

A study of potential factor investing strategy from
ESG score and intangible capital in Thailand

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การศึกษาปัจจัยศักยภาพในการขับเคลื่อนผลตอบแทนหลักทรัพย์ (Factor Investing)
จากการวิเคราะห์ผลคะแนนการประเมิน ESG และระดับสินทรัพย์ไม่มีตัวตนของบริษัท
: หลักฐานจากตลาดหลักทรัพย์แห่งประเทศไทย



สารนิพนธ์นี้เป็นส่วนหนึ่งของการศึกษาตามหลักสูตรปริญญาวิทยาศาสตรมหาบัณฑิต
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อสิราภรณ์ วรรณารวิวัฒน์ : การศึกษาปัจจัยศักยภาพในการขับเคลื่อนผลตอบแทนหลักทรัพย์ (Factor Investing) จากการศึกษาวิเคราะห์ผลคะแนนการประเมิน ESG และระดับสินทรัพย์ไม่มีตัวตนของบริษัท: หลักฐานจากตลาดหลักทรัพย์แห่งประเทศไทย . (A study of potential factor investing strategy from ESG score and intangible capital in Thailand) อ.ที่ปรึกษาหลัก : รศ. ดร.คณิตร์ แสงโชติ

การศึกษานี้มุ่งหวังที่จะตรวจสอบความสัมพันธ์ระหว่างคะแนน ESG (Environmental, Social, and Governance) และอัตราสินทรัพย์ไม่มีตัวตน (Intangible Capital Ratio: ICR) และผลกระทบต่อผลตอบแทนการถือครองหลักทรัพย์ (Buy-and-Hold Returns: BHR) รวมถึงประสิทธิภาพของการลงทุนในหลักทรัพย์กลุ่มดังกล่าวในตลาดหลักทรัพย์แห่งประเทศไทย (Stock Exchange of Thailand: SET) โดยศึกษาเฉพาะบริษัทที่เป็นสมาชิก SET ที่มีคะแนน ESG ในระหว่างปี 2018-2022 (จำนวน 169 บริษัท)

วัตถุประสงค์แรกพบว่าการเพิ่มขึ้นของคะแนน ESG นำไปสู่การเพิ่มขึ้นในอัตราสินทรัพย์ไม่มีตัวตน การค้นพบนี้เน้นถึงความสำคัญของคะแนน ESG ขนาดของบริษัทและ มูลค่าทางบัญชีต่อราคาหลักทรัพย์ที่สูงในการกำหนดอัตราสินทรัพย์ไม่มีตัวตนของบริษัท อย่างไรก็ตาม หากพิจารณาถึงผลกระทบคงที่ ทั้งปัจจัยหลักทรัพย์ ปี และอุตสาหกรรม อิทธิพลของคะแนน ESG ต่ออัตราสินทรัพย์ไม่มีตัวตน ไม่ได้แสดงให้เห็นนัยสำคัญทางสถิติ ทำให้ไม่สามารถสรุปความสัมพันธ์ได้จากการศึกษาวิเคราะห์ ถือเป็นช่องว่างในการรับรู้และการใช้ประโยชน์จากศักยภาพในการลงทุน ESG เพื่อสร้างและเพิ่มมูลค่าในสินทรัพย์ไม่มีตัวตน นอกจากนี้ การลงทุน ESG ถือได้ว่าเป็นการสร้างมูลค่าในระยะยาวซึ่งอาจใช้เวลาในการสร้างมูลค่ากลับสู่บริษัท

วัตถุประสงค์ที่สอง ผลการวิจัยแสดงให้เห็นว่าคะแนน ESG และอัตราสินทรัพย์ไม่มีตัวตนไม่มีผลอย่างมีนัยสำคัญต่อผลตอบแทนในทุกควมแบบจำลอง ไม่มีหลักฐานเพียงพอที่จะสรุปความสัมพันธ์ที่มีนัยสำคัญระหว่างตัวแปรอิสระเหล่านี้กับผลตอบแทนของหลักทรัพย์ ซึ่งสอดคล้องกับผลการวิจัยก่อนหน้าบางส่วนที่ทดสอบว่า การลงทุนใน ESG ไม่ได้ส่งผลต่อผลตอบแทนของหลักทรัพย์และอาจบ่งชี้ถึงปัญหาจากตัวแทน (“Agency Problem”) อีกทั้งยังสอดคล้องกับการสำรวจ ESG ของ CFA ที่ระบุว่านักลงทุนบางส่วนไม่ได้รวม ESG ในกระบวนการประเมินมูลค่าหลักทรัพย์ นอกจากนี้ สินทรัพย์ไม่มีตัวตน เช่น ชื่อเสียงของแบรนด์ สิทธิบัตร หรือเทคโนโลยีที่เป็นกรรมสิทธิ์ซึ่งถือได้ว่ามีบทบาทสำคัญในความสำเร็จและศักยภาพในการเติบโตของบริษัทในปัจจุบันและอนาคต แต่ด้านมูลค่าอาจไม่ได้สะท้อนออกมาในการเคลื่อนไหวของราคาหลักทรัพย์เสมอไป แต่เป็นการส่งผลกระทบต่อตำแหน่งทางการตลาดและผลประโยชน์ทางการเงินของบริษัท

อย่างไรก็ตาม การศึกษานี้ดำเนินการวิเคราะห์ต่อยอดในพอร์ตโฟลิโอการลงทุนเพื่อวิเคราะห์ถึงผลตอบแทนที่ผิดปกติและความเสี่ยง ผลพบว่าพอร์ตโฟลิโอที่มีคะแนน ESG ต่ำ อัตราสินทรัพย์ไม่มีตัวตน สูง มีผลตอบแทนสะสมสูงที่สุดที่ 61.64% ซึ่งดีกว่าเกณฑ์เปรียบเทียบซึ่งคือ SETTRI ที่ 21.99% นอกจากนี้ พอร์ตโฟลิโอดังกล่าวยังแสดงค่า Alpha สูงสุดที่ 55.95% และประสิทธิภาพที่ปรับตามความเสี่ยงได้ดีขึ้นตามอัตราส่วนของ Sharpe และ Treynor

การศึกษานี้แสดงให้เห็นถึงความท้าทายและโอกาสที่เกิดจากช่องว่างในการลงทุน ESG กับการต่อ ยอดมูลค่าสินทรัพย์ไม่มีตัวตน ด้วยขนาดตัวอย่างจำกัดสำหรับบริษัทที่มีคะแนน ESG ในประเทศไทย จึงควรมีการวิเคราะห์เพิ่มเติมเพื่อเสริมความเข้าใจในอนาคต รวมถึงมีประเด็นที่ควรเน้นให้ความสำคัญ คือ การประเมิน ESG ที่ครอบคลุม การประเมินค่า มาตรฐานการรายงาน การสนับสนุนด้านกฎระเบียบ และการเพิ่มความตระหนักเพื่อสร้างความเข้าใจและความสำคัญต่อการลงทุนด้าน ESG การสร้างมูลค่า รวมถึงการพัฒนาสู่กลยุทธ์การลงทุนและการประเมินสินทรัพย์ไม่มีตัวตนอย่างมีประสิทธิภาพต่อไป

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The independent study aimed to examine the relationship between Environmental, Social, and Governance (ESG) scores and Intangible Capital Ratio (ICR) and their implications for buy-and-hold returns (BHR) and stock performance among Thai listed companies. The study focuses on firms listed on the Stock Exchange of Thailand (SET) with available ESG scores, covering the period from 2018 to 2022 (169 companies).

The finding for the first objective found that an increase in the ESG score leads to a rise in the ICR, these findings highlight the importance of ESG scores and company size & high BTM in determining a firm's ICR. However, the study also considered fixed effects in terms of Stock, Year and Industry factors. The influence of the ESG score on the ICR did not demonstrate statistical significance. We could not conclude from this analysis. There is a gap in recognizing and capitalizing on the potential of ESG investing to build and enhance intangible capital. Moreover, ESG investment is considered as a long-term value, it might take time to create value through company.

The second objective: the findings show that ESG score and the ICR do not significantly influence the return (RI) across all models. We do not have sufficient evidence to claim a significant relationship between these independent variables and Return. The result supported the existing research on ESG did not significantly affect stock performance and ESG/CSR investments may indicate agency problems. Moreover, there is in line with CFA global ESG survey that some investors did not integrate ESG in the process of valuation. In addition, intangible assets like brand reputation, patents, or proprietary technology can play a crucial role in a company's success and potential for growth. Their value might not always be fully reflected in short-term stock price movements but could have long-term effects on a company's market position and financial performance.

However, the study conducts a portfolio analysis to further explore abnormal returns and risk aspects. The portfolio characterized by a Low ESG Score and High ICR (LH) demonstrates an impressive cumulative return of 61.64%, outperforming the SETTRI benchmark at 21.99%. Furthermore, the LH portfolio exhibits the highest alpha at 55.95% and better risk-adjusted performance based on the Sharpe and Treynor ratios.

In conclusion, the dissertation highlights the challenge and opportunity presented by the gap in integrating ESG investing with intangible capital. With a limited sample size of 169 SET companies providing ESG score data, further analysis is recommended to deepen our understanding of this subject. There is significant potential for comprehensive ESG assessment, valuation, reporting standards, regulatory support, and increased awareness to facilitate the full integration of ESG principles into investment strategies and the valuation of intangible capital.

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Chapter 1: Introduction

Introduction

Background and Significant of the problem

Leading & significant future trends based on many research houses/forums such as the International Monetary Fund (IMF), Mckinsey and the Stock Exchange of Thailand (SET) have focused on **Social and Environmental Movement & increasingly dematerialized world intangible capital**. In recent years, there has been a significant increase in the adoption of the Environment, Social and Governance (ESG) agenda by prominent organizations worldwide. ESG has become a new challenge in today's business world due to many reasons such as growing investor interest, including institutional investors and retail investors, increasing regulatory focus, responding to climate change, shifting consumer preferences, and embedding ESG in business operations. In the past few years, there has been a rapid increase in the number of worldwide and Thai Google searches for the terms "ESG" and "Sustainable Finance"¹. On the other hand, Intangible capital have become increasingly important in today's business world due to several factors such as shifting towards knowledge-based economy, growing importance of intangible capital in valuation, contribution to competitive advantage. Nowadays' value is dominated by tangible such as Research & Development (R&D), technology, software, human capital, brands, and business model as % intangibles of the capitalization of index like S&P500. There has been a significant increase in the past quarter, and the COVID-19 pandemic seems to have expedited this transition towards a digitalized economy. It is important for companies to effectively manage and leverage their intangible capital to remain competitive and achieve long-term success. These could emphasize how interesting and important of ESG and Intangible capital not only over the world but also in Thailand as another factor investing focused.

To extent on the statement above that ESG concept play an important role as you can see from top global conference such as the United Nations (UN), the 26th UN

¹ <https://trends.google.com/trends/explore?date=2019-12-25%202023-01-25&q=ESG>
<https://trends.google.com/trends/explore?date=2019-12-25%202023-01-25&q=Sustainable%20Finance>

Conference of the Parties leading to green economy commitment (UN 2021) & the 17 Sustainable Development Goals (SDGs) of the 2030 Agenda (UN 2015). In addition, UN's Principles for Responsible Investment (PRI) report presented number of signatories & AUM of asset owners, asset managers and service providers who incorporate ESG issues. In 2006, there are 63 investment companies with USD 6.5 trillion in AUM and this significantly increased into 2,750 signatories with USD 100 trillion AUM in 2020 (PRI 2020). This is the same trend with historical fund flows of sustainable fund in the United States (US) – from USD 5 billion in 2018 to USD 50 billion in 2020. Inflows into sustainable funds in the US accounted for 25% of total inflows into equity and fixed income funds of the US (Morningstar 2020). Thailand has also been riding on this trend, for example, the Sustainability Fund has a net asset value of 52 billion baht in Q4 2022, which significantly increased from less than 10 billion baht in 2019 (Morningstar 2022). According to a report by SET, the 900,000 individual investors who traded stocks in the first half of 2022, it was found that about 80% traded at least one sustainable stock (SET note vol.8/2022). It reflects that Thai investors are increasingly interested in this theme of investment. Moreover, SET has more focused on ESG as you can see from SET 2023-2025 strategic plan; Strategy no. 4: Merge ESG with substance: Deploying ESG in driving internal operations and collaborative efforts with external partners towards sustainable growth. SET also established the Thailand Sustainability Investment (THSI) list in 2015 as a means of providing investors with an alternative investment opportunity in high-performing ESG stocks and promoting sustainability among Thai companies. ESG is going to be the key impact on people behavior, business strategy, stakeholders' management and on the rise trend of investors' investment decision & risk management in the future.

