Exploring the Link Between ESG Scores and Downside Risks of Stock Returns During Periods of Negative Shock: Evidence in APAC

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การวิจัยความเชื่อมโยงระหว่างคะแนนจากปัจจัย สิ่งแวดล้อม สังคม และ ธรรมภิบาล (ESG) กับความเสี่ยงขาลงของผลตอบแทนของหุ้นในช่วงวิกฤติ :หลักฐานจากประเทศในภูมิภาคเอเชียแปซิฟิค

นายณัฐกิจ สัมมาคารวะ

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ณัฐกิจ สัมมาคารวะ : การวิจัยความเชื่อมโยงระหว่างคะแนนจากปัจจัย สิ่งแวดล้อม สังคม และ ธรรมภิบาล (ESG) กับความเสี่ยงขาลงของผลตอบแทนของหุ้นในช่วงวิกฤติ :หลักฐานจากประเทศในภูมิภาคเอเชียแปซิฟิค. (Exploring the Link Between ESG Scores and Downside Risks of Stock Returns During Periods of Negative Shock: Evidence in APAC) อ.ที่ปรึกษาหลัก : ผศ. ดร.รุ่งเกียรติ รัตนบานชื่น

งานวิจัยนี้ศึกษาความสัมพันธ์เชิงประจักษ์ระหว่างปัจจัยด้านสิ่งแวดล้อม สังคม และธรรมาภิบาล (ESG) กับความเสี่ยงขาลงของผลตอบแทนหุ้นในช่วงตลาดเกิดวิกฤติ โดยมุ่งเน้นไปที่ 13 ประเทศภายในภูมิภาคเอเชียแปซิฟิก (APAC)การศึกษานี้ประเมินประสิทธิภาพของ ESG โดยใช้คะแนนรวมของESG คะแนนสิ่งแวดล้อม คะแนนสังคม คะแนนธรรมภิบาล และคะแนนข้อขัดแย้ง โดยพิจารณาผลกระทบต่อความเสี่ยงขาลง ที่วัดโดย Value at Risk (VaR) และ Maximum Drawdown (MDD) กลุ่มตัวอย่างประกอบด้วยบริษัทที่มีการซื้อขายหุ้นในตลาดทุนของประเทศเอเชียแปซิฟิก ตั้งแต่ปีพ.ศ. 2555 ถึง 2564 งานวิจัยนี้ระบุบริบทความสำคัญระดับโลกของแนวปฏิบัติ ESG โดยเน้นบทบาทของESGในการลดความเสี่ยงทางการเงินและการมีส่วนร่วมในตลาดการเงินที่ยั่งยืน การศึกษานี้แก้ไขช่องว่างด้านการวิจัยโดยการสำรวจภูมิภาคเอเชียแปซิฟิกโดยเฉพาะ โดยให้ข้อมูลเชิงลึกแก่นักลงทุน หน่วยงานกำกับดูแล และสังคม ผลลัพธ์ของแบบจำลองยืนยันความสัมพันธ์เชิงลบระหว่างประสิทธิภาพ ESG กับความเสี่ยงขาลง ยกเว้นด้านสิ่งแวดล้อมที่ไม่มีนัยสำคัญต่อความสัมพันธ์นี้ ผลลัพธ์นี้อาจสะท้อนถึงความแตกต่างในระดับภูมิภาคในมาตรฐานด้านสิ่งแวดล้อม การศึกษาเน้นถึงความสำคัญของการแยกส่วนตัวชี้วัด ESG เพื่อการประเมินความเสี่ยงที่แม่นยำ ผลลัพธ์เผยให้เห็นถึงความสัมพันธ์ที่ซับซ้อนระหว่างการวัด ESG การบังคับใช้กฎหมาย และความเสี่ยงทางการเงิน ความซับซ้อนนี้เกิดขึ้นเนื่องจาก ESG อาจมีผลกระทบต่อความเสี่ยงทางการเงินที่แตกต่างกันไป ขึ้นอยู่กับความเข้มงวดและลักษณะของการบังคับใช้กฎหมายในแต่ละประเทศที่แตกต่างกัน การค้นพบนี้มีส่วนสำคัญในการทำความเข้าใจความสัมพันธ์ระหว่าง ESG กรอบกฎหมาย และความเสี่ยงขาลงในภูมิภาคเอเชียแปรซิฟิก นักลงทุน รัฐบาล และผู้กำหนดนโยบายสามารถใช้ประโยชน์จากข้อมูลเชิงลึกเหล่านี้เพื่อจัดการความเสี่ยง เสริมสร้างกรอบทางกฎหมาย และส่งเสริมตลาดการเงินที่ยั่งยืนทั้งในประเทศที่พัฒนาแล้วและประเทศที่กำลังพัฒนา

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สาขาวิชา การเงิน ลายมือชื่อนิสิต .....

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Nattakij Summakarawa : Exploring the Link Between ESG Scores and Downside Risks of Stock Returns During Periods of Negative Shock: Evidence in APAC. Advisor: Asst. Prof. ROONGKIAT RATANABANCHUEN, Ph.D.

This study investigates the empirical association between Environmental, Social, and Governance (ESG) factors and downside risks in stock returns during negative shocks focusing on 13 countries within the Asia-Pacific (APAC) region. The study assesses ESG performance using combined ESG scores, E pillar, S pillar, G pillar and controversy scores, examining their impact on downside risk measured by Value at Risk (VaR) and Maximum Drawdown (MDD). The sample includes publicly traded companies across diverse APAC countries from 2012 to 2021. The research contextualizes the global significance of ESG practices, emphasizing their role in mitigating financial risks and contributing to sustainable financial markets. The study addresses a research gap by specifically exploring the APAC region, providing insights for investors, regulators, and society. The regression results confirm the negative relationship between ESG performance and downside risk, except for the Environmental pillar is not significant. This possibly reflects regional differences in environmental standards. The study emphasizes the importance of disaggregating ESG metrics for accurate risk assessment. Results reveal the complex interplay between ESG metrics, the rule of law, and financial risk. This complexity arises because ESG may have varying impacts on financial risk depending on the strength and nature of the rule of law in different jurisdictions. The findings contribute significantly to understanding the relationship between ESG aspects, legal frameworks, and downside risk in the APAC region. Investors, governments, and policymakers can leverage these insights to manage risk exposure, strengthen legal frameworks, and promote sustainable financial markets in both developed and emerging economies.

