fact, for high-tech companies, the role of intellectual capital in value creation ability is particularly outstanding. Hence, it is important to uncover the relationship between capital structure and intellectual capital in the high-tech industry. Therefore, the research questions are:

General research question:

Are there significant effects of capital structure and intellectual capital on corporate performance of the high technology industries?

Specific research questions:

- Is there a significant effect of capital structure on corporate performance in the high-tech industry of China and United States?
- Is there a significant effect of intellectual capital on corporate performance in the high-tech industry of China and United States?
- Is there a moderating effect of intellectual capital on the relationship between capital structure and corporate performance in the high-tech industry of China and United States?

Accordingly, the objectives of this study are:

General research objective:

To investigate the effect of capital structure and intellectual capital on corporate performance of high technology industries.

Specific research objectives:

- To examine the effect of the capital structure on corporate performance in the high-tech industry of China and United States.
- To explore the effect of intellectual capital on corporate performance in the high-tech industry of China and United States.
- To investigate the moderating effect of intellectual capital on the relationship between capital structure and corporate performance in the high-tech industry of China and United States.

1.4 Definition of Terms

For the purpose of this research, the following three key definitions are provided briefly to ensure a basic understanding of terms used in this research. As for their detailed description and relevant theories, these will be presented in the next chapter.

Capital structure: Capital structure refers to the proportional relationship between different sources of capital within a company (Margaritis and Psillaki, 2010). It plays a key role in how the company allocates financing, debt, and equity, and directly affects the size of shareholders' and creditors' control over the company. Sources of capital are generally the capital invested by shareholders and the external debts of the company. Since the external debts of the company must be repaid with the principal and interest due, the capital invested by shareholders is an inflow of resources and only has the residual claim (Le and Phan, 2017). The company's total liabilities incorporate long-term liabilities and short-term liabilities. From different perspectives, capital structure has different interpretations. Therefore, the definition of capital structure can be divided into broad capital structure and narrow capital structure. It is believed that the biggest difference between current liabilities and long-term liabilities is the difference in duration (Kochhar, 1997; Salim and Yadav, 2012; Asaolu, 2021). Broad capital structure treats current liabilities as part of the capital structure. High-tech listed companies are characterized by enormous investment in research and development and high return on investment. This is especially so, for most listed high-tech companies in China, where most of the liabilities are short-term liabilities while long-term liabilities constitute only a small part (Ahmed and Afza, 2019). Therefore, this study adopts broad capital structure as the definition foundation to research the effect of capital structure on corporate performance. A description of the current status quo of capital structure in the high-tech industry will be presented in the next chapter.

Intellectual capital: Stewart defined intellectual capital in 1991: The sum of things that corporate personnel can give to a company that can create competitive advantage. Based on the knowledge capability view, Edvinsson et al., (2001) define intellectual capital as a strategic resource owned or controlled by enterprises, which is based on knowledge and which can enable enterprises to obtain sustainable competitiveness through knowledge of employees. Regarding the composition of intellectual capital, this research adopts the current mainstream view, namely the 2-dimensional structure proposed by Mohammad (2022). He argued that intellectual capital should be divided into human capital and intellectual capital, and since then the dualism of intellectual capital has been widely adopted (Roos, 1997; Bastalich, 2010; Kweh, Lu and Wang, 2014). According to scholars using intellectual capital dualism, human capital is a form of intelligence that reflects the level of knowledge, work experience, and problem-solving abilities of organizational members, which can enhance product and service effectiveness. The structural capital is the structure that supports the human capital and includes organizational processes, procedures, technologies, information resources and intellectual property rights (Maji and Goswami, 2017). Intellectual capital is a mixture of individual capabilities and organizational factors, and it has some unique properties compared to traditional physical or monetary capital. Value-add is the most critical characteristic of intellectual capital. The traditional investment of physical or monetary capital can also generate value-added for a company, but this value-added process requires a long period of original accumulation and effort to reach the desired height. Intellectual capital is a dynamic capital that can increase the competitiveness of an organization through continuous innovation and development while rapidly contributing to capital appreciation, and this impact is long-term and long-lasting.

Intellectual capital is a type of capital that has no fixed physical form and is hardly measurable. It manifests itself in the form of skills and experience on an individual level and in the form of organizational structure, customer relationships, and other elements on an organizational level (Cuozzo et al., 2017). Intellectual capital is attached to a specific organization and cannot be directly reflected in traditional financial statement data. Intellectual capital is intangible but can be transformed into tangible capital and profit in certain ways, thus becoming an influential factor in adding value to a company. Intellectual capital is the product of the knowledge economy. The competition for knowledge in today's era has become increasingly fierce, and intellectual capital with knowledge as the core is considered as the top priority for the competitive goal of enterprises. In today's market economy, however, the incompleteness of information makes the acquisition of intellectual capital tough, leading to its rarity.