To further extent the statement that ESG will become another important role in decision making of investment to investors, there were research that presented the evidence that ESG performance can affect to stock performance Kempf and Osthoff (2007), Eccles et al. (2014), Cornett et al. (2016) and Cheema-Fox et al. (2021) presented the evidence that high socially responsible ratings (SRI) or high ESG score provided high abnormal return as they buy high score group and sell low score group. Therefore, they found that the ESG performance has a significant impact of stock performance. Moreover, in terms of risk aspects, MSCI concluded that high ESG-rated

companies well manage both idiosyncratic risk and systematic risk that resulted in a decrease in the possibility of downside risk, including reduced volatility. El Ghouli et al. (2011) also extent that strong ESG profile company show lower systematic risk then led to a lower cost of capital and higher valuations of stock price.

To support on the other side of future trends, today global GDP is more than in services and knowledge, where intangible capital has become increasing components and make up between 60 and 80 percent of corporate worth (Caruso, 2008). In recent years, there has been a marked increase in investment in intangible capital, including intellectual property, research and development, technology and software, brand, customer base, and human capital. The COVID-19 pandemic and the ongoing drive for innovation on a global scale seem to have further accelerated the trend towards a more digitalized economy. In recent decades, much of the innovation has focused on intangible products such as vaccine formulas, blockchain technology, data, and artificial intelligence. This type of intangible capital is becoming increasingly critical in the economy. Percentage proportion of intangible capital to S&P 500 index's market cap increased to more than 90 percent in 2020 as the post-pandemic context. As demonstrated by Corrado et al. (2009), investments in intangibles have surpassed investments in tangible assets in the US economy. This trend indicates the necessity of intangible investments for corporations to produce future cash flow returns in a progressively knowledge-centric economy. In addition, the topic about intangible capital was also in the IMF's focus as you can see from the 10th IMF Statistical Forum (IMF November 2022): Measuring the Tangible Benefits of Intangible Capital Topic – to strong indicate that intangible capital is playing an increasingly important role in the business and economy perspective.

According to Peters and Taylor (2017), when it comes to intangible capital, one way to measure intangible capital is by adding up the total value of intangible capital that were acquired from external sources as well as those that were created internally. If a company acquired intangible capital from an outside source, they usually record them as assets on their balance sheet. However, Generally Accepted Accounting Principles classify investments in intangible capital as expenses (Financial Accounting Standards Board: FASB). Intangible capital is typically not captured on firms' balance sheets. According to Falato et al. (2022), The intangible capital of a company consists

of two components: knowledge capital and organizational capital. The company's knowledge capital was established through investments in R&D. In terms of organizational capital, Expenditures on SG&A activities can be seen as investments in the company's organizational capital. This includes advertising, distribution system costs, employee training, and so on. Therefore, Corrado et al. (2009) measured the stock of by accumulating a fraction of past SG&A expenses. Jung and Kho (2022) & Demers et al. (2021) also used capitalization method to value intangible capital. Moreover, Peters and Taylor (2017) claimed that intangible capital should be considered as an important factor in assessing a firm's investment decisions, alongside traditional measures such as physical capital and profitability as they develop new Tobin's q to add intangible capital measurement. The study can provide a better explanation for investment prospects. However, it is also subject to greater risk and uncertainty of being intangible capital characteristics. In addition, Eisfeldt and Papanikolaou (2013) focused on organization capital or human capital. The study categorized firms into five portfolios by ratio of organization capital to book assets relative to their industry peers (O/K). The results show that high O/K firms provided more productive, higher Tobin's q and have more risk on human aspects. On another study aspect, Demers et al. (2021) performed multiple regression analysis to examine the relationship between a firm's ESG scores and its buy-and-hold abnormal returns, while accounting for other factors such as intangible capital investment in Q1 2020 COVID market crisis period and full COVID year of 2020. The study found that an increase of one standard deviation in RD&SGA leads to a noteworthy 9.3% rise in full year abnormal returns for the entire COVID year of 2020. There is interesting study area to explore.

Based on “A Framework to Assess ESG Value Creation” of International Valuation Standards Council (IVSC 2021) and CFA article (CFA, 2021), intangible asset value drivers provide linkage on how investments in Environment, Social, and Governance factors lead to the creation of intangible value. ESG performance represented value creation gap in financial reporting and the shift in value creation towards intangibles persists. The researchers concluded that the potential value creation process can be broken down into three distinct stages: 1) Direct assets refer to intangible capital that is directly impacted by ESG investments in either E, S, or G aspects. 2) Indirect assets are intangible capital that can derive advantages from the increased value

of the direct intangible asset(s) targeted by the ESG investment and 3) The creation of value for intangible capital through ESG investments has the potential to generate scalable returns, owing to its interdependence with other intangible capital. This creates the linkage on ESG information might enhance value of intangible capital of the firm such as firm's reputation, efficiency, human capital, and organizational processes.

Therefore, this paper shed further light on empirical evidence studying the relationship of ESG score and intangible capital on stock performance by utilizing data from Thai stock market, while most of the existing studies mainly focus on US data or developing countries. Moreover, there are some studies on the relationship between CSR and Intellectual capital (IC), but there are not studies explore on the relationship between these 2 factors and link to investment performance. Our research will include Thai stock market, interesting future trends, ESG score, and intangible capital. This study would like to explain another investment opportunity area with firm with better ESG score and intangible capital. As such, there is plenty room for indicating the important of ESG score implication through intangible asset value creation, and ultimately affecting investment performance.

In this paper, our study had three main goals: First, this paper studies the relationship power of ESG score and intangible capital. Second, the paper further analyzes on the impact of ESG score, intangible capital and both interaction terms on stock return. Third, this paper examines whether this relationship is able to assess risk & return that might be another factor investing focused for investor.

The first objective is to examine the relationship between ESG score and intangible capital. ESG score assessment will be examined through Refinitiv as a third-party assessment aspect. As the relationship framework of IVSC (IVSC 2021) and CFA article (CFA, 2021), we expect to see positive correlation, especially High ESG score & High intangible capital segment. The second objective is to see the impact of ESG, Intangible capital ratio and both interaction terms on Buy-and-Hold returns of each stock. The Third objective is to examine the impact of the ESG score and intangible capital to become rule-based portfolio investment. The study will categorize into 2x2 matrix which rely on High & Low level of each factor. The study also explores the impact of ESG score through both willingness to participate and third-party assessment groups.

According to the objectives mentioned above, the hypothesis of this paper are, First, the higher ESG scores will have significant higher intangible capital ratio. Second, interaction term of ESG score & intangible capital ratio will provide high impact on the return. Third, the higher ESG scores together with higher intangible capital ratio will have significant impact by increasing abnormal return as the stakeholder theory framework (Parmar et al., 2010). ESG scores and intangible capital could create a rule-based portfolio investment strategy that captures risk-adjusted returns and generates alpha. Companies that implement measures to address the requirements or needs of various stakeholder groups, including employees, customers, and regulators, will generate opportunities for expansion and reduce potential risks. Moreover, according to adverse selection problem (Akerlof, 1970), Distinguishing between good and bad companies will be indicated by signals such as investments in and disclosure of ESG information. Therefore, High ESG scores firm might increase firm value and obtain investor preference.

The remainder of this paper is organized as follows; Section 2 documents the literature review. Section 3 describes methodology of ESG Score & intangible capital and data. Section 4 analyzes the result and discussion and Section 5 conclusion.

Chapter 2: Literature Review

Literature Review

This section reviews the conceptual and theory and the relevant previous literatures behind the Special project and seek to explain the relationship of ESG score, Intangible capital, and stock market performance. The relevant research section divided into 3 parts 1) ESG and stock performance 2) Intangible Capital and 3) the linkage between ESG and Intangible Capital.

Relevant research

1) ESG and stock performance:

There are numerous studies have shown that ESG can affect stock performance. The performance of companies with regards to ESG factors is frequently evaluated through ESG scores obtained from various rating providers such as Bloomberg, MSCI, and Refinitiv. An ESG score is an objective assessment of company's performance with respect to Environmental, Social, and Governance (ESG) issues. Kempf and Osthoff

(2007) found that using a long-short investment strategy of buying stock with high socially responsible ratings (SRI) and selling stocks with low SRI, leads to high abnormal returns of up to 8.7% per year. Their SRI ratings based on KLD (Nowadays is MSCI ESG Stats database). They measure performance using the Carhart four-factor model (Carhart, 1997). This is also consistent with Eccles et al. (2014) found similar out-performance by high ESG score companies using a high-low strategy. This result is also confirmed by Cornett et al. (2016) and Cheema-Fox et al. (2021), using the Carhart four-factor model and a high-low strategy. Moreover, there are another study area of ESG on risk aspects that high ESG-rated companies well manage both idiosyncratic risk and systematic risk. Hoepner et al. (2011) observe that high ESG-rated companies showed statistically significant lower downside risk measures such as volatility, lower partial moments, and worst-case loss. Better risk management should help reduce stock-specific risk in stock price. El Ghouli et al. (2011) also extent that strong ESG profile company show lower systematic risk and lead to a lower cost of capital and higher valuations. This is also supported by MSCI study in 2019, shown that ESG affected the valuation and performance of companies, both through their systematic risk profile (lower costs of capital and higher valuations) and idiosyncratic risk profile (higher profitability and lower exposures to tail risk). However, there are opposite studies have shown that ESG performance did not affect to stock performance. The study by Chang et al. (2022) utilized a DCF valuation framework to identify value drivers and concluded that green bonds and SRI funds do not exhibit superior performance compared to their conventional equivalents. Demers et al. (2021) also shown that ESG did not immunize stocks during the COVID-19 crisis, but those investments in intangible capital did. After controlling for other factors, they conducted a regression analysis of a firm's ESG scores on its buy-and-hold abnormal returns. In addition, an agency theory perspective of corporate ESG investments, ESG related activities may destroy value. According to BÉNABOU and TIROLE (2010), certain ESG/CSR investments may indicate agency problems, which can lead to a decrease in a company's profits and value.

2) Intangible Capital

Subsequently, the service and technology-based sectors have become more prevalent in the global economy, causing intangible capital such as patents, brands, software, databases, human capital, innovative products, customer relationships, and distribution systems to gain greater significance. Peters and Taylor (2017) examines the relationship between intangible capital, the class Q investment theory as they created a new Tobin's q to be a proxy for accounting intangible capital which refers to dividing the company's market value by the combined value of its tangible and intangible capital. In the study, a company's intangible capital are evaluated by adding its knowledge capital and organizational capital. The new Tobin's q , which takes into account intangible capital, can provide a better explanation for investment prospects, even in groups with lower levels of intangible capital, such as the manufacturing sector. They also argue that intangible capital should be considered as an important factor in assessing a firm's investment decisions, alongside traditional measures such as physical capital and profitability. A high Q ratio implies that investors expect the firm's future profits to be higher than the cost of replacing its assets, indicating favorable investment opportunities. In addition, Eisfeldt and Papanikolaou (2013), companies that utilize a greater amount of organizational capital demonstrate higher productivity levels, even when taking into consideration physical capital and labor. They clarified the distinguish of organizational capital are 2 main parts. First, its effectiveness being tied in part to the company itself and second, its being represented by the valuable skills of the firm's key employees. The cash flows derived from organizational capital are claimed by both the shareholders and the crucial talent within the company. When investing in companies with substantial organizational capital, shareholders face additional risks because they can only claim a portion of the cash flows generated by this type of capital. Moreover, variations in the asset composition of companies, particularly between physical and organizational capital, result in dissimilarities in risk premiums since investors require compensation for the extra risks they incur. The study resulted that high organizational capital to book assets ratio (O/K) relative to peers are more productive, have higher Tobin's q , high level of executive compensation, spend more technology and more likely to disclose loss of key personnel as a risk factor. The data indicates that shareholders expect higher compensation for the risk they undertake when investing in firms that have more organization capital than those with primarily physical

capital. The O/K portfolio minus low-O/K has average returns of 4.7% per year. Moreover, Demers et al. (2021) performed multiple regression analysis to examine the relationship between a firm's ESG scores and its buy-and-hold abnormal returns, while accounting for other factors such as intangible capital investments in Q1 2020 COVID market crisis period and full COVID year of 2020. As part of the study, they also incorporated capitalization of past investments in both acquired and internally developed intangible capital for the firm. According to the study, a one-standard deviation increase in RD&SGA resulted in a noteworthy 9.3% rise in full year abnormal returns for the complete COVID year of 2020. Moreover, Ritter and Wells (2006) found that 1) a positive association between stock prices and voluntarily recognized and disclosed identifiable intangible capital and 2) a positive association between identifiable intangible capital and realized future period income. These findings told us about the association between stock prices and identifiable intangible capital and emphasized on the investors more care on intangible capital for their investment decision. While some argument studies remarked on intangible capital is hard to accurate measure. Dong et al. (2017) stated that investors pay less attention to intangible capital owing to the cognitive limits on invisible and uncertain objects.