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Nattakij Summakarawa

จุฬาลงกรณ์มหาวิทยาลัย
Chulalongkorn University

TABLE OF CONTENTS

Page

จุฬาลงกรณ์มหาวิทยาลัย
Chulalongkorn University

INTRODUCTION

Objective

The study seeks to investigate the empirical association between the Environment, Social, and Governance (ESG) factors of firms, as measured by their respective scores in each component of E, S, G and controversy, and the level of downside risk inherent in stock returns during periods of negative shock, as indicated by metrics such as Value at Risk (VaR) and Maximum Drawdown (MDD)

Background and significance of the problems

The Environmental, Social, and Governance (ESG) practices of firms have become more than a mere trend. In developed nations, these practices have been made mandatory to ensure that firms are able to mitigate carbon emissions and contribute to the global effort to address climate change. Such efforts are aimed at achieving the goal of limiting the annual increase in global temperature to less than 1-2 degrees Celsius.

The growth of sustainable finance is driven by the increasing integration of ESG factors into investment decisions, leading to a rise in investments in sustainable activities. ESG investing is motivated by the desire to achieve both financial performance and environmental and social impact. ESG ratings play a crucial role in the implementation of these concepts. The objective of ESG investing is to incorporate long-term financial risks and opportunities, including controversies and downside risks, to enhance risk management and portfolio returns. This approach aims to integrate consistent ESG information into asset allocation and risk management decisions to generate sustainable financial returns (Eccles, Ioannou et al. 2012); (Ortiz-de-Mandojana and Bansal 2016)

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CHULALONGKORN UNIVERSITY

Furthermore, incorporating environmental, social, and governance (ESG) information can also support investors and stakeholders in ethical investing, where financial returns are not the primary objective. There is a growing demand among these investor types to align their investments with societal values, such as addressing climate change, promoting social justice and upholding corporate governance standards. Issuers that consider these societal issues are more likely to avoid controversies, enhance their reputations, retain customers and employees, and maintain the trust of shareholders, particularly during uncertain and transitional periods.

While the societal alignment of investments is crucial, sustainable finance aims to contribute to a better understanding of the extent to which ESG investment processes and practices strengthen transparency and market integrity. From Figure1 the top reason professional investors primarily consider ESG-related information not for reputational benefits, but to assess whether a company effectively manages risks and aligns its strategy for long-term returns. Recent investor surveys consistently highlight the pursuit of maximizing financial returns and enhancing risk management as key motivations for embracing ESG integration. Consequently, measuring downside risks becomes significant for investors to gain a clear understanding of their investment outcomes especially during negative shock. (Boffo and Patalano 2020)

Developing nations have begun to consider Environmental, Social, and Governance (ESG) practices as an alternative to traditional approaches, with a growing recognition that these practices are increasingly important for firms. While ESG considerations may not be as intensely utilized in developing countries as in other regions, firms in these nations are expected to increasingly prioritize ESG concerns in the near future, particularly given the impending introduction of a carbon border adjustment tax.

Given that we share the same planet, it is imperative that Environmental, Social, and Governance (ESG) considerations be viewed as a global standard that transcends national boundaries. Irrespective of location, ESG practices are of utmost importance for firms, as they seek to meet the evolving expectations of investors, regulators, and society as a whole.

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Chulalongkorn University

Accordingly, the present study will focus on the Asia-Pacific (APAC) regions as a sample population. Leading to the research question as the following.

Is there empirical evidence to support the notion that higher ESG scores effectively mitigate the downside risks of firms during periods of negative shock in the APAC region?

Would it be advisable for investors who are interested in APAC market seeking to minimize their risk exposure to consider investing in firms with high ESG scores, given the potential for greater downside risk protection during the shock?

Developing countries have the potential to generate returns as they have room for growth, which makes them attractive to investors worldwide. However, this also means that there is a higher possibility of experiencing higher downside risk compared to developed countries that have already established high standards of ESG integration.

Our research has two main contributions. Firstly, we will fill the research gap by conducting a study specifically within the APAC regions. This will provide valuable insights into the relationship between ESG aspects and downside risk in these markets, allowing us to compare our findings with previous studies conducted in developed markets. This comparative analysis will offer guidance to investors operating in emerging economies.

Secondly, we will examine the influence of ESG on investment performance across different countries, with a particular focus on the rule of law in each country. By analyzing the impact of the legal framework on downside risk, we aim to uncover how the strength of the rule of law affects investment risk. This analysis will provide important insights into how ESG aspects interact with downside risk in different jurisdictions, shedding light on the role of the rule of law in shaping this relationship.

Hypothesis development

In this section, we will discuss how ESG aspects such as environment pillar, social pillar and governance pillar affect stock performance during a downturn which represented by downside risk of the stock performance that is the stock return that could possibly generate a capital loss which we use value at risk to be a measurement of the downside risk of the stock and develop testable hypothesizes.

จุฬาลงกรณ์มหาวิทยาลัย
Chulalongkorn University

Value at Risk (VaR) is a commonly utilized approach to estimate the maximum financial risk investors may encounter within a specific timeframe under normal circumstances. According to (Hull 2012), VaR is a numerical representation that summarizes the overall risk associated with a portfolio. It is widely employed as a method for assessing total risk. Our hypothesis posits that the environmental, social, and governance (ESG) performance, encompassing the E, S, and G pillars of companies, has a negative impact on the value at risk of stock performance. In addition to the aforementioned findings, (Orlitzky and Benjamin 2001) discovered that corporate social responsibility (CSR) reputation has an impact on firm risk. They also

noted that a firm's ESG reputation is influenced by media coverage regarding its engagement in controversial matters, which subsequently amplifies firm risk. As the ESG Controversy Score increases, a firm becomes less embroiled in controversy. This observation leads to a hypothesis.

H1a: ESG performance measured by combined ESG score and ESGC pillar scores negatively affect value at risk (VaR).