Corporate performance and corporate efficiency: According to Uremadu and Onyekachi (2018), corporate performance covers the two aspects of behavior and results, where behavior is both the process of goal achievement and the premise of results; and results is the culmination of a series of intellectual and physical actions by the laborer. In other words, business performance is a comprehensive result of behavior and results, which incorporates the organizational performance of the enterprise and the personal performance of the operator (Xu and Li, 2019). Rather than traditional financial ratios as the measurement of corporate performance, this study adopts corporate efficiency by the Data Envelopment Analysis (DEA) model. The efficiency of a company mainly refers to managerial efficiency, keeping with the rationale that the company's production of outputs from inputs, significantly relates to managerial factors. Here, company efficiency relates to the concept of technical (managerial) efficiency which is defined as the ability of a company to generate the maximum output from a given combination of inputs, given the existing technology (Cummins and Weiss, 2013; Farah and Abouzeid, 2017).

1.5 Significance of the Study

In the background of the trade war, one of the most affected sectors is the high-tech industry. High-tech industry products with high technology content and little substitutability, so the price elasticity of demand is small, or even zero. For less flexible products, most of the tariffs imposed would need to be borne by the importers. Two countries in a trade war restrict each other's exports of goods by increasing the imposition of tariffs. High technology companies suffer from capital structure due to tariffs, which affects company performance. High-tech industry is knowledge-intensive and in the current knowledge-based economy, especially, intellectual capital is one of the core competencies of such companies. Several studies have shown that the value of intellectual capital is linked to a company's performance. Capital and intellectual capital in the capital structure are important tangible assets and intangible resources of the enterprise respectively. In the current knowledge economy, human capital and structural capital in intellectual capital will affect potentially the allocation and proportion of company funds. Therefore, this study focuses on the impact of capital structure

and intellectual capital on corporate performance and the moderating role of intellectual capital by analyzing listed high technology companies in China and United States. The specific research implications are reflected in the following aspects.

First, this study advances the literature on the subject of the relationship between capital structure and corporate performance in the high-tech industry. Most of the previous evidence on capital structure and corporate performance have been mainly derived from the analyses of these two variables without any moderator. This study is the first attempt to investigate the effects of capital structure and intellectual capital on corporate performance, where intellectual capital constitutes a moderator between capital structural and corporate performance. It provides a reference for promoting the vigorous development of the high-tech industry and makes up for the lacks in previous research on financial performance in the high-tech industry.

Second, this study contributes to corporate financial and management policy and adds to the body of knowledge on how shareholders value intellectual capital. With the knowledge economy occupying the mainstream of this era, the competition between enterprises is intensifying and the focus of competition is no longer on traditional material capital; instead, enterprise-specific factors and scarce intellectual capital have become the focus for sustainable competitive advantage to enterprises. Therefore, how intellectual capital can be effectively developed and managed, to enhance corporate performance is an issue that corporations need to address urgently. From the practical aspect, this research aims to raise the awareness of high-tech managers on the potential of intangible assets to increase core competitiveness; and high-tech corporations can have better measures of capital structure.

The literature review shows that there is few research about the relationships between intellectual capital, capital structure and corporate performance in the high-tech industry. Therefore, this study can, not only contribute more to the intellectual capital literature in the high-tech industry, but also provide further insights into the role of intellectual capital as moderator of the capital structure and company performance relationship. Furthermore, as a basis for measuring corporate performance and efficiency, this study also affords more evidence on the DEA (Data Envelopment Analysis) method being more accurate for evaluating a company's ability to generate earnings and compete with other companies.

1.6 Scope of the Study

As one of the knowledge-intensive industries, the high-tech industry is the main engine in the process of industrial structure upgrade of countries, and it plays a key role in improving their industrial development capabilities and international competitiveness (Xu et al., 2021; Kabir, 2019). Naturally, as the industry with

advanced technology, high knowledge intensity and heavy competition, the high-tech industry determines that the value creation of high-tech enterprises mainly builds on the creation, accumulation, sharing and integration of knowledge. The creation and advancement of intellectual capital is a far-reaching link that affects the performance of high-tech enterprises (Lee et al., 2019). As such, it makes a lot of sense to treat the high-tech industry as a research industry for intellectual capital and corporate performance, because the capital structure of high-tech enterprises is characterized by immense capital intensiveness, large initial investments, and relatively great intangible assets.

Nowadays, science and technology have developed by leaps and bounds, and they continue to enable national economic progress and the improvement of the quality of human life over the world. Consequently, with the rise of high-tech industries in the world, their scale has expanded rapidly and their proportion in the economic cake of many countries has greatly increased. In fact, the pace and degree of high-tech development has become one of the key variables for evaluating the competitiveness and development potential of a country or region—taking Silicon Valley, California, USA and Zhongguancun Technology Park, Beijing, China, as prime examples. Recently, from 2018 to 2020, the trade war between China and the US has obviously become one of the hot topics in the world economy. The economic measures taken by the two countries have had major effects on the world economy. This is even more reason why this study focuses on China and US high-tech industries: To examine the effect of capital structure and intellectual capital on corporate performance in these 2 giant economies.