3) the linkage between ESG and Intangible Capital:

Based on “A Framework to Assess ESG Value Creation” of International Valuation Standards Council (IVSC 2021) and CFA article (CFA, 2021), intangible asset value drivers provide linkage on how E, S, and G investments result in intangible value creation. ESG performance represented value creation gap in financial reporting and the value creation continues to shift to intangibles. Moreover, value creation contributed by ESG accountability is not captured by the market and may not be apparent, as the contributions of sustainability tend to be intangibles.

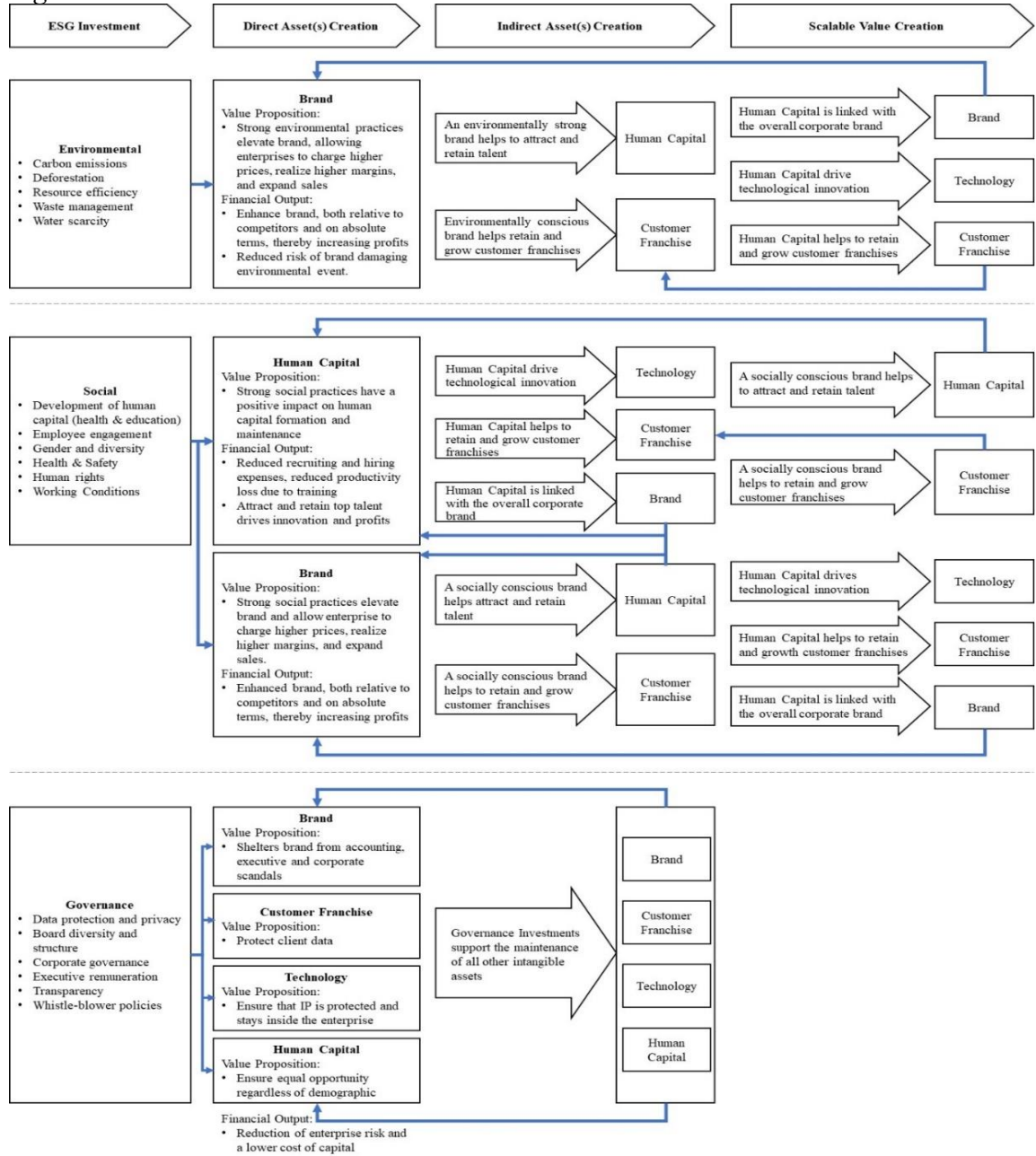
It examines the value creation lifecycle through three separate stages: 1) Intangible capital that are directly impact by E, S, or G investment 2) Intangible capital that benefit from the value accretion of the direct intangible asset(s) which was targeted with the E, S, or G investment and 3) Scalable Value Creation through interconnection with other intangible capital. This identifies 6 characteristics to assess expected relative value creation of ESG investments between enterprises – (1) Reliance on Brand/Brand

Strength, (2) Reliance on Human Capital, (3) Value-Added Business Model, (4) Nature of Customer Relationships, (5) Tangible Asset Intensity and (6) Market-Dominant Technology. The detailed was shown in Figure 1.

This linkage also was examined by Jun et al. (2022), ESG investment can lead two social impact mechanisms – 1) It could build a positive social brand image and increase intangible capital which led to attract potential customer base and expand market share 2) It also cloud improve overall productivity via good working environment.



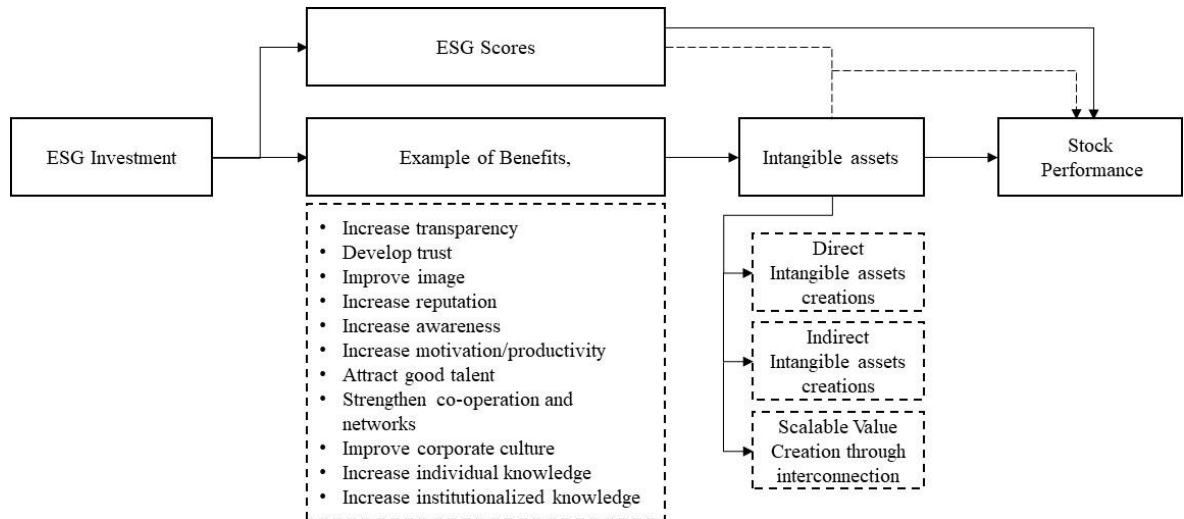
Figure 1: A Framework to Assess ESG Value Creation



Source: International Valuation Standards Council (IVSC 2021) and CFA article (CFA, 2021)

Conceptual summary Framework

Figure 2: A conceptual summary framework



There is research gap to study relationship between ESG score and intangible capital. This could create academic contribution on future return prediction and potential investing strategy for portfolio investment.

Chapter 3: Data & Methodology

Data

Measurement of ESG score

This paper focuses on firms listed on SET, using data from 2018-2022, all information is retrieved from SET and Refinitiv DataStream. For Thailand, there are two aspects of ESG score assessment. First, the Thailand Sustainability Investment (THSI) was created by The Stock Exchange of Thailand in 2015. Second, the ESG score was evaluated by third parties such as Refinitiv, ESG book and S&P Global Market Intelligence. This paper selected to analyze based on Refinitiv data because of the amount of data and data accessibility.

For Refinitiv, Refinitiv boasts one of the most comprehensive databases for environmental, social, and governance metrics in the industry, covering over 85% of the global market capitalization. The database comprises information on more than 630 specific ESG metrics and has records that date back to 2002 (Refinitiv, 2022). The Refinitiv ESG score evaluates a company's ESG performance by utilizing data that is publicly available and has been verified through reporting. The publicly available information sources are annual reports, company websites, stock exchange filings, CSR reports and News. The various metrics are categorized into 10 distinct categories, which are used to calculate the three separate pillar scores as well as the overall ESG score. The final ESG score reflects a company's performance, dedication, and effectiveness in regard to environmental, social, and governance factors, based on information that has been publicly reported. As you can see from Table 1. The ESG pillar score is a relative sum of the category weights, which vary per industry for the environmental and social categories. For governance, the weights remain the same across all industries. To extent on Scores calculation methodology, the first step starts with Boolean questions are typically answered with 'Yes' 'No' or 'Null'. Boolean data points are converted to numeric values for the percentile score calculation. Details are below: Positive aspect Yes = 1 No/Null = 0, Negative aspect Yes/Null = 0 No = 1. Then Refinitiv will proceed in their calculation method.

Refinitiv categorized score range into four groups which ranked score 0-25 to become the first quartile which indicates poor relative ESG performance in comparison to others and a lack of sufficient transparency in regards to reporting significant ESG

information to the public, >25 to 50 as second quartile, >50 to 75 as third quartile and >75 to 100 as fourth quartile which indicates excellent relative ESG performance and high degree of transparency in reporting material ESG data publicly.

In this study includes a sample of equity stocks listed on the SET from 2018 to 2022, which consists of 169 listed firms. The study will be based on 169 company lists in 2022 so that it could categorize and form the appropriate investment portfolio. If a company has insufficient data for the study year, the study will backfill ESG score from previous year to meet the portfolio diversification objective.

Table 1: a detailed view on the ESG themes covered in each category

Pillars	Refinitiv	
	Categories	Themes
Environmental	Emission	<ul style="list-style-type: none"> - Emission - Water - Biodiversity - Environmental management systems
	Innovation	<ul style="list-style-type: none"> - Product innovation - Green revenues, research and development (R&D) and capital expenditures (CapEx)
	Resource use	<ul style="list-style-type: none"> - Water - Energy - Sustainable packaging - Environmental supply chain
Social	Community	- Equally important to all industry groups, hence a median weight of five is assigned to all
	Human rights	- Human rights
	Product responsibility	<ul style="list-style-type: none"> - Responsible marketing - Product quality - Data privacy
	Workforce	<ul style="list-style-type: none"> - Diversity and inclusion - Career development and training - Working conditions - Health and safety
Governance/ Economic	CSR strategy	<ul style="list-style-type: none"> - CSR strategy - ESG reporting and transparency
	Management	<ul style="list-style-type: none"> - Structure (independence, diversity, committees) - Compensation
	Shareholders	<ul style="list-style-type: none"> - Shareholder rights - Takeover defenses

Measurement of Intangible capital

Following Peters and Taylor (2017), measure intangible capital as the sum of 3 components: externally purchased intangible capital, internally created knowledge capital, and internally created organization capital. This paper will use intangible capital from the balance sheet as externally purchased intangible capital. However, due to the lack of R&D data for each company in the Thai database, this study requests to drop the consideration of such information from the calculation of intangible capital. In terms of organizational capital, which is not booked on the balance sheet, part of SG&A spending will represent investments in organizational capital. Therefore, this study will use capitalization approach for calculating intangible capital value which refers to Peters and Taylor (2017) approach and also on the same idea with recent studies which attempt to overcome the omission of in-house intangible investments in reported assets by capitalizing the outlays reported in selling, general, and administrative (SG&A) expenses e.g., Hulten and Hao (2008), Eisfeldt and Papanikolaou (2013).

$$int_cap_{it} = EIM_{it} + OC_{it}$$

Where; int_cap_{it} means Intangible capital in the end-of-period

EIM_{it} means externally purchased intangible capital in
balance sheet

OC_{it} represents organizational capital

$$OC_{it} = (1 - \delta_{SG\&A}) OC_{it-1} + 30\% * SG\&A_{it}$$

; $\delta = depreciation\ rates$

which depreciation rates was set to 20% followed Falato et al. (2022) and Peters and Taylor (2017).

Note: 1) The study will also recheck and test robustness of the depreciation rate to ensure the appropriate depreciation rate for Thailand.

2) Using the perpetual inventory method for knowledge capital & organizational capital, the initial value will apply the calculation as below.

$$OC_0 = \frac{SG\&A_1}{g + \delta_0}; g = \text{the average growth rate of SG\&A which was set to}$$

10% followed Eisfeldt and Papanikolaou (2013)

3) The study treats missing values as zero

Other financial data: from Refinitiv DataStream & Bloomberg

Methodology

For the first objective is to examine the relationship between ESG score and intangible capital.