Because VaR cannot capture all of the risk that could happen with the stock performance. So, Maximum Drawdown (MDD) is a risk metric used in finance to quantify the largest decline in an investment's value over a specified time period. It measures the percentage loss from the peak value of an investment to its lowest point (trough) before a new peak is attained. Incorporating MDD into investment decision-making can help investors better manage their risk exposure, allocate assets more effectively, and implement appropriate risk management strategies. By considering MDD in conjunction with other risk measures, investors can improve their overall investment process and enhance their long-term financial outcomes. We hypothesize that Maximum Drawdown (MDD) and Value at Risk (VaR) share a similar relationship as they both capture left-tail risk. However, we expect MDD to have a larger magnitude than VaR because it reflects the largest decline in past returns. This leads us to formulate an additional hypothesis for our study.

H1b: ESG performance measured by combined ESG score and ESGC pillar scores negatively affect MMD.

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Chulalongkorn University

(Cai, Pan et al. 2016) found that Countries with strong civil liberties and political rights, and cultures oriented toward harmony and autonomy (country factors) tend to have higher CSP ratings. The study uses data from the MSCI ESG Intangible Value Assessment (IVA) database, providing a worldwide sample for analyzing CSP ratings. These country factors can suggest that effective law enforcement is a contributing factor. The rule of law (ROL) can be measured using the worldwide governance indicators from the World Bank (Kaufmann, Kraay et al. 2011). According to our earlier hypothesis (H1), an increase in ESG is associated with a decrease in downside risk.

Specifically, we hypothesize that the interaction between ESG performance and the rule of law will result in an amplification of the impact on downside risk. In the

presence of higher rule of law, we expect a stronger relationship between ESG performance and downside risk, indicating that firms with higher ESG scores will experience a greater reduction in downside risk when operating in countries with a stronger legal framework. This highlights the critical role of the rule of law in shaping the relationship between ESG performance and downside risk. Based on this, we propose the following hypothesis.

H2: The relationship between a firm's ESG performance and downside risk is influenced by the strength of the rule of law (ROL).

The relationship between ESG performance and downside risk may vary between developed and emerging countries. Developed countries typically have more mature ESG frameworks, stricter regulations, and higher market expectations for sustainable practices. As a result, the impact of ESG performance on downside risk might be more pronounced in developed countries. In contrast, emerging countries may still be in the process of developing their ESG frameworks and regulatory mechanisms. The enforcement of ESG practices might be less rigorous, leading to a potentially weaker association between ESG performance and downside risk compared to developed countries.

By examining the relationship between ESG performance and downside risk across both developed and emerging countries, the study aims to provide insights into the similarities and differences in this relationship. This will enhance our understanding of the role of ESG practices in mitigating downside risk. Leading to this following hypothesis.

จุฬาลงกรณ์มหาวิทยาลัย
Chulalongkorn University

H3: The association between ESG performance and downside risk differs between developed and emerging countries.

LITERATURE REVIEW

In recent years, there has been a growing recognition of the importance of considering environmental, social, and governance (ESG) factors in business. The UN Principles of Responsible Investment (UNPRI) is a United Nations-supported international network of financial institutions working together to implement its six aspirational principles (Sjåfjell and Richardson 2015). UNPRI have played a significant role in supporting the ESG trend, particularly in Europe. However, APAC regions have been slower to hold the UNPRI, despite the fact that they face higher vulnerabilities related to ESG issues. According to the PRI public signatory reports from 2014 to 2020, all of the signatories collectively amount to 2,191 databases. The majority of these signatories, specifically 1,208 (55.1%), are from Europe. In contrast, Asia and Oceania contribute a relatively smaller number of signatories, with only 157 (7.2%) and 159 (7.3%) respectively. These figures highlight a significant discrepancy in ESG adoption between Europe and the Asia/Oceania regions. ESG studies on emerging equities are relatively scarce. Institutional investors are consistently active in driving firms to increase E&S performance only if they are from countries with strong E&S social norms (Dyck, Lins et al. 2019).

ESG and stock performance

According to the study by (Albuquerque, Koskinen et al. 2020), which utilized U.S. stocks in the Refinitiv database as their primary data source, firms with high environmental and social (ES) scores exhibited better stock market performance compared to other firms. This performance was particularly strong during the market collapse caused by the COVID-19 pandemic, especially for high ES stocks with high advertising. Additionally, firms with high ES scores experienced an increase in their operating profit margin, and the volatility of stock returns was lower for high ES stocks. Moreover, firms held by investors who prioritize ES considerations showed larger reductions in stock return volatility. Similar findings were reported by (Flammer 2013) in a study on U.S. publicly traded companies. The research revealed that companies demonstrating responsible environmental behavior witnessed an increase in their stock prices compared to those with environmentally harmful practices. This suggests that investors display optimism towards companies that prioritize ESG matters. In a European context, (Abate, Basile et al. 2021) examined the relationship between

จุฬาลงกรณ์มหาวิทยาลัย
CHULALONGKORN UNIVERSITY

sustainability and mutual fund performance using ESG ratings. Their analysis, based on a sample of 634 European mutual funds, indicated that funds with high ESG ratings outperformed funds with low ESG ratings. These studies collectively demonstrate the positive impact of ESG performance on stock market performance, investor reactions, and mutual fund performance in different regions, namely the U.S. and Europe.

However, there is evidence suggesting that the impact of ESG on investment performance may vary across different countries. (Van Duuren, Plantinga et al. 2016) examined the integration of ESG in the investment process and found significant differences between American and European fund managers. Similarly, (Cesarone, Martino et al. 2022) discovered contrasting outcomes. They found that in the US markets, imposing a high ESG target tended to select portfolios with better financial performance compared to other strategies. However, in European markets, the ESG constraint did not seem to improve portfolio profitability. Furthermore, evidence from Asia-Pacific countries was examined by (Tan, Szulczyk et al. 2023). Their study focused on China, Malaysia, Singapore, Australia, and Hong Kong. It remains unclear whether investment opportunities with a strong ESG proposition can generate superior investment performance in these markets. More research is needed to provide clearer guidance for investors, especially in emerging markets where such evidence is lacking. Therefore, the influence of countries on the relationship between ESG aspects and price performance is substantial. (Cai, Pan et al. 2016) have already tested and confirmed the significant impact of countries on corporate social performance. Overall, these studies highlight the importance of considering country-specific factors when assessing the relationship between ESG and investment performance. Different markets may exhibit varying outcomes, emphasizing the need for further research to guide investors, particularly in emerging economies.