1.7 Organization of the study

The first chapter provides an overview of the background and motivation for the research. It outlines the problem statement, research objectives and questions with this study scope. The existing literature and underpinning theories are presented in next chapter. Chapter 3 discusses research methods and data selection, hypotheses, analytical methods and models employed. The results and findings are covered in the following chapter. The final chapter concludes with the main findings and recommendation of the future study.

1.8 Chapter Summary

This chapter firstly introduce a general overview and background of this research, problem statement, research problems and research objectives. Then three core definitions of term and research significance of the study are presented. Here Figure 1.4 provides a summary of this chapter.

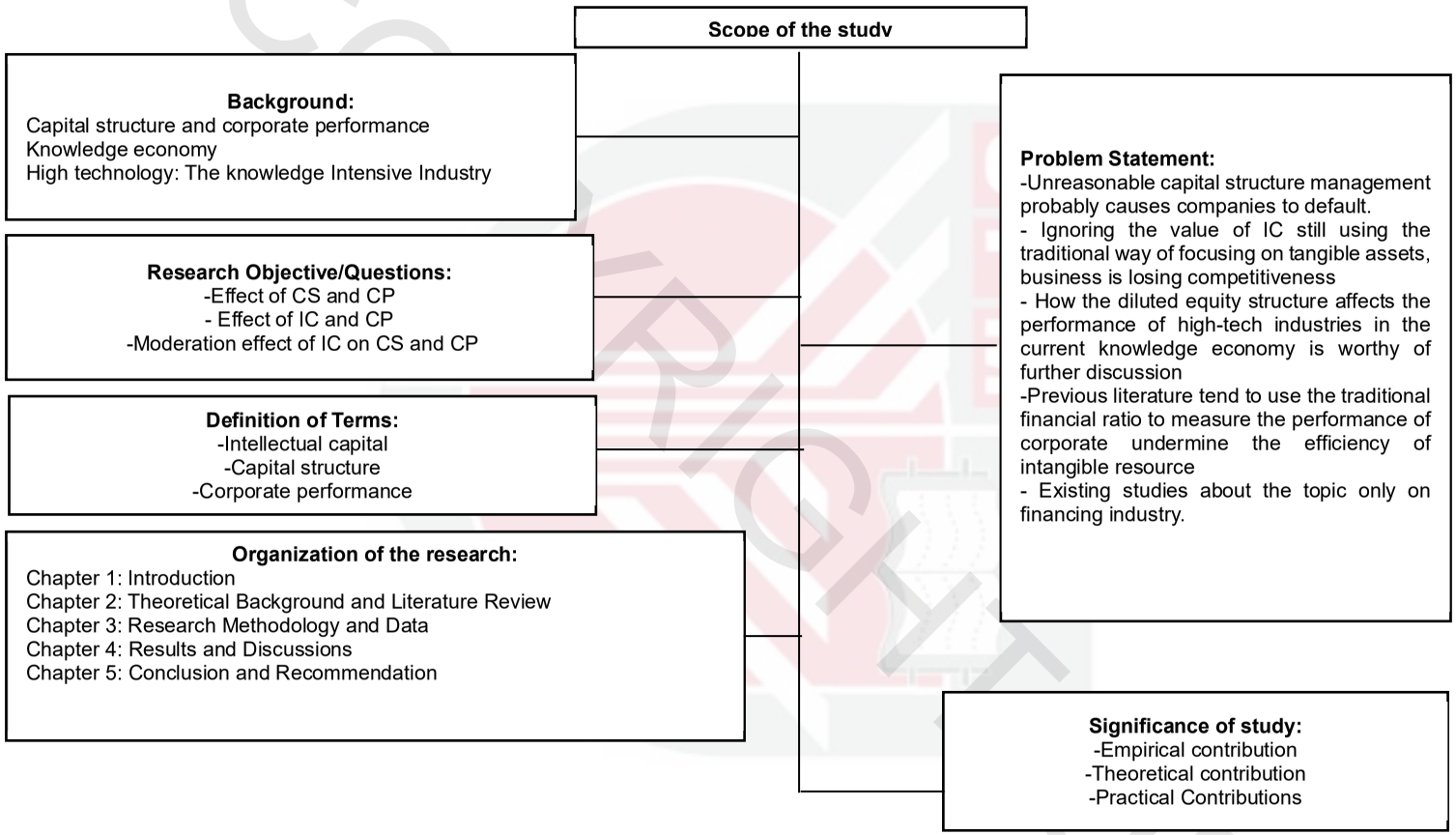

Figure 1.4: Summary of Chapter

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