Hypothesis 1: high ESG score will have high Intangible capital ratio.

The study will regress ESG score to the Intangible capital ratio in Equation (1)

$$int_cap\ ratio_{it} = \alpha + \beta_1 ESG_{it} + \sum_1^n \gamma_k Control_{kit} + \varepsilon_{it} \quad (1)$$

Where:

- $int_cap\ ratio_{it}$ is ratio for Intangible capital/Total capital
(Total capital = Total assets + OC_{it} which we capitalized from SG&A)
- ESG representing the company's ESG score
- X is the control variables
- ε is the error term

First, the study collects Intangible capital information from the company's financial report baes on yearly basis, which comprised on externally purchased intangible capital in balance sheet and SG&A in income statement and note to financial statement. Then calculation for Intangible capital value. I use Refinitiv as the source of the data. The annual basis data is to align with ESG score which was announced on annual basis. ESG scores was received by Refinitiv ESG scores. For control variables comprised of Total Assets, Debt Ratio, Return on Assets (ROA), Book-to-Market Ratio (BTM)

For the second objective is to analyze further on the impact of ESG scores, Intangible capital level and both factors on buy-and-hold returns (BHR) in equation (2)
Hypothesis 2: $ESG * int_cap\ ratio$ will have high impact or buy-and-hold returns (BHR).

$$BHR = \gamma_0 + \gamma_1 ESG + \gamma_2 int_cap\ ratio + \gamma_3 ESG * int_cap\ ratio + \delta X + \varepsilon \quad (2)$$

Where:

- $int_cap\ ratio$ is ratio for Intangible capital/Total capital
(Total capital = Tangible capital + Intangible capital)

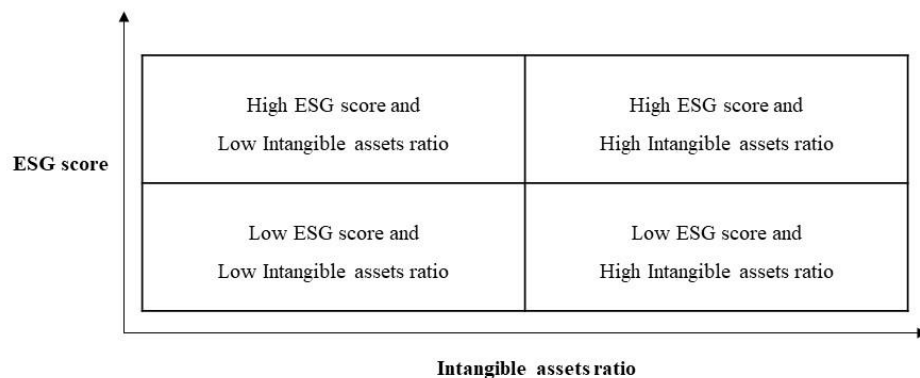
- ESG representing the company's ESG score
- X is the control variables
- ε is the error term

For control variables comprised of Total Assets, Debt Ratio, Return on Assets (ROA), Book-to-Market Ratio (BTM)

For the third objective is to examine the impact of ESG score & Intangible capital to stock performance of Thai listed companies.

We categorized company with ESG scores & Intangible capital into 4 groups (2x2 matrix).

Figure 3: the relationship between ESG score and intangible capital.



Hypothesis 3: Companies with High ESG score & high intangible capital ratio will provide greater abnormal return than companies with Low ESG score or Low Intangible capital ratio.

According to Figure 3, the study will build portfolios comprised 4 portfolios.

Portfolio 1 (H,H): High ESG score and High Intangible capital ratio

Portfolio 2 (H,L): High ESG score and Low Intangible capital ratio

Portfolio 3 (L,H): Low ESG score and High Intangible capital ratio

Portfolio 4 (L,L): Low ESG score and Low Intangible capital ratio

By doing this, we could compare the performance of the portfolio with each group through a buy-and-hold strategy. The buy-and-hold approach is a method used by investors where they purchase securities with the intention of holding on to them for an extended period of time, rather than selling them in the short term. It involves making an investment for the long term and keeping it in the portfolio. The portfolios were re-adjusted based on changes in the ESG scores after the stocks had been held for an entire

year. We will create portfolios with an equally weighted method. The return of the buy-and-hold strategy (BHR) portfolio will be calculated by multiplying the return of each individual stock by its respective weight within the portfolio.

In addition, they could have been firms that were affected by the industry factor on Intangible capital point more or less than others. For example, Peters and Taylor (2017) indicates that companies in the high-tech and health industries heavily rely on intangible capital, whereas those in the manufacturing sector utilize them to a lesser extent. Therefore, we will add factors into two groups which are above and below mean of Intangible capital ratio to further explain as another factor in model.

In order to examine the effect of ESG & Intangible capital on investment return, this study regress with Fama-French three-factor (Fama & French, 1993), Carhart four-factor (Carhart, 1997), Fama French five-factor models (Fama & French, 2015) to see factor loading statistic result. All these models are extensions of the CAPM framework. Taking into consideration the limited empirical success and the appearance of various risk factors, the application of the CAPM model has been challenged, as highlighted by Fama and French. Therefore, we have decided to exclude the CAPM model from our research.

(i) Fama-French Three-factor Model

The Fama-French three-factor model expands upon the Capital Asset Pricing Model (CAPM) framework by incorporating two additional risk factors, "Small minus Big" (SML) and "High minus Low" (HML).

(ii) Carhart Four-Factor Model

Aside from the three aforementioned factors, Carhart (1997) suggests adding a momentum factor that accounts for the sustained performance observed in some stocks. This persistence is based on the one-year return anomaly for both high-performing and low-performing stocks that was discovered by Jegadeesh and Titman (1993).

(iii) Fama-French Five-Factor Model

In 2015, Fama and French expanded the three-factor model to include two additional factors: profitability and investment. The two additional factors incorporated into the Five-Factor Model are RMW (Robust Minus Weak) and CMA (Conservative Minus Aggressive). The profitability factor aims to capture the return premium associated with companies that have a high ability to generate profits, while the

investment factor aims to capture the return premium associated with companies that have a high level of investment in their operations.

the relation between risks and return are captured by equation (4) on daily basis

$$R_{i,t} - R_{f,t} = \alpha_i + \sum_1^n \beta_{i,Factor} Factor_t + \epsilon_{i,t} \quad (4)$$

Where:

- $Factor_t$ stands for each factor as mentioned above in each model
- ϵ is the error term

Factor data will obtain from Thailand's Factor Library, supported by Capital Market Development Fund (CMDF) and SETSMART Enterprise, SET.

Moreover, the study will benchmark with SETTRI - Total return Index (TRI) measures market performance, including price movements (capital gain/loss), rights offered to current shareholders allowing them to purchase additional shares, usually at a discount to market price (rights offering), and income from dividend payments (dividends) assuming they are reinvested in securities. Then the study will analyze on risk and return performance through Sharpe ratio, Alpha and so on to see whether ESG scores and intangible capital could create investing strategy as a rule-based to capture risk-adjusted returns and generates alpha of portfolio.

Chapter 4: Result and Discussion

4.1 Data Analysis

Descriptive statistics for 169 firms in 5 years period (2018-2022) are shown in Table 2. The main intangible capital ratio (ICR) was ICR2 in 2018-2022. The study also measured other periods, ICR2.1: 2017-2021, ICR2.2: 2016-2020, ICR2.3: 2015-2019 and ICR2.4: 2014-2018. The mean ranged from 0.15 to 0.18, indicating a slight increase as the level progressed. The median was slightly lower than the mean, suggesting a skew in the data. The standard deviation ranged from 0.11 to 0.14, indicating a moderate spread of data around the mean. ESG score had a mean value of 48.92 and a median value of 49.25, suggesting a roughly symmetrical distribution. The scores ranged from a minimum of 17.47 to a maximum of 78.51, with a standard deviation of 17.30, indicating a wide spread of ESG scores among the companies. The study took logarithm of the total assets (TA) and had a mean of 17.34 and a median value of 17.32, suggesting a symmetrical distribution. The standard deviation was 1.60, indicating a relatively tight spread of total assets among the companies. Debt Ratio had a mean value of 0.31 and a median value of 0.33. The standard deviation was 0.20, indicating a moderate spread of debt ratios among the companies. Return on Assets (ROA) had a mean value of 6.33 and a median value of 5.86. Book-to-Market Ratio (BTM) had a mean value of 0.66 and a median value of 0.57. Return (RI) had a mean value of 5.65, but a median value of 0.00, indicating a significant skew in the data. The standard deviation was 28.69, indicating a very wide spread of RI among the companies.

Table 2: Descriptive Statistics under Different Variables

	Obs.	Mean	Median	Max	Min	Std Dev.
ICR2	845	0.150	0.120	0.420	0.020	0.110
ICR2.1	845	0.160	0.120	0.430	0.020	0.120
ICR2.2	845	0.160	0.130	0.440	0.020	0.120
ICR2.3	845	0.170	0.140	0.460	0.020	0.130
ICR2.4	845	0.180	0.150	0.480	0.010	0.140
ESG score	845	48.920	49.250	78.510	17.470	17.300
lnTotalAssets	845	17.340	17.320	20.370	14.760	1.600
DebtRatio	845	0.310	0.330	0.670	0.000	0.200
ROA	845	6.330	5.860	15.530	-1.020	4.450
BTM	845	0.660	0.570	1.640	0.100	0.450
RI	845	5.650	0.000	74.130	-36.270	28.690

All data are winsorized at the 5% and 95% level.

Table 3: Correlation Matrix between Variables

	ICR2	ICR2.1	ICR2.2	ICR2.3	ICR2.4	ESG	TA	DebtRatio	ROA	BTM	RI
<i>ICR2</i>											
<i>ICR2.1</i>	0.970 (<i><.001</i>)										
<i>ICR2.2</i>	0.932 (<i><.001</i>)	0.959 (<i><.001</i>)									
<i>ICR2.3</i>	0.882 (<i><.001</i>)	0.914 (<i><.001</i>)	0.955 (<i><.001</i>)								
<i>ICR2.4</i>	0.830 (<i><.001</i>)	0.859 (<i><.001</i>)	0.905 (<i><.001</i>)	0.954 (<i><.001</i>)							
<i>ESG</i>	0.006 (.862)	0.012 (.727)	0.018 (.594)	0.032 (.355)	0.030 (.377)						
<i>TA</i>	-0.259 (<i><.001</i>)	-0.260 (<i><.001</i>)	-0.256 (<i><.001</i>)	-0.250 (<i><.001</i>)	-0.252 (<i><.001</i>)	0.427 (<i><.001</i>)					
<i>DebtRatio</i>	-0.063 (.067)	-0.056 (.101)	-0.058 (.094)	-0.050 (.149)	-0.039 (.255)	-0.046 (.181)	0.299 (<i><.001</i>)				
<i>ROA</i>	0.147 (<i><.001</i>)	0.166 (<i><.001</i>)	0.171 (<i><.001</i>)	0.163 (<i><.001</i>)	0.151 (<i><.001</i>)	-0.203 (<i><.001</i>)	-0.284 (<i><.001</i>)	-0.238 (<i><.001</i>)			
<i>BTM</i>	-0.241 (<i><.001</i>)	-0.240 (<i><.001</i>)	-0.224 (<i><.001</i>)	-0.192 (<i><.001</i>)	-0.156 (<i><.001</i>)	0.127 (<i><.001</i>)	0.128 (<i><.001</i>)	-0.155 (<i><.001</i>)	-0.471 (<i><.001</i>)		

<i>RI</i>	-0.031 (.372)	-0.000 (.996)	0.020 (.560)	0.001 (.979)	-0.010 (.770)	-0.018 (.601)	-0.010 (.775)	-0.015 (.670)	0.271 (<.001)	-0.223 (<.001)
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4.2 Empirical Results

The results of the study are segmented into 3 sections. The first section explains the relationship between ESG score and intangible capital. The second part further investigates the impact of ESG scores, intangible capital level and both factors on buy-and-hold returns. The third part shows the impact of ESG score & intangible capital on stock performance in each group of ESG score & intangible capital ratio portfolio.

4.2.1 Analysis of the relationship between ESG score and intangible capital.

The results of winsorized panel data regressions based on fixed-effect model. Moreover, we also conducted clustered standard errors to enhance effective of result.

Table 4 exhibits the results of a regression analysis where the Intangible Capital Ratio (ICR) is regressed on the ESG score and other control variables across multiple distinct periods of ICR. These periods include ICR (2018-2022) for Model (1), ICR2.1 (2017-2021) for Model (2), ICR2.2 (2016-2020) for Model (3), ICR2.3 (2015-2019) for Model (4), and ICR2.4 (2014-2018) for Model (5). The control variables incorporated into the analysis are Total Assets (TA), DebtRatio, ROA, and BTM.

Table 4: Intangible Capital Ratio with ESG score Regression.