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ESG and downside risk

There is a limited amount of research that specifically investigates the relationship between ESG aspects and downside risk. Most studies in this area focus on stock performance, leaving a gap in the literature. However, it is worth noting that several papers addressing downside risk have been conducted by practitioners from Europe. This observation sparked my interest in studying the relationship between ESG aspects and downside risk within the APAC regions. I aim to determine whether the

findings align with those from studies that have predominantly used developed markets as their sample.

(Hoepner, Oikonomou et al. 2018) examined this relationship using a sample that consisted of companies from various countries. Specifically, they included companies from the US (313 or 18%), UK (278 or 16%), Japan (104 or 6%), South Korea (70 or 4%), France and Germany (each around 4%), and Brazil (3%). Their findings indicated that shareholder engagement on ESG topics can contribute to a reduction in downside risk. The effectiveness of risk reduction varied across different ESG engagement themes, with environmental topics having the most significant impact. Within this category, climate change emerged as a primary concern. However, it is important to note that their sample included companies from various nations worldwide.

To bridge the research gap and provide insights specific to the APAC regions, it is crucial to conduct a study focused on this geographical area. By exploring the relationship between ESG aspects and downside risk within APAC markets, we can determine if the results align with or differ from previous studies conducted in developed markets.

The study conducted by (Lööf and Stephan 2019) focused on examining the impact of ESG factors on stocks' downside risk and risk-adjusted returns. Their research specifically investigated five European countries: Sweden, Germany, France, the United Kingdom, and the Netherlands. To analyze the data, they employed the Fama-French three-factor model along with ESG factors.

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The findings of their study have important implications for both investors and companies. Reduced downside risk is advantageous for investors as it decreases the likelihood of extreme negative returns. For companies, a decrease in downside risk can lead to a lower cost of capital. When a company's ESG performance improves and its downside risk decreases, not only equity investors but also debt holders such as banks may demand lower interest rates on the company's loans.

Based on the results obtained from these predominantly developed countries, we can conclude that ESG aspects have a negative impact on downside risk. The environmental pillar appears to have the most significant influence, as developed countries exhibit a greater concern for climate change. Consequently, firms that do not

prioritize environmental sustainability face more significant market penalties or lawsuit in developed countries compared to developing countries. Compliance with ESG standards is mandatory for firms operating in Europe, suggesting that the rule of law in these countries may be a key differentiating factor between developing and developed nations.

จุฬาลงกรณ์มหาวิทยาลัย
CHULALONGKORN UNIVERSITY

DATA

Sample

13 countries within the Asia-Pacific Economic Cooperation (APAC) region, namely Australia, China, Hong Kong, India, Indonesia, Japan, South Korea, Malaysia, Philippines, Russia, Singapore, Taiwan and Thailand.

We selected the Asia-Pacific regions (APAC) region as the focal point of our research due to the lack of prior studies linking ESG performance to downside risk measures within the APAC context. Previous research on this subject primarily focused on countries with larger economies, as demonstrated by the study conducted by (Hoepner, Oikonomou et al. 2018) encompassing various nations worldwide. Additionally, given the APAC region's reputation for hosting rapidly growing emerging markets, it becomes crucial to explore these topics in this specific region. Furthermore, we aim to address the question of whether consistent results exist within the APAC region when compared to the global context, with a particular focus on examining the magnitude of the impact.

The research sample encompassed publicly listed firms in the Asia-Pacific (APAC) region that had established their ESG scores through Thomson Reuters ESG Research. The study period spanned from 2012 to 2021. Each year, there were a total of 1,256 APAC firms that possessed their own ESG scores as provided by Thomson Reuters ESG Research. The firm count for each country was Australia, 190 firms (15.13%); China, 71 firms (5.65%); Hong Kong, 149 firms (11.86%); India, 74 firms (5.89%); Indonesia, 28 firms (2.23%); Japan, 377 firms (30.02%); South Korea, 95 firms (7.56%); Malaysia, 43 firms (3.42%); Philippines, 20 firms (1.59%); Russia, 29 firms (2.31%); Singapore, 38 firms (3.03%); Taiwan, 121 firms (9.63%) and Thailand, 21 firms (1.67%). This sample exclusively included firms with ESG data with complete ESG scores for ten consecutive years provided by Refinitiv, as firms lacking ESG scores were excluded. Subsequently, after filtering for firms with all specified control variables, the final observation count was 10,565 data points, down from the initial 12,560 data points. This represents a data cleaning process that removed 1,995 data points, or approximately 16% of the original sample.

Table 1 below summarized the distribution of firms across countries in both the developed and emerging markets.

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Table1 Firm-year distribution across country

Country	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
Australia	148	150	150	134	143	148	147	150	148	143
China	51	53	57	61	56	61	61	62	61	59
Hong Kong	121	117	113	118	122	129	134	126	116	115
India	67	64	66	65	65	63	61	58	58	56
Indonesia	27	25	23	23	25	25	27	26	25	21
Japan	311	319	327	338	345	355	355	361	343	349
South Korea	77	77	85	90	90	91	89	88	42	75
Malaysia	31	36	36	37	37	38	39	39	38	39
Philippines	17	16	17	18	17	19	20	19	16	19
Russia	17	18	19	17	18	20	15	15	14	20
Singapore	33	35	35	34	35	33	34	32	33	34
Taiwan	100	107	99	103	100	100	93	98	84	83
Thailand	20	20	21	21	21	21	21	21	21	21
Total	1020	1037	1048	1059	1074	1103	1096	1095	999	1034

Table 2 below summarized the distribution of firms across the industry classification based on the Global Industry Classification Standard (GICS).

Table2 Firm-year distribution across sector

Sector	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
Communication Services	56	57	56	55	57	57	57	55	53	54
Consumer Discretionary	125	129	130	131	134	135	136	136	119	126
Consumer Staples	71	73	70	76	77	79	79	77	77	78
Energy	47	52	52	49	49	52	51	49	45	49
Financials	136	135	142	149	150	146	147	149	130	137
Health Care	44	43	40	44	46	49	48	48	47	47
Industrials	198	198	200	200	202	214	210	214	190	200
Information Technology	100	103	105	104	109	113	111	109	101	100
Materials	130	129	135	133	132	138	140	143	129	135
Real Estate	66	65	67	68	67	71	69	68	64	62
Utilities	47	53	51	50	51	49	48	47	44	46
Total	1020	1037	1048	1059	1074	1103	1096	1095	999	1034

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Table 1 and Table 2 provide a detailed distribution of firm-year observations across different countries and sectors for the period from 2012 to 2021. In Table 1, we observe the country-wise distribution, where Japan consistently has the highest number of firms throughout the period, suggesting a significant Japanese presence in

the dataset, while other countries like Indonesia and the Philippines represent smaller but integral parts of the regional market structure. On the other hand, Table 2 categorizes these observations by sectors following the Global Industry Classification Standard (GICS). It shows that the Industrials sector has a dominant presence with an increasing trend up to 2017 and maintains high representation, while sectors like Energy and Utilities have a more modest and stable representation over the years. Both tables also highlight a decrease in total firm-year observations in 2020, which could be associated with the global economic impact of the COVID-19 pandemic, affecting the number of reporting firms or the capacity for data collection. Collectively, these tables illustrate the diverse and dynamic composition of the Asia-Pacific market in terms of both geographical and sectorial presence, reflecting the multifaceted nature of economic activity in the region over a decade.

Independent variable

In order to determine the appropriate use of ESG performance as our independent variables in the study, it is essential to have a thorough understanding of the background knowledge. This understanding will guide us in making an informed decision regarding the selection and implementation of ESG performance in our research.

ESG ratings are derived from established ESG providers such as MSCI, Sustainalytics, Bloomberg, Thomson Reuters, and RobecoSAM. Also, traditional ratings agencies such as Moody's, S&P and Fitch now also provide forms of ESG ratings.

Pro: Offer assessments of issuers based on ESG disclosures, providing sustainability metrics and information for ESG scores.

Con: Variability in methodologies used by different providers may lead to inconsistencies in ratings and comparability.

ESG indices play a crucial role in promoting the expansion of ESG investing by serving as a foundation for the development of active and passive strategies in funds and ETFs. To facilitate this, a rising number of independent analytical firms, including index providers and rating agencies like MSCI, FTSE Russell, Bloomberg, Thomson Reuters, Vigeo Eiris, and others, contribute to the growth of ESG investing.

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Pro: Provide benchmarks for tracking the relative performance of ESG tilted portfolios, allowing for portfolio comparisons and investment product development.
Con: The construction of indices, including exclusions and tilting strategies, can influence overall ESG portfolio management but may lack standardization.

These providers employ distinct methodologies, yet their ultimate ratings serve a common purpose: aiding market investors in identifying companies that have adopted superior ESG practices. Consequently, analyzing these methodological approaches becomes valuable in comprehending the factors that contribute to the final ESG ratings. The impact of ratings providers, the variations in ratings methodologies, and the transparency levels in the final rating decisions, which encompass qualitative assessments, are vital factors in understanding the robustness of the ESG financial intermediation process.

Various ESG data providers utilize different criteria to rank companies based on their sustainability performance. These providers evaluate multiple aspects related to sustainability, which are then consolidated into a comprehensive metric reflecting a company's overall sustainability performance. For instance, MSCI and Sustainalytics offer services that assist investors in identifying and comprehending financially relevant ESG risks and opportunities. Their aim is to enable investors to incorporate these factors into their portfolio construction and management processes.

Thomson Reuters employs a wide range of more than 400 ESG metrics. However, they select a subset of 186 fields with a historical record dating back to 2002. These metrics are classified into ten categories, such as resource use, emissions, innovation, workforce, human rights, community, product responsibility, management, shareholders, and CSR strategy. By combining these categories, Thomson Reuters generates three pillar scores representing the Environmental, Social, and Governance aspects of a company's sustainability performance.
On the other hand, Bloomberg offers its proprietary ESG data that primarily focuses on selecting metrics that capture environmental and social impact. Industries are categorized into broad groups based on their environmental impact (higher, medium, and lower) and social impact (higher and lower), while governance metrics remain consistent across industries. This approach helps investors assess companies within their respective industry contexts. These ESG data providers offer valuable information

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to investors, enabling them to make informed decisions by considering the sustainability performance of companies across different dimensions (Boffo and Patalano 2020). Table3

The lack of comparability among ESG metrics, ratings, and investing approaches makes it challenging for investors to determine how to manage material ESG risks while pursuing ESG outcomes that may require a trade-off in financial performance. The use of ESG information by investors relies heavily on company disclosures, but even with access to the same information, ESG scores from major ratings providers can vary significantly (Fatemi, Glaum et al. 2018). This discrepancy is attributed to differences in methodologies, leading to diverse results for individual issuers. Consequently, the choice of rating provider can drive the inputs for securities selection and weighting, resulting in radically different exposures and undermining the overall meaning of the ESG investing process. Inconsistencies and lack of transparency also affect the metrics used by companies and data providers. Despite using similar frameworks, major market data providers like Bloomberg, Thomson Reuters FTSE, MSCI, and Sustainalytics have distinct methodologies, resulting in low correlation among the scores assigned to the same companies. An analysis of different rating providers, such as Bloomberg, MSCI, and Refinitiv, revealed wide differences in ratings when examining specific indices like the S&P 500. This indicates that companies ranked highly by one provider may receive significantly lower scores from others, depending on the metrics used, weighting, qualitative judgment, and company disclosure. Figure2

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A study conducted by (Berg, Kölbel et al. 2020) examined the variation in environmental, social, and governance (ESG) ratings provided by five different sources. The research identified three main factors that contribute to the differences in ratings: variations in the scope of ESG assessments, differences in weighting methodologies, and variances in measurement approaches. The study revealed that the scope of ESG ratings had the greatest impact on the assessment of ESG categories, accounting for over 50% of the variations observed. The remaining differences were attributed to variations in weighting and measurement methods.

These findings raise concerns about the meaning and value of current ESG scores for investors. The differences in frameworks, measures, key indicators, metrics,

data usage, qualitative judgment, and subcategory weighting among rating providers can significantly impact the ratings assigned to companies. Such variations in ESG ratings across providers can undermine the reliability of ESG portfolios that heavily rely on higher-rated firms. To gain a better understanding of these differences, it is advisable for investors to review the methodologies employed by prominent ESG rating providers in the investment industry. By paying attention to these variations, investors can recognize the need for additional due diligence when utilizing third-party ESG ratings and better comprehend the factors contributing to diverse outcomes.