	ICR with ESG score				
	(1) ICR2	(2) ICR2.1	(3) ICR2.2	(4) ICR2.3	(5) ICR2.4
Constant	0.517*** (0.095)	0.521*** (0.095)	0.524*** (0.095)	0.537*** (0.096)	0.566*** (0.102)
ESG score	0.001** (0.0005)	0.001** (0.0005)	0.001** (0.001)	0.001** (0.001)	0.002** (0.001)
TA	-0.022*** (0.006)	-0.023*** (0.006)	-0.023*** (0.006)	-0.025*** (0.006)	-0.027*** (0.006)
DebtRatio	-0.003 (0.034)	0.009 (0.035)	0.013 (0.036)	0.028 (0.038)	0.046 (0.04)
ROA	-0.0004 (0.002)	0.0005 (0.002)	0.001 (0.002)	0.002 (0.002)	0.002 (0.002)
BTM	-0.058*** (0.017)	-0.055*** (0.017)	-0.050*** (0.018)	-0.040** (0.018)	-0.028 (0.019)
Observations	845	845	845	845	845
R ²	0.1326	0.1352	0.1290	0.1193	0.1107
Adjusted R ²	0.1274	0.1300	0.1238	0.1141	0.1054

Clustered standard errors in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

In each model, the ESG score consistently has a positive impact on the ICR. The positive coefficients suggest that an increase in ESG score leads to an increase in

ICR. The consistent statistical significance at the 5% level across all models underscores a solid relationship between these two variables, thereby reinforcing the positive influence of ESG factors on ICR. Additionally, the standard deviation of the ESG score is notably high at 17.30, particularly when compared to ICR values. This reflects a broader spread or increased variability in ESG scores compared to ICR values. The significant standard deviation of ESG scores might imply that differing ESG scores can result in substantial variations in ICR. Pairing this with the statistically significant positive correlation between ESG score and ICR, as evidenced by the regression analysis, it can be inferred that alterations in ESG scores could significantly impact ICR. To quantify the change in ICR linked to a one standard deviation increase in ESG score, this study multiplies the ESG score's standard deviation by the regression coefficient for the ESG score: $17.30 \text{ (standard deviation of ESG score)} * 0.001\text{-}0.002$ (ESG coefficient with ICR across different periods) equals a range of 0.0173-0.0346. Thus, a one standard deviation increase in ESG score could be correlated with an ICR increase within the range of 0.0173-0.0346. Considering the median ICR value ranges from 0.12 to 0.15 (dependent on the specific time period), an increase of 0.0173 equates to an approximate 11.53%-28.83% rise, which is significant.

For result from control variables, Total Assets (TA) exhibit a negative relationship with ICR in all models, suggesting that larger companies (in terms of total assets) tend to have a lower ICR. This relationship is also statistically significant at the 1% level in each model. For the first model (ICR2), the coefficient of -0.022 suggests that a one-unit increase in TA is associated with a decrease of 0.022 in the ICR. Debt Ratio does not show statistical significance in any of the models. The coefficient for Return on Assets (ROA) is also not statistically significant in any model. The Book-to-Market ratio (BTM) exhibits a negative relationship with the ICR, becoming less significant as we move from model 1 to model 5. This suggests that companies with higher market valuation relative to their book value tend to have a lower ICR. In the first model (ICR2), the coefficient of -0.058 suggests that a one-unit increase in BTM is associated with a decrease of 0.058 in the ICR.

R-squared and adjusted R-squared values show that all these models have some explanatory power. This could mean that there are other factors not included in the models that are influential in determining ICR.

This study's findings have crucial implications. They highlight the relevance of ESG scores, company size (as measured by total assets) and The Book-to-Market ratio in determining the intangible capital ratio of a firm.

In addition, the study also considered fixed effects in terms of factor (Stock), factor (Year) and factor (Industry). Table 5 explains the results of a regression analysis where the Intangible Capital Ratio (ICR) is regressed on the ESG score and other control variables across multiple distinct periods of ICR. These periods include ICR2 (2018-2022), ICR2.1 (2017-2021), ICR2.2 (2016-2020), ICR2.3 (2015-2019), and ICR2.4 (2014-2018). The control variables incorporated into the analysis are Total Assets (TA), DebtRatio, ROA, and BTM together with the Fixed effects.

Table 5: Intangible Capital Ratio with ESG score Regression (with Fixed Effect)

	ICR with ESG score (with Fixed Effect)				
	(1) ICR2	(2) ICR2.1	(3) ICR2.2	(4) ICR2.3	(5) ICR2.4
Constant	0.725** (0.327)	0.519*** (0.181)	0.406*** (0.151)	0.169 (0.167)	0.336** (0.148)
ESG score	0.00004 (0.0003)	-0.0002 (0.0003)	-0.00005 (0.0003)	0.0003 (0.0004)	0.001 (0.001)
TA	-0.019 (0.018)	-0.008 (0.011)	0.001 (0.009)	0.014 (0.009)	0.003 (0.008)
DebtRatio	-0.007 (0.035)	0.028 (0.028)	-0.014 (0.029)	-0.0001 (0.047)	0.031 (0.038)
ROA	-0.0004 (0.001)	0.001 (0.001)	0.001 (0.001)	0.0002 (0.001)	-0.0001 (0.001)
BTM	0.023* (0.012)	0.017 (0.011)	0.017 (0.01)	0.024* (0.013)	0.044*** (0.012)
Fixed-Effect	YES	YES	YES	YES	YES
Observations	845	845	845	845	845
R ²	0.9500	0.9498	0.9379	0.9165	0.9077
Adjusted R ²	0.9367	0.9365	0.9214	0.8943	0.8832

Clustered standard errors in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

The ESG score's impact on the ICR varied across the models. The coefficient was positive in models (1), (4), and (5), indicating that an increase in the ESG score was associated with an increase in the ICR in these models. In the first model (ICR2),

the coefficient of 0.00004 suggests that a one-unit increase in ESG score is associated with an increase of 0.00004 in the ICR. However, the ESG score was not statistically significant in any of the models, indicating that the observed effects could have been due to random chance.

For result from control variables, The Total Assets (TA) and Debt Ratio didn't show a consistent direction across models, and they were not statistically significant in any of the models. Return on Assets (ROA) also displayed inconsistent coefficients across the models, indicating that its effect on ICR may vary under different conditions. For instance, the first model (ICR2), the coefficient of -0.019 suggests that a one-unit increase in TA is associated with a decrease of 0.019 in the ICR but not statistically significant. The coefficient of -0.007 suggests that a one-unit increase in DebtRatio is associated with a decrease of 0.007 in ICR. However, none of them are statistically significant at conventional levels (like 1%, 5%, or 10%). This means that the observed relationships in these models might have occurred by chance.

On the other hand, the Book-to-Market ratio (BTM) was positive in all models, suggesting that higher BTM values were associated with higher ICR. This variable was also statistically significant in models (1), (4), and (5), implying a robust relationship between BTM and ICR in these models. In the first model (ICR2), the coefficient of 0.023 suggests that a one-unit increase in BTM is associated with an increase of 0.023 in the ICR.

The R-squared (R^2) values were relatively high in all the models, ranging from 0.9077 to 0.9500, indicating that a high proportion of the variance in ICR could be explained by the models. The adjusted R-squared values, which take into account the number of predictors in the model, were also relatively high, ranging from 0.8832 to 0.9367, providing further confirmation of the model's explanatory power.

This could imply that the relationship between ESG and ICR is not as clear-cut when we account for other relevant factors.

4.2.2 Analysis of ESG scores, Intangible capital level and both factors on buy-and-hold returns (BHR) Regression

The study investigates the results of the winsorized panel data regressions based on Fixed-effect model. Moreover, we also conducted clustered standard errors to enhance effective of result.

Table 6 exhibits the results of a regression analysis where the return (RI) is regressed on the Intangible Capital Ratio (ICR), the ESG score, interaction term and other control variables across multiple distinct periods of ICR. These periods include ICR (2018-2022) for Model (1), ICR2.1 (2017-2021) for Model (2), ICR2.2 (2016-2020) for Model (3), ICR2.3 (2015-2019) for Model (4), and ICR2.4 (2014-2018) for Model (5). The control variables incorporated into the analysis are Total Assets (TA), DebtRatio, ROA, and BTM.

Table 6: Return with Intangible Capital Ratio and ESG score Regression.

	Return with ICR and ESG score				
	(1)	(2)	(3)	(4)	(5)
	RI	RI	RI	RI	RI
Constant	-8.474 (10.202)	-13.997 (9.722)	-18.485* (9.606)	-18.062* (9.605)	-18.136* (9.738)
ESG score	0.048 (0.095)	0.068 (0.091)	0.087 (0.092)	0.123 (0.091)	0.138 (0.091)
ICR ¹	-24.882 (21.570)	-8.459 (20.772)	5.321 (21.032)	10.597 (20.859)	13.395 (20.806)
ICR ¹ *ESG	0.048 (0.386)	-0.124 (0.375)	-0.276 (0.385)	-0.444 (0.374)	-0.506 (0.368)
TA	0.651 (0.523)	0.813 (0.523)	0.945* (0.540)	0.848 (0.543)	0.810 (0.554)
DebtRatio	0.590 (4.145)	1.011 (4.052)	1.230 (4.008)	1.607 (4.006)	1.760 (3.987)
ROA	1.521*** (0.251)	1.545*** (0.246)	1.553*** (0.245)	1.562*** (0.245)	1.567*** (0.245)
BTM	-8.927*** (2.183)	-8.437*** (2.164)	-8.101*** (2.160)	-8.272*** (2.145)	-8.235*** (2.139)
Observations	845	845	845	845	845
R ²	0.09745	0.09363	0.09192	0.09380	0.09467
Adjusted R ²	0.08990	0.08605	0.08432	0.08622	0.08710

Clustered standard errors in parentheses. * p < 0.10, ** p < 0.05, *** p < 0.01.

Note: 1: The Intangible Capital ratio (ICR) varies across different periods for each model in the analysis.

The ESG score is not statistically significant across all five models. This indicates that, according to these models, ESG score does not have a significant influence on RI, holding other variables constant. The ICR also shows no significant impact on RI across all models, suggesting that the proportion of a company's value that comes from intangible assets does not significantly influence the RI, according to these models. However, intangible assets like brand reputation, patents, or proprietary technology can play a crucial role in a company's success and potential for growth. Their value might not always be fully reflected in short-term stock price movements but could have long-term effects on a company's market position and financial performance. The interaction term between ICR and ESG score is not statistically significant in all models. This implies that there is no significant joint effect of ICR and ESG score on RI.

For result from control variables, the coefficient for TA is not statistically significant in most models, except model 3 where it is significant at the 10% level. This suggests that the total assets of a company have a marginally significant positive impact on RI. The Debt Ratio also does not show a significant impact on RI in any of the models. This implies that the proportion of a company's capital that is debt does not significantly influence RI, as per these models. The ROA has a positive and significant impact on RI at the 1% level across all models. This suggests that firms with higher return on assets are associated with higher RI. The BTM shows a negative and significant impact on RI at the 1% level across all models. This suggests that companies with higher book-to-market ratios tend to have lower RI, all else being equal.

The R-squared (R^2) values for each of the five models, we notice that the independent variables in the models explain between approximately 9.192% to 9.745% of the variation in RI. the Adjusted R^2 values range from 8.432% to 8.990%, slightly lower than the corresponding R^2 values.

In addition, the study also considered fixed effect in terms of factor (Stock), factor (Year) and factor(Industry). Table 7 explains the results of a regression analysis where the return (RI) is regressed on the Intangible Capital Ratio (ICR), the ESG score, interaction term and other control variables across multiple distinct periods of ICR.

These periods include ICR (2018-2022) for Model (1), ICR2.1 (2017-2021) for Model (2), ICR2.2 (2016-2020) for Model (3), ICR2.3 (2015-2019) for Model (4), and ICR2.4 (2014-2018) for Model (5). The control variables incorporated into the analysis are Total Assets (TA), DebtRatio, ROA, and BTM together with the Fixed effect.

Table 7: Return with Intangible Capital Ratio and ESG score Regression.