The use of different ESG rating criteria by various data providers can introduce uncertainty when predicting the relationship between downside risk of stock returns and ESG factors. This uncertainty arises because each data provider may prioritize different aspects of ESG and employ unique methodologies to assess company sustainability. As a result, the ratings assigned to companies may vary depending on the specific ESG criteria used by each data provider. This variation can lead to different predictions and interpretations of the linkage between ESG factors and downside risk of the stock return. The utilization of a scoring method seems the most suitable approach due to its ability to evaluate issuers based on ESG disclosures, thereby providing sustainability metrics and information for ESG scores. Using a scoring method is beneficial as it allows for the combination of both quantitative and qualitative data, making data analysis easier (Boffo and Patalano 2020).

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However, selecting the most appropriate ESG measurement for the study is subjective. Personally, I would choose data sourced from Refinitiv as it provides easy accessibility and encompasses ESG combined scores, scores for each ESG pillar, and ESG controversy scores. Nonetheless, this may cause inconsistencies in ratings and comparability, prompting the consideration of an alternative ESG provider to ensure robustness within the study.

Refinitiv data

ESG Score provide a rounded and comprehensive scoring of a company's ESG performance, based on the reported information pertaining to the ESG pillars.

ESG controversies overlay captured from global media sources. The main objective of this score is to discount the ESG performance score based on negative media stories. It does this by incorporating the impact of significant, material ESG

controversies in the overall ESGC score. When companies are involved in ESG controversies, the ESGC score is calculated as the weighted average of the ESG scores and ESG controversies score per fiscal period, with recent controversies reflected in the latest completed period. When companies are not involved in ESG controversies, the ESGC score is equal to the ESG score. Figure3

If controversies score is >=ESG score, then ESG score = ESGC score

If controversies score is <ESG score, then ESGC score = average of ESG and controversies score

So, we use combined ESG score and ESGC scores in each pillar as independent variables.

Rule of Law (ROL)

Uses data from Worldwide Governance Indicator rule of law index provided by world bank (Kaufmann, Kraay et al. 2011). The index has the number between 0-100 for ranking the level enforcement of the law.

Dependent variable

Stocks are widely favored by investors as they offer the potential for attractive returns in the financial market. However, it's important to acknowledge that investments, including stocks, carry inherent risks. Financial risk refers to the potential loss that investors may encounter, which could result in either a reduction of invested capital or missed profit opportunities. In the context of stock transactions, losses occur when investors sell their shares at a price lower than the purchase price, leading to a capital loss.

The fluctuations in stock prices are influenced by a combination of internal and external factors associated with the company. Internal factors encompass elements such as management, reputation, financial performance, company governance, and product offerings. External factors, on the other hand, include political dynamics, regional and global economic conditions, technological advancements, regulatory frameworks, consumer purchasing power, and competitive landscape. Investors have the expectation of attaining maximum returns while managing a certain level of risk. Hence, it is crucial for investors to possess the ability to assess and measure the risks associated with each investment they undertake.

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The dependent variable in the study will be measured using two separate metrics of downside risk, namely Value at Risk (VaR) and Maximum Drawdown (MDD). The use of both metrics will be employed to test, given that VaR only captures the normal distribution of expected returns, whereas MDD can capture outliers in the data.

Value at Risk (VaR)

VaR can be calculated using different methods, including the historical method, variance-covariance methods, and Monte Carlo simulation. The determination of VaR using the historical and variance-covariance approaches was introduced by (Irsan, Kasau et al. 2019).

VaR, at a given probability level α, refers to the estimated financial loss that a portfolio may experience over a specific time horizon, as defined by (Degiannakis, Floros et al. 2012). It is an attempt to quantify the maximum potential capital loss that could occur within a defined period, as explained by (Wirch 1999).

In determining VaR, three essential elements need to be considered: the potential loss amount, the specific time period for which the risk is estimated, and the probability or reliability of the loss, as outlined by (Bogdan, Baresa et al. 2015).

(Bogdan, Baresa et al. 2015) describe three fundamental methods for calculating VaR:

Historical method: This approach is widely utilized by both financial and non-financial institutions due to its simplicity and adaptability. The historical method relies on past market prices to assess the potential loss based on historical scenarios.

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Variance-Covariance method: Also known as the parametric method, this technique employs two key variables: the mean yield rate and the standard deviation of the data. The parametric method assumes that the yields of securities follow a normal distribution that corresponds to a theoretical distribution, such as Gauss's. It requires the assumption that the yield distribution is normally distributed.

The Monte Carlo method: The stochastics methods that requires computer simulation of various influences on the observed portfolio of securities.

To calculate VaR using the methods mentioned above, the initial step is to calculate the return of the stock price. The return price can be determined through the following process:

$$R = \frac{P_1 - P_0}{P_0}$$

Where, P_i is the price at time t and R is the return

The historical VaR method is commonly used to calculate VaR because it doesn't assume a specific distribution for returns, making it flexible and adaptable. It relies solely on observed historical data, reflecting the actual behavior of the market or investment being analyzed. Implementing historical VaR is straightforward: it involves sorting historical returns and identifying the value at a specific quantile for the desired confidence level. This simplicity makes it accessible and easier to explain to stakeholders.

However, it's important to note that historical VaR may not capture tail risk or extreme events that haven't occurred in the historical data. Therefore, it's advisable to complement historical VaR with other risk measures and consider its limitations when making risk management decisions. We are using the historical method with weekly frequency to calculate VaR for our study, aiming to estimate the yearly VaR. This approach allows us to utilize historical data without assuming a specific return distribution. By sorting the weekly returns and applying the desired confidence level, we can determine the potential loss over a one-year period. Specifically, we utilize the "percentile.inc" function in Microsoft Excel with a confidence level at 95% to extract the Value at Risk for a one-year horizon from the weekly returns.

Maximum Draw Down (MDD)

Investors and fund managers commonly use MDD to assess the historical risk of various assets and investment strategies. MDD is an important risk assessment tool because it captures the worst-case scenario for an investment, providing insight into the potential magnitude of losses during periods of market turmoil. By understanding the MDD of various assets, investors can better assess their risk tolerance and make more informed decisions about asset allocation, investment strategies, and risk management. By combining multiple risk measures, investors can better understand their investments' risk profiles. In our study, we employ closing prices on a weekly frequency basis to calculate MDD, specifically targeting the estimation of yearly MDD. This approach

allows us to evaluate the potential loss over a one-year duration. The following steps outline the methodology employed for MDD computation. Firstly, we utilize closing prices on a weekly basis. Secondly, we identify peak values within each time period, focusing on data points from week 1 to week 52 of each year. This facilitates the computation of peak values over a one-year span. To ensure the peak value consistently precedes the trough value, we organize the peak values chronologically from week 1 to week 52. Thirdly, we calculate drawdown values by subtracting the current period's value from the corresponding peak value (drawdown value = current value – peak value). In cases where the current value exceeds the peak value, I designate the drawdown value as "none" This approach ensures drawdown values are computed under the condition that the peak value precedes the trough value. Fourthly, we determine the percentage drawdown by dividing the drawdown value by the peak value. Once we have the percentage drawdown, we can ascertain the Maximum Drawdown by employing the "min" function in Microsoft Excel, which identifies the most significant drawdown value among the calculated percentage drawdowns. These steps collectively constitute the methodology employed in calculating MDD.

$$MMD = \frac{trough\ value - peak\ value}{peak\ value}$$

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Control variable

Several control variables were considered to account for potential influences on an individual firm's downside risk. One control variable was firm size (SIZE), which was measured by the natural logarithm of total assets. Previous studies, such as (Jo and Na 2012), have indicated that larger firms are typically more adept at managing risk and are thus less exposed to downside risk, especially during periods of high volatility.

Another control variable was the market-to-book ratio (MTB), which was based on research by (Lewellen 1999). Analysts tend to associate firms with lower market-to-book ratios as having higher exposure to downside risk, implying greater riskiness.

The variable of leverage (LEV) was also controlled for, measured by the total debt to total assets ratio. (Lewellen 1999) suggested that firms with higher leverage in their capital structure are more prone to increased downside risk.

Furthermore, profitability, measured by return on assets (ROA), was included as a control variable. Prior findings, as noted by (Jo and Na 2012), suggest that more profitable firms tend to have lower downside risk.

Lastly, asset growth (ASGR) was controlled for, as previous studies by (Jo and Na 2012) indicate that firms with higher asset growth generally exhibit greater downside risk.

Size of the firms (SIZE) as measured by natural logarithm to total assets because prior studies showed a negative relationship between size and firm's downside risk. Because they are more able to manage risk, especially in times of high volatility.

Market-to-book ratio (MTB) based on a study expected a negative relationship between downside risk and MTB.

Leverage (LEV) is measured by the total debt to total assets ratio. We expected a positive relationship between leverage and downside risk.

Profitability measured by (ROA) since previous findings suggested a negative relationship between profitable firms and downside risk.

Asset growth of a firm (ASGR) measured by total assets in year t minus total assets in year t-1 divided by total assets in year t–1. There is a positive relationship between asset growth and downside risk.

Industrial fixed effect (Industrial FE) when collecting the data from Refinitiv. There provides a sector of the firms in the sample which they provide things called "GICS" classifying each firm into their industries by using dummy variable to specify firm's industries.

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Country-fixed effect (CountryFE) controls for time-invariant unobserved country characteristics that perhaps impact both ESG performance and downside risk, as individual countries might have different ESG regulations.

Time-fixed effect (Time FE) controls for variables that are constant across firms but vary over time.

EMPIRICAL MODELS AND METHODOLOGY

1. The link between ESG performance and downside risk

According to the Hypothesis 1 mentioned earlier, to investigate the relationship between ESG pillars scores and Downside risk. This research does a regression model as below using OLS.

$$Downside\ risk_{i,c,t} = \alpha_0 + \beta_1 ESGscores_{i,c,t} + \beta_2 SIZE_{i,c,t} + \beta_3 MTB_{i,c,t} + \beta_4 LEV_{i,c,t} + \beta_5 ROA_{i,c,t} + \beta_6 ASGR_{i,c,t} + \beta_7 GICS_{i,c,t} + \beta_8 Country\ FE_{i,c,t} + \beta_9 Time\ FE_{i.c.t} + \varepsilon_{i.c.t}$$-----(1)

i represent for the firm, c represent for the country and t represent for the time. The dependent variable is $Downside\ risk_{i,c,t}$ of the stock performance of each firm which measured by VaR and MDD, the values of downside risk are negative number. The independent variable is $ESG\ score_{i,c,t}$ which including combined ESG score and ESGC pillar scores. Control variables are included in the model that is size of the firm, market-to-book ratio, leverage, profitability and asset growth of a firm. These can influence downside risk and ESG scores across the firms but constant through time. Industrial fixed effect uses The Global Industry Classification Standard ($GICS_{i,c,t}$) as a dummy variable to classify the industry of that firm which affect downside risk and ESG scores but constant through time. Also, Countries fixed effect may use in order to control over the countries that may influence downside risk and ESG scores but constant through time. Time fixed effects vary across the time but constant across downside risk and ESG scores of firms. α_0 is a constant and $\varepsilon_{i.c.t}$ is an error term of the regression model.

We expected that β_1 of the equation1 should be positive as the hypotheses that we mentioned earlier in H1a and H1b which are showed the negative relationship between ESG performance including combined ESG score and ESGC pillar scores and downside risk including VaR and MDD.

2. The relationship between a firm's ESG performance and downside risk is influenced by the strength of the rule of law (ROL).

According to the hypothesis 2 mentioned earlier, investigated that higher ROL index has less affect downside risk than lower ROL index. The interaction effect of ESG and ROL ($ESG\ scores * ROL_{i,c,t}$) provides insights into how the relationship

between ESG performance and downside risk may be influenced by the presence of the ROL. It will help to determine whether the impact of ESG performance on downside risk differs between higher ROL score index and lower ROL score index. This research does a regression model as below using OLS.

$$Downside\ risk_{i,c,t} = \alpha_0 + \beta_1 ESGscores_{i,c,t} + \beta_2 ROL_{i,c,t} + \beta_3 ESG\ scores * ROL_{i,c,t} + \beta_4 SIZE_{i,c,t} + \beta_5 MTB_{i,c,t} + \beta_6 LEV_{i,c,t} + \beta_7 ROA_{i,c,t} + \beta_8 ASGR_{i,c,t} + \beta_9 GICS_{i,c,t} + \beta_{10} Time\ FE_{i,c,t} + \varepsilon_{i.c.t}$$-----(2)

Rule of Law $(ROL)_{i,c,t}$ uses data from WGI rule of law index that provide the index between 0-100 for ranking the level enforcement of the law. Under the hypothesis, higher ROL index score more mitigate downside risk than lower ROL index score.