	Return with ICR and ESG score (with Fixed Effect)				
	(1) RI	(2) RI	(3) RI	(4) RI	(5) RI
Constant	84.323 (65.085)	30.483 (58.045)	22.579 (59.652)	30.097 (56.013)	40.651 (57.120)
ESG score	-0.113 (0.243)	-0.100 (0.233)	-0.012 (0.258)	0.041 (0.231)	0.012 (0.223)
ICR ¹	-59.644 (58.338)	19.216 (55.730)	42.032 (42.786)	19.137 (31.970)	-4.077 (37.848)
ICR ¹ *ESG	-0.461 (0.944)	-0.568 (0.869)	-1.031 (1.015)	-1.255* (0.722)	-0.917 (0.722)
TA	-0.119 (3.203)	1.219 (3.178)	1.297 (3.185)	1.498 (3.170)	1.239 (3.155)
DebtRatio	-27.206** (11.815)	-26.683** (11.296)	-26.088** (11.374)	-26.292** (11.330)	-25.674** (11.212)
ROA	1.817*** (0.437)	1.847*** (0.431)	1.850*** (0.432)	1.835*** (0.432)	1.822*** (0.430)
BTM	-49.847*** (6.008)	-51.717*** (6.016)	-52.230*** (6.057)	-51.849*** (6.059)	-50.328*** (6.140)
Fixed-Effect	YES	YES	YES	YES	YES
Observations	845	845	845	845	845
R ²	0.4763	0.4709	0.4716	0.4738	0.4753
Adjusted R ²	0.3353	0.3285	0.3294	0.3322	0.3341

Clustered standard errors in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Note: 1: The Intangible Capital ratio (ICR) varies across different periods for each model in the analysis.

The ESG score coefficients in all the models are negative, apart from model (4) & (5), but none are statistically significant. This suggests that there's no significant relationship between the ESG score and the RI in these models, as per the available data. The ICR coefficients vary in direction across the models, and none are statistically significant. This indicates that the ICR doesn't have a significant impact on the RI

within the observed data. The interaction term $ICR*ESG$ is negative across all models, and statistically significant at the 10% level only in model (4). This suggests a negative relationship between the interaction of ESG scores and ICR and the RI in model (4), implying that increasing the product of ESG score and ICR by one unit decreases RI by about 1.255 units. However, the lack of significance in the other models suggests the interaction effect may not be consistent across different periods.

For result from control variables, The TA shows positive coefficients across last 4 models, although they're not statistically significant. This suggests an increase in total assets might lead to an increase in RI, although the results are not statistically reliable. DebtRatio is negative and statistically significant at the 5% level in all models, indicating a robust negative relationship between debt ratio and RI. ROA has a positive impact on RI, which is statistically significant at the 1% level in all models. This suggests a robust and consistent relationship between ROA and RI. BTM is negatively related to RI and statistically significant at the 1% level in all models, indicating a consistent negative relationship across all models.

The R-squared (R^2) values for each model indicate that the independent variables in the models explain between 47.09% to 47.63% of the variation in RI. The adjusted R^2 values, which account for the number of predictors in the model, range from 32.85% to 33.53%.

Overall, the results suggest that while some variables (DebtRatio, ROA, and BTM) have a consistent and significant relationship with RI, other variables, including ESG scores, ICR, and the interaction term, do not consistently impact RI in a statistically significant way.

4.2.3 Analysis of the impact of ESG score & Intangible capital to stock performance of Thai listed companies.

Despite the absence of statistically significant results in the above regression, this study further explores the impact of ESG scores and ICR on equity abnormal returns. Companies are segmented into four portfolios based on the median values of ESG scores and ICR. Specifically, companies with values exceeding the median are categorized as 'High' (H), while those with values below the median are classified as 'Low' (L).

Portfolio 1 (H, H): High ESG score and High Intangible capital ratio

Portfolio 2 (H, L): High ESG score and Low Intangible capital ratio

Portfolio 3 (L, H): Low ESG score and High Intangible capital ratio

Portfolio 4 (L, L): Low ESG score and Low Intangible capital ratio

The study employed three models: the three-factor model (Fama & French, 1993), the Four-factor model (Carhart, 1997) and the Five-factor model ((Fama & French, 2015) with daily basis data frequency for 2018-2022 period.

Table 8 shows the estimated results from the three-factor model, the Four-factor model and the Five-factor model, where the dependent variable is the returns from the High ESG Score & High ICR (HH), the High ESG Score & Low ICR (HL), the Low ESG Score & High ICR (LH) and the Low ESG Score & Low ICR (LL) portfolio returns.

Table 8: Results from each portfolio with the three-factor model

		(1)	(2)	(3)	(4)
		Alpha	MKT	SMB	HML
High ESG Score & High ICR (HH)	COEF	0.0002*	0.961***	0.299***	-0.037**
	SE	(0.0001)	(0.010)	(0.016)	(0.015)
High ESG Score & Low ICR (HL)	COEF	0.0001	1.055***	0.207***	0.203***
	SE	(0.0001)	(0.010)	(0.016)	(0.015)
Low ESG Score & High ICR (LH)	COEF	0.0003***	1.094***	0.661***	-0.007
	SE	(0.0001)	(0.012)	(0.020)	(0.019)

		(1)	(2)	(3)	(4)
		Alpha	MKT	SMB	HML
Low ESG Score & Low ICR (LL)	COEF	0.0001	1.009***	0.608***	0.006
	SE	0.0001	(0.012)	(0.019)	(0.018)
Observations		1213	1213	1213	1213

* p < 0.10, ** p < 0.05, *** p < 0.01.

In the case of portfolio High ESG Score & High ICR (HH), the coefficient of Alpha is 0.0002, statistically significant at a 10% level, indicating that firms with high ESG scores and high ICR do have marginally higher abnormal returns. For portfolio High ESG Score & Low ICR (HL), however, the Alpha coefficient is not statistically significant, suggesting no difference from the average market return. The same is observed in portfolio Low ESG Score & Low ICR (LL). On the other hand, portfolio Low ESG Score & High ICR (LH) shows a significant positive relationship with a coefficient of 0.0003 at a 1% level, implying that firms with low ESG scores but high ICR generate higher abnormal returns.

Table 9: Results from each portfolio with the four-factor model

		(1)	(2)	(3)	(4)	(5)
		Alpha	MKT	SMB	HML	UMD
High ESG Score & High ICR (HH)	COEF	0.0002*	0.959***	0.302***	-0.052***	-0.039***
	SE	(0.0001)	(0.010)	(0.016)	(0.015)	(0.010)
High ESG Score & Low ICR (HL)	COEF	0.0001	1.050***	0.211***	0.175***	-0.069***
	SE	(0.0001)	(0.010)	(0.015)	(0.015)	(0.010)
Low ESG Score & High ICR (LH)	COEF	0.0003***	1.092***	0.663***	-0.018	-0.028**
	SE	(0.0001)	(0.012)	(0.020)	(0.019)	(0.013)
Low ESG Score & Low ICR (LL)	COEF	0.0001	1.007***	0.611***	-0.008	-0.035***
	SE	(0.0001)	(0.012)	(0.019)	(0.018)	(0.013)
Observations		1213	1213	1213	1213	1213

* p < 0.10, ** p < 0.05, *** p < 0.01.

The Alpha for the High ESG Score & High ICR (HH) portfolio shows a coefficient of 0.0002, which is statistically significant at a 10% level, indicating that firms with high ESG scores and high ICR do have slightly higher abnormal returns beyond market movements. In contrast, the Alpha coefficient for the High ESG Score & Low ICR (HL) and Low ESG Score & Low ICR (LL) portfolios is not statistically significant, suggesting no abnormal returns. For the Low ESG Score & High ICR (LH) portfolio, however, the Alpha is 0.0003 and highly significant at 1% level, suggesting substantial abnormal returns for companies with low ESG scores but high ICR.

Table 10: Results from each portfolio with the five-factor model

		(1)	(2)	(3)	(4)	(5)	(6)
		Alpha	MKT	SMB	HML	RMW	CMA
High ESG Score & High ICR (HH)	COEF	0.0001	0.969***	0.300***	-0.057***	-0.047**	0.024*
	SE	(0.0001)	(0.010)	(0.016)	(0.016)	(0.019)	(0.014)
High ESG Score & Low ICR (HL)	COEF	0.0001*	1.039***	0.173***	0.189***	-0.100***	-0.113***
	SE	(0.0001)	(0.010)	(0.015)	(0.016)	(0.018)	(0.013)
Low ESG Score & High ICR (LH)	COEF	0.0003***	1.092***	0.656***	-0.010	-0.017	-0.019
	SE	(0.0001)	(0.013)	(0.020)	(0.021)	(0.024)	(0.018)
Low ESG Score & Low ICR (LL)	COEF	0.0002	0.994***	0.587***	0.011	-0.031	-0.086***
	SE	(0.0001)	(0.012)	(0.019)	(0.019)	(0.023)	(0.017)
Observations		1213	1213	1213	1213	1213	1213

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

The Alpha for the High ESG Score & High ICR (HH) portfolio shows a coefficient of 0.0001, but it is not statistically significant, suggesting no substantial abnormal returns for firms with high ESG scores and high ICR. The Alpha for the High ESG Score & Low ICR (HL) portfolio, however, is statistically significant at a 10% level, implying slightly higher abnormal returns for companies with high ESG scores but low ICR. For the Low ESG Score & High ICR (LH) portfolio, the Alpha is 0.0003 and highly significant at 1%, suggesting substantial abnormal returns for companies

with low ESG scores but high ICR. The Alpha for Low ESG Score & Low ICR (LL) portfolio is not statistically significant.

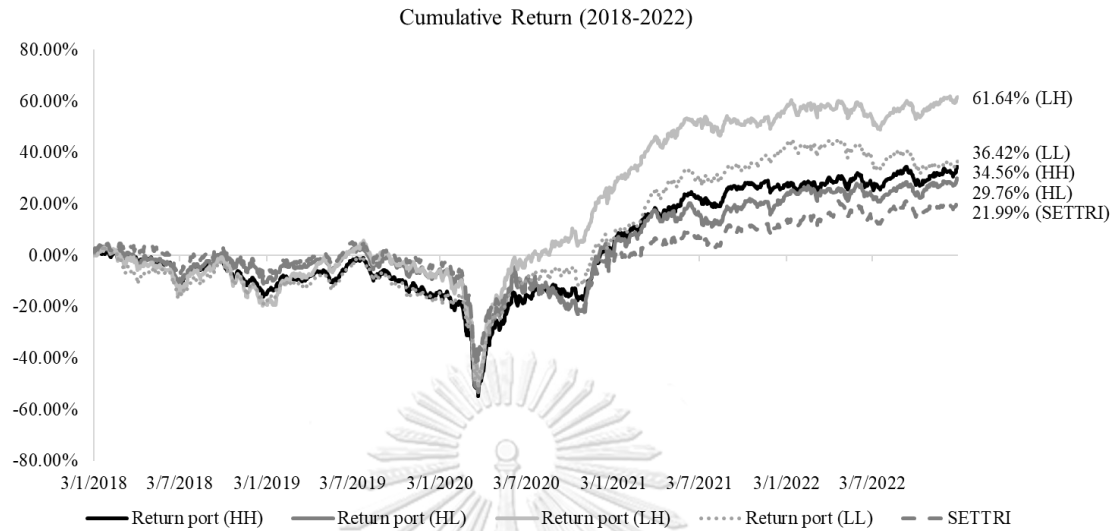
When examining the four portfolios based on ESG scores and Intangible Capital ratios, we observe diverse turnover trends. Portfolio 1 (High ESG, High Intangible) shows about 55% of the stocks remaining consistent in the portfolio over a 5-year period. This suggests a moderate level of turnover and potentially moderate trading costs. Conversely, Portfolio 2 (High ESG, Low Intangible) has a slightly higher stability, with 65% of the stocks being retained for the same duration, implying lower turnover and, potentially, trading costs. For Portfolio 3 (Low ESG, High Intangible), only 45% of the stocks are retained, indicating a higher turnover and associated trading costs. Lastly, Portfolio 4 (Low ESG, Low Intangible) demonstrates a turnover rate similar to Portfolio 1, with 57% of the stocks being held consistently, indicating moderate turnover and trading costs. Looking at the four different portfolios, on average, the 55% average stability across the portfolios over five years indicates a considerable degree of variation within the data. The trading costs for these portfolios are probably not too high.

Portfolio key performance summary

- Return Performance (Each port return compared with SETTRI)

In the period between 2018 and 2022, an analysis of the portfolio returns in comparison with the SETTRI shown that 4 portfolios generated cumulative return higher than SETTRI in all ports. The portfolio with Low ESG Score & High ICR (LH) offered a remarkable return of 61.64%, the highest among the four portfolios and far exceeding the SETTRI. This may indicate that, in the given period, a high ICR contributed more substantially to returns than a high ESG score. The Low ESG Score & Low ICR (LL) portfolio and the High ESG Score & High ICR (HH) portfolio showed cumulative return around 34.56%-36.42%. The portfolio featuring High ESG Score & Low ICR (HL) resulted in a return of 29.76%. All portfolios outperformed the SETTRI which cumulative return at 21.99%

Figure 4: the cumulative return performance of portfolios & SETTRI (2018-2022)



Additionally, Figure 5 presents the cumulative returns for the period from April 2020 to 2022. This timeframe has been specifically chosen to examine return performance following a significant decline in the stock market of the COVID-19 pandemic and the enforcement of circuit breaker policies. The portfolio returns substantially outperformed the SETTRI benchmark especially after the crisis. Ranking from the portfolio with Low ESG score and High ICR (LH) demonstrated a remarkable return of 103.97% and the portfolio with High ESG score and High ICR (HH) exhibited a return of 80.68%, compared with the SETTRI index registered a significantly lower return of 55.14% during the same period.

Figure 5: the cumulative return performance of portfolios & SETTRI (April 2020-2022)

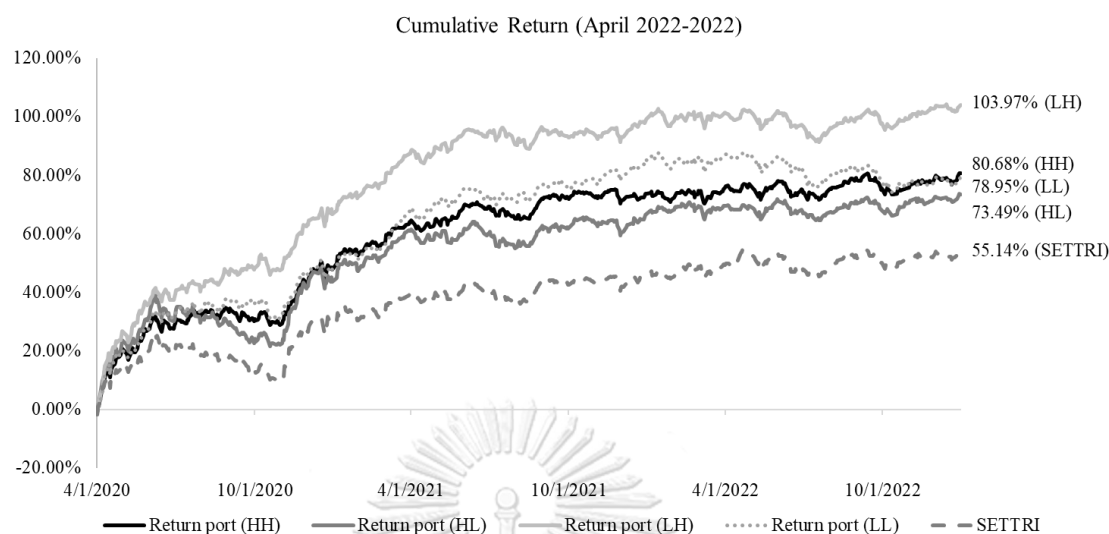


Table 11: Alpha result of portfolios & SETTRI (2018-2022)

Portfolios	Port Return (2018-2022)	Alpha
High ESG Score & High ICR (HH)	33.04%	16.75%
High ESG Score & Low ICR (HL)	24.80%	8.51%
Low ESG Score & High ICR (LH)	72.24%	55.95%
Low ESG Score & Low ICR (LL)	35.26%	18.97%
SETTRI	16.29%	

Between 2018 and 2022, the calculated alpha values suggest that each of the 4 portfolios generated a substantial degree of excess returns over the SETTRI benchmark. The portfolio with Low ESG Score and High ICR (LH) demonstrated the highest outperformance, with an alpha of 55.95% and an overall return of 72.24%. This illustrates that the portfolio was extremely successful in generating returns that were far beyond the returns by SETTRI.

Table 12: Sharpe ratio result of portfolios & SETTRI (2018-2022)

Portfolios	Shape Ratio	Treynor Ratio
High ESG Score & High ICR (HH)	0.42	0.08
High ESG Score & Low ICR (HL)	0.32	0.06
Low ESG Score & High ICR (LH)	0.71	0.14

Low ESG Score & Low ICR (LL)	0.44	0.09
SETTRI	0.24	0.04

The Sharpe ratio of different portfolios and the SETTRI provides an insight into their risk-adjusted performance. The Low ESG Score & High ICR (LH) portfolio achieved the highest Sharpe ratio of 0.71, indicating that it provided the best risk-adjusted performance over this period. This means that for each unit of risk taken, the LH portfolio generated the highest returns compared to the others. The High ESG Score & High ICR (HH) and the Low ESG Score & Low ICR (LL) portfolios had Sharpe ratios of 0.42 and 0.44 respectively, signifying that they offered decent risk-adjusted returns, but not as high as the LH portfolio. The High ESG Score & Low ICR (HL) portfolio exhibited the lowest Sharpe ratio among the portfolios at 0.32. The SETTRI, which serves as the market benchmark, had a Sharpe ratio of 0.24, which is lower than all the portfolios. This suggests that all the portfolios outperformed the market on a risk-adjusted basis during the period from 2018 to 2022. Thus, these portfolios would have been a more attractive investment option for risk-averse investors seeking to maximize their returns for a given level of risk.

The portfolio with Low ESG Score & High ICR (LH) has the highest Treynor Ratio of 0.14, suggesting it has delivered the most excess return per unit of risk among the portfolios. This is followed by the Low ESG Score & Low ICR (LL) portfolio and the High ESG Score & High ICR (HH) portfolio, which have Treynor Ratios of 0.09 and 0.08, respectively. The portfolio with the High ESG Score & Low ICR (HL) has a Treynor Ratio of 0.06, indicating lower risk-adjusted returns than the other portfolios. In comparison, the SETTRI benchmark has a Treynor Ratio of just 0.04, meaning all portfolios outperformed the market on a risk-adjusted basis over the period from 2018-2022.

For other indicators, Beta results represent the sensitivity of the expected excess asset returns to the expected excess market returns. The portfolio with High ESG Score & Low ICR (HL) shows the highest Beta value of 0.99, suggesting that this portfolio's returns are almost perfectly correlated with the market and would likely react strongly to market movements. The Beta of the Low ESG Score & High ICR (LH) portfolio is

also relatively high at 0.89, indicating a significant level of market-related risk. Conversely, the portfolios with High ESG Score & High ICR (HH) and Low ESG Score & Low ICR (LL) exhibit lower Beta values of 0.87 and 0.82 respectively. These lower Beta values suggest these portfolios would generally be less affected by market fluctuations than the former portfolios. While Standard Deviation of all portfolios is lower than SETTRI.



Chapter 5: Conclusion

The main purpose of this research is to analyze the impact of ESG score and Intangible Capital in terms of relationship and return as the rising of social and environmental movement & increasingly dematerialized world intangible assets. The research focuses on Thai firms listed on the Stock Exchange of Thailand (SET) that have an ESG score, covering the period from 2018 to 2022. This study has three main objectives. First, it aims to explore the relationship between the ESG score and Intangible assets, using Refinitiv's measurement as a third-party assessment tool. For the second objective is to analyze further on the impact of ESG scores, Intangible capital level and both factors on buy-and-hold returns (BHR). For the third objective is to examine the impact of ESG score & Intangible capital to stock performance of Thai listed companies.

The finding for the first objective found that an increase in the ESG score leads to a rise in the ICR, with a one standard deviation increase in ESG score correlating with an ICR increase of 0.0173-0.0346. This could signify an approximate 11.53%-28.83% rise, which is significant. Among the control variables, Total Assets (TA) consistently show a negative relationship with ICR, indicating that larger companies tend to have a lower ICR. Debt Ratio and Return on Assets (ROA) do not show statistical significance in any models. The Book to Market ratio (BTM) exhibits a negative relationship with the ICR, suggesting that companies with higher market valuation relative to their book value tend to have a lower ICR. These findings highlight the importance of ESG scores and company size in determining a firm's intangible capital ratio. However, the study also considered fixed effects in terms of Stock and Year factors. The influence of the ESG score on the Intangible Capital Ratio (ICR) showed variation across different models and did not demonstrate statistical significance in any of the models, suggesting that the observed effects might be attributable to random variation. ESG investing is still developing. Therefore, it could be argued that there is a gap in recognizing and capitalizing on the potential of ESG investing to build and enhance intangible capital. Moreover, ESG investment is considered as a long-term value, it might take time to create value through company, including create value in intangible capital. For example, Jun W et al. (2022) shown

that the early stage of ESG information disclosure may lead to a significant increase in costs and a decline in corporate business performance. However, when ESG inputs reach a certain level, ESG information disclosure will promote the improvement of intangible capital.

In addition, when analyzed deep down into the second objective, the findings shown that ESG score and the ICR do not significantly influence the return (RI) across all models, indicating that these factors may not be as impactful as initially thought. The interaction between ICR and ESG score also lacks statistical significance, suggesting no significant joint effect on RI. Among the control variables, these findings highlight the potential influence of ROA and BTM on a company's return as Return on Assets (ROA) consistently shows a positive and significant impact on RI across all models, suggesting that firms with higher ROA are associated with higher RI. Conversely, the Book to Market ratio (BTM) & DebtRatio has a negative and significant impact on RI across all models, indicating that companies with higher book-to-market ratios & DebtRatio tend to have lower RI, all else being equal. The result supported the opposite studies that have shown about ESG performance did not significantly affect to stock performance as Chang et al. (2022), Demers et al. (2021). Moreover, certain ESG/CSR investments may indicate agency problems, which can lead to a decrease in a company's profits and value (BÉNABOU and TIROLE (2010).

The study also conducted 4 portfolios which are High ESG Score & High ICR (HH), the High ESG Score & Low ICR (HL), the Low ESG Score & High ICR (LH) and the Low ESG Score & Low ICR (LL) portfolio to further investigate abnormal return & risk aspect analysis. Between 2018 and 2022, a comparative analysis of portfolio returns against the SETTRI (Stock Exchange of Thailand Total Return Index) revealed that all portfolios outperformed the SETTRI. Notably, the portfolio characterized by a Low ESG Score and High Intangible Capital Ratio (ICR) (LH) yielded an impressive return of 61.64%. This was the highest return among the four portfolios, significantly surpassing SETTRI. The portfolio returns substantially outperformed the SETTRI benchmark especially after the crisis. From 2018 to 2022, the computed alpha values indicate that all four portfolios produced significant excess returns compared to the SETTRI benchmark. In terms of risk aspect, The Low ESG

Score & High ICR (LH) portfolio achieved the highest Sharpe ratio of 0.71, This suggests that all the portfolios outperformed the market on a risk-adjusted basis during the period. Treynor ratio also in line with Sharpe ratio, meaning all portfolios outperformed the benchmark. Lower Beta values suggest these portfolios would generally be less affected by market fluctuations than the former portfolios. While Standard Deviation of all portfolios is lower than SETTRI.

In conclusion, the gap in Environmental, Social, and Governance (ESG) investing with respect to intangible capital presents both a challenge and an opportunity. Given that the ESG score data of SET companies encompasses only 169 companies, it would be a logical next step to continue further analysis on this subject. Therefore, there is substantial scope to highlight the importance of ESG scores through their implications for the creation of intangible asset value. A comprehensive ESG assessment and reporting standards, regulatory support, and awareness, there is still a potential development in fully integrating ESG principles into investment strategies and valuing intangible capital.

Appendix

Table 13: Intangible Capital Ratio with ESG score Regression in each period

Model 1: ICR 2018-2022 with ESG score 2018-2022						
	(1)	(2)	(3)	(4)	(5)	(6)
	ICR	ICR2	ICR2	ICR2	ICR2	ICR2
Constant	0.150*** (0.022)	0.504*** (0.101)	0.515*** (0.099)	0.468*** (0.102)	0.517*** (0.095)	0.725** (0.327)
ESG score	0.00004 (0.0004)	0.001** (0.0005)	0.001** (0.0005)	0.001** (0.0005)	0.001** (0.0005)	0.00004 (0.0003)
TA		-0.023*** (0.006)	-0.024*** (0.006)	-0.023*** (0.006)	-0.022*** (0.006)	-0.019 (0.018)
DebtRatio			0.025 (0.034)	0.037 (0.033)	-0.003 (0.034)	-0.007 (0.035)
ROA				0.003* (0.002)	-0.0004 (0.002)	-0.0004 (0.001)
BTM					-0.058*** (0.017)	0.023* (0.012)
Fixed-Effect						YES
Observations	845	845	845	845	845	845
R ²	0.00004	0.08374	0.08552	0.09529	0.1326	0.9500
Adjusted R ²	-0.00115	0.08157	0.08226	0.09099	0.1274	0.9367

Clustered standard errors in parentheses. * p < 0.10, ** p < 0.05, *** p < 0.01.

Model 2: ICR 2017-2021 with ESG score 2018-2022						
	(1)	(2)	(3)	(4)	(5)	(6)
	ICR	ICR2	ICR2	ICR2	ICR2	ICR2
Constant	0.153*** (0.023)	0.520*** (0.102)	0.534*** (0.100)	0.474*** (0.102)	0.521*** (0.095)	0.519*** (0.181)
ESG score	0.0001 (0.0005)	0.001** (0.0005)	0.001** (0.0005)	0.001** (0.001)	0.001** (0.0005)	-0.0002 (0.0003)
TA		-0.024*** (0.006)	-0.025*** (0.006)	-0.024*** (0.006)	-0.023*** (0.006)	-0.008 (0.011)
DebtRatio			0.031 (0.035)	0.046 (0.034)	0.009 (0.035)	0.028 (0.028)
ROA				0.003** (0.002)	0.0005 (0.002)	0.001 (0.001)
BTM					-0.055*** (0.017)	0.017 (0.011)
Fixed-Effect						YES
Observations	845	845	845	845	845	845
R ²	0.0001451	0.08624	0.08885	0.1037	0.1352	0.9498
Adjusted R ²	-0.001041	0.08407	0.0856	0.09938	0.1300	0.9365

Clustered standard errors in parentheses. * p < 0.10, ** p < 0.05, *** p < 0.01.

Model 3: ICR 2016-2020 with ESG score 2018-2022						
	(1)	(2)	(3)	(4)	(5)	(6)
	ICR	ICR2	ICR2	ICR2	ICR2	ICR2
Constant	0.157*** (0.023)	0.534*** (0.103)	0.547*** (0.100)	0.482*** (0.101)	0.524*** (0.095)	0.406*** (0.151)
ESG score	0.0001 (0.0005)	0.001** (0.0005)	0.001** (0.0005)	0.001** (0.001)	0.001** (0.001)	-0.00005 (0.0003)
TA		-0.024*** (0.006)	-0.026*** (0.006)	-0.024*** (0.006)	-0.023*** (0.006)	0.001 (0.009)
DebtRatio			0.031 (0.037)	0.047 (0.036)	0.013 (0.036)	-0.014 (0.029)
ROA				0.004** (0.002)	0.001 (0.002)	0.001 (0.001)
BTM					-0.050*** (0.018)	0.017 (0.010)
Fixed-Effect						YES
Observations	845	845	845	845	845	845
R ²	0.0003375	0.0858	0.08826	0.1048	0.1290	0.9379
Adjusted R ²	-0.0008483	0.08363	0.08500	0.1005	0.1238	0.9214

Clustered standard errors in parentheses. * p < 0.10, ** p < 0.05, *** p < 0.01.

Model 4: ICR 2015-2019 with ESG score 2018-2022						
	(1)	(2)	(3)	(4)	(5)	(6)
	ICR	ICR2	ICR2	ICR2	ICR2	ICR2
Constant	0.158*** (0.024)	0.553*** (0.104)	0.569*** (0.101)	0.503*** (0.101)	0.537*** (0.096)	0.169 (0.167)
ESG score	0.0002 (0.0005)	0.001** (0.001)	0.001** (0.001)	0.001*** (0.001)	0.001*** (0.001)	0.0003 (0.0004)
TA		-0.026*** (0.007)	-0.028*** (0.006)	-0.026*** (0.006)	-0.025*** (0.006)	0.014 (0.009)
DebtRatio			0.039 (0.039)	0.055 (0.038)	0.028 (0.038)	-0.0001 (0.047)
ROA				0.004** (0.002)	0.002 (0.002)	0.0002 (0.001)
BTM					-0.040** (0.018)	0.024* (0.013)
Fixed-Effect						YES
Observations	845	845	845	845	845	845
R ²	0.001014	0.08609	0.08951	0.1049	0.1193	0.9165
Adjusted R ²	-0.0001714	0.08392	0.08626	0.1006	0.1141	0.8943

Clustered standard errors in parentheses. * p < 0.10, ** p < 0.05, *** p < 0.01.

Model 5: ICR 2014-2018 with ESG score 2018-2022						
	(1)	(2)	(3)	(4)	(5)	(6)
	ICR	ICR2	ICR2	ICR2	ICR2	ICR2
Constant	0.164*** (0.026)	0.584*** (0.109)	0.606*** (0.106)	0.542*** (0.106)	0.566*** (0.102)	0.336** (0.148)
ESG score	0.0002 (0.001)	0.001** (0.001)	0.001*** (0.001)	0.002*** (0.001)	0.002*** (0.001)	0.001 (0.001)
TA		-0.027*** (0.007)	-0.030*** (0.007)	-0.028*** (0.006)	-0.027*** (0.006)	0.003 (0.008)
DebtRatio			0.049 (0.041)	0.065 (0.040)	0.046 (0.040)	0.031 (0.038)
ROA				0.004** (0.002)	0.002 (0.002)	-0.0001 (0.001)
BTM					-0.028 (0.019)	0.044*** (0.012)
Fixed-Effect						YES
Observations	845	845	845	845	845	845
R ²	0.0009256	0.08653	0.0914	0.1043	0.1107	0.9077
Adjusted R ²	-0.0002595	0.08436	0.08816	0.1000	0.1054	0.8832

Clustered standard errors in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table 14: Return with Intangible Capital Ratio and ESG score Regression in each period

Model 1: ICR 2018-2022 with ESG score 2018-2022					
	(1)	(2)	(3)	(4)	(5)
	RI	RI	RI	RI	RI
Constant	7.113** (2.757)	8.264*** (3.023)	12.188** (5.118)	-8.474 (10.202)	84.323 (65.085)
ESG score	-0.030 (0.048)	-0.030 (0.048)	-0.108 (0.090)	0.048 (0.095)	-0.113 (0.243)
ICR		-7.646 (6.504)	-34.175 (23.701)	-24.882 (21.570)	-59.644 (58.338)
ICR*ESG			0.528 (0.412)	0.048 (0.386)	-0.461 (0.944)
TA				0.651 (0.523)	-0.119 (3.203)
DebtRatio				0.590 (4.145)	-27.206** (11.815)
ROA				1.521*** (0.251)	1.817*** (0.437)
BTM				-8.927*** (2.183)	-49.847*** (6.008)
Fixed-Effect					YES
Observations	845	845	845	845	845
R ²	0.000324	0.001262	0.002484	0.09745	0.4763
Adjusted R ²	-0.0008618	-0.00111	-0.001074	0.0899	0.3353

Clustered standard errors in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Model 2: ICR 2017-2021 with ESG score 2018-2022					
	(1)	(2)	(3)	(4)	(5)
	RI	RI	RI	RI	RI
Constant	7.113** (2.757)	7.112** (2.969)	9.380* (4.931)	-13.997 (9.722)	30.483 (58.045)
ESG score	-0.030 (0.048)	-0.030 (0.048)	-0.075 (0.086)	0.068 (0.091)	-0.100 (0.233)
ICR		0.007 (6.556)	-14.924 (23.922)	-8.459 (20.772)	19.216 (55.730)
ICR*ESG			0.296 (0.412)	-0.124 (0.375)	-0.568 (0.869)
TA				0.813 (0.523)	1.219 (3.178)
DebtRatio				1.011 (4.052)	-26.683** (11.296)
ROA				1.545*** (0.246)	1.847*** (0.431)
BTM				-8.437*** (2.164)	-51.717*** (6.016)
Fixed-Effect					YES
Observations	845	845	845	845	845
R ²	0.000324	0.000324	0.0007291	0.09363	0.4709
Adjusted R ²	-0.0008618	-0.00205	-0.002836	0.08605	0.3285

Clustered standard errors in parentheses. * p < 0.10, ** p < 0.05, *** p < 0.01.

Model 3: ICR 2016-2020 with ESG score 2018-2022					
	(1)	(2)	(3)	(4)	(5)
	RI	RI	RI	RI	RI
Constant	7.113** (2.757)	6.355** (2.909)	7.702 (4.744)	-18.485* (9.606)	22.579 (59.652)
ESG score	-0.030 (0.048)	-0.030 (0.048)	-0.057 (0.084)	0.087 (0.092)	-0.012 (0.258)
ICR		4.835 (6.544)	-3.707 (23.413)	5.321 (21.032)	42.032 (42.786)
ICR*ESG			0.169 (0.402)	-0.276 (0.385)	-1.031 (1.015)
TA				0.945* (0.540)	1.297 (3.185)
DebtRatio				1.230 (4.008)	-26.088** (11.374)
ROA				1.553*** (0.245)	1.850*** (0.432)
BTM				-8.101*** (2.160)	-52.230*** (6.057)
Fixed-Effect					YES
Observations	845	845	845	845	845
R ²	0.000324	0.0007413	0.0008828	0.09192	0.4716
Adjusted R ²	-0.0008618	-0.001632	-0.002681	0.08432	0.3294

Clustered standard errors in parentheses. * p < 0.10, ** p < 0.05, *** p < 0.01.

Model 4: ICR 2015-2019 with ESG score 2018-2022					
	(1)	(2)	(3)	(4)	(5)
	RI	RI	RI	RI	RI
Constant	7.113** (2.757)	7.061** (2.868)	7.034 (4.637)	-18.062* (9.605)	30.097 (56.013)
ESG score	-0.030 (0.048)	-0.030 (0.048)	-0.029 (0.082)	0.123 (0.091)	0.041 (0.231)
ICR		0.329 (6.392)	0.495 (22.889)	10.597 (20.859)	19.137 (31.970)
ICR*ESG			-0.003 (0.387)	-0.444 (0.374)	-1.255* (0.722)
TA				0.848 (0.543)	1.498 (3.170)
DebtRatio				1.607 (4.006)	-26.292** (11.330)
ROA				1.562*** (0.245)	1.835*** (0.432)
BTM				-8.272*** (2.145)	-51.849*** (6.059)
Fixed-Effect					YES
Observations	845	845	845	845	845
R ²	0.000324	0.0003262	0.0003262	0.0938	0.4738
Adjusted R ²	-0.0008618	-0.002048	-0.00324	0.08622	0.3322

Clustered standard errors in parentheses. * p < 0.10, ** p < 0.05, *** p < 0.01.

Model 5: ICR 2014-2018 with ESG score 2018-2022					
	(1)	(2)	(3)	(4)	(5)
	RI	RI	RI	RI	RI
Constant	7.113** (2.757)	7.445*** (2.849)	6.862 (4.666)	-18.136* (9.738)	40.651 (57.120)
ESG score	-0.030 (0.048)	-0.029 (0.049)	-0.018 (0.082)	0.138 (0.091)	0.012 (0.223)
ICR		-2.022 (6.503)	1.423 (23.233)	13.395 (20.806)	-4.077 (37.848)
ICR*ESG			-0.069 (0.392)	-0.506 (0.368)	-0.917 (0.722)
TA				0.810 (0.554)	1.239 (3.155)
DebtRatio				1.760 (3.987)	-25.674** (11.212)
ROA				1.567*** (0.245)	1.822*** (0.430)
BTM				-8.235*** (2.139)	-50.328*** (6.140)
Fixed-Effect					YES
Observations	845	845	845	845	845
R ²	0.000324	0.0004146	0.0004438	0.09467	0.4753
Adjusted R ²	-0.0008618	-0.00196	-0.003122	0.0871	0.3341

Clustered standard errors in parentheses. * p < 0.10, ** p < 0.05, *** p < 0.01.

Table 15: Top 5 Industries in ESG score

Sector	%
Energy & Utilities	17.16%
Food & Beverage	10.65%
Property Development	9.47%
Commerce	7.10%
Transportation & Logistics	6.51%

Table 16: Top 5 Industries for each portfolio

- High ESG Score & High ICR (HH)

Sector	2018	2019	2020	2021	2022
Energy & Utilities	12.77%	20.83%	16.28%	19.05%	19.57%
Commerce	8.51%	10.42%	13.95%	16.67%	15.22%
Food & Beverage	17.02%	14.58%	13.95%	16.67%	13.04%
Construction Materials	6.38%	6.25%	6.98%	7.14%	6.52%
Health Care Services	4.26%	2.08%	6.98%	7.14%	6.52%

- High ESG Score & Low ICR (HL)

Sector	2018	2019	2020	2021	2022
Energy & Utilities	26.32%	18.92%	23.81%	27.91%	30.77%
Banking	23.68%	24.32%	21.43%	20.93%	20.51%
Property Development	18.42%	18.92%	16.67%	16.28%	17.95%
Food & Beverage	2.63%	5.41%	4.76%	2.33%	5.13%
Media & Publishing	0.00%	0.00%	4.76%	4.65%	5.13%

- Low ESG Score & High ICR (LH)

Sector	2018	2019	2020	2021	2022
Food & Beverage	18.42%	18.92%	19.05%	18.60%	20.51%
Transportation & Logistics	7.89%	5.41%	11.90%	13.95%	15.38%
Automotive	5.26%	8.11%	9.52%	6.98%	10.26%
Commerce	15.79%	13.51%	9.52%	6.98%	7.69%
Construction Materials	7.89%	8.11%	7.14%	6.98%	7.69%

- Low ESG Score & Low ICR (LL)

Sector	2018	2019	2020	2021	2022
Energy & Utilities	23.91%	19.15%	19.05%	14.63%	13.33%
Finance & Securities	13.04%	12.77%	11.90%	12.20%	13.33%
Information & Communication Technology	4.35%	6.38%	9.52%	12.20%	13.33%
Property Development	10.87%	12.77%	11.90%	12.20%	11.11%
Construction Services	8.70%	8.51%	7.14%	7.32%	8.89%



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