We expected that β_2 of the equation 2 should be positive as following by the hypothesis 2 that we mentioned which is showed the negative relationship between ROL and downside risk.

We expected that β_3 the interaction variable in the equation 2 will be significantly positive value, this finding would support our hypothesis 2 that the impact of ESG performance on downside risk is amplified when there is a stronger rule of law in place. In other words, a higher level of ESG performance is expected to have a more pronounced effect in reducing downside risk when accompanied by a strong legal framework. This can be attributed to several key factors. Firstly, increased scrutiny and accountability in countries with strong legal frameworks mean that firms face greater oversight and accountability for their ESG-related actions, thereby driving improved practices and transparency, reducing the likelihood of unforeseen risks. Additionally, firms operating in regions with higher legal standards are perceived as more responsible and reliable, attracting long-term investors and loyal customers, which, in turn, leads to market stability with reduced volatility. Moreover, adherence to stricter legal standards often prompts companies to adopt more efficient operational practices, resulting in cost savings and long-term risk mitigation. Lastly, companies within robust legal frameworks are less likely to be embroiled in controversies related to ESG issues, protecting them from potential reputational damage that could adversely impact stock prices.

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3. The association between ESG performance and downside risk differs between developed and emerging countries.

$$Downside\ risk_{i,c,t} = \alpha_0 + \beta_1 ESGscores_{i,c,t} + \beta_2 Developed_{i,c,t} + \beta_3 ESGscores * Developed_{i,c,t} + \beta_4 SIZE_{i,c,t} + \beta_5 MTB_{i,c,t} + \beta_6 LEV_{i,c,t} + \beta_7 ROA_{i,c,t} + \beta_8 ASGR_{i,c,t} + \beta_9 GICS_{i,c,t} + \beta_{10} Time\ FE_{i,c,t} + \varepsilon_{i.c.t}$$-----(3)

Developed countries ($Developed_{i,c,t}$) will be measured through a dummy variable that takes a value of 1 if it is developed country, and a value of 0 if it is emerging country. Interaction term will be present in the equation 3 as $ESGscores * Developed_{i,c,t}$. Under the hypothesis 3, level of market development assigns incremental importance to ESG performance. When there is a developed country, typically have more mature ESG frameworks, stricter regulations, and higher market expectations for sustainable practices, the impact of ESG performance on downside risk might be more pronounced in developed countries.

We expected that β_2 of the equation 3 should be positive as following by the hypothesis 3, we mentioned that in developed country has negatively impact to downside risk.

Also, the hypothesis 3 predicts that the coefficient of $\beta_3\ ESGscores * Developed_{i,c,t}$ will be positively impact to downside risk which means lower the risk. In developed countries, firms with better ESG performance may have more pronounced effect in reducing downside risk.

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RESULT AND DISCUSSION

Descriptive statistic

Table 4: Descriptive statistic

VARIABLES	Observation	mean	s.d.	min	p25	median	p75	max
Dependent variables								
VaR	10,565	-0.0637	0.0275	-0.318	-0.076	-0.0584	-0.0449	0
MDD	10,565	-0.273	0.142	-0.98	-0.352	-0.242	-0.168	-0.00192
Independent variables								
ESGcombined	10,565	46.4	20.52	1.189	30.83	47.69	62.28	92.49
Escore	10,565	45.28	27.65	0	21.45	48.12	67.99	98.64
Sscore	10,565	45.14	25.06	0.0527	24.88	45	65.41	97.13
Gscore	10,565	52.08	22.8	0.101	34.07	53.12	70.71	99.34
CS	10,565	93.52	18.87	0.562	100	100	100	100
ROL	10,565	80.75	18.62	19.23	81.25	89.42	91.35	98.56
Control variables								
SIZE	10,565	22.95	1.725	14.15	21.87	22.88	23.94	29.34
MTB	10,565	2.073	2.438	0.00444	0.823	1.292	2.248	16.45
LEV	10,565	0.538	0.223	0.00702	0.371	0.533	0.696	1.226
ROA	10,565	0.0514	0.0667	-0.652	0.0163	0.0405	0.0752	0.775
ASGR	10,565	0.0517	0.151	-0.938	-0.0299	0.0378	0.114	0.719
Developed	10,565	0.775	0.418	0	1	1	1	1

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The table 4 delineates the descriptive statistics for a dataset representing firms within the Asia-Pacific region, spanning 13 countries with a total of 10,565 observations. The data, compiled annually from 2012 to 2021, is divided into three primary categories: dependent variables, independent variables, and control variables.

Dependent Variables

Value at Risk (VaR) from Weekly Returns: The average VaR is approximately -6.37%, pointing to a typical risk value within the dataset. The distribution of VaR is left-skewed, indicating that the mean is lesser than the median and suggesting that a majority of firms experience higher levels of risk. The data varies around this mean with a standard deviation of 2.75%. The range of VaR spans from a minimum of -31.8%

to a maximum of 0%, with the 25th, 50th (median), and 75th percentiles being -7.6%, -5.84%, and -4.49%, respectively.

Maximum Drawdown (MDD) from Weekly Closing Prices: The average MDD stands at approximately -27.3%. Intuitively, MDD exhibits a higher mean than VaR, given that MDD measures more extreme downside risks compared to VaR. Similarly, to VaR, the distribution for MDD is also left-skewed. The variability from this mean is represented by a standard deviation of 14.2%. MDD ranges from a significant low of -98% to a high of -0.192%, with its quartiles marked at -35.2% (25th percentile), -24.2% (median), and -16.8% (75th percentile).

Independent Variables

Environmental, Social, and Governance (ESG) Combined Score: The average ESG score for the firms is 46.4, with a standard deviation of 20.52. This score ranges from a minimum of 1.189 to a maximum of 92.49. The distribution of the combined ESG score across quartiles is observed with the 25th, 50th (median), and 75th percentiles being 30.83, 47.69, and 62.28, respectively.

Environmental (E) Score: The firms have an average E score of 45.28. This score spans a broad range, starting from 0 to a peak of 98.64, highlighting the variability in the environmental practices of the firms. The quartiles for this score are placed at 21.45 (25th percentile), 48.12 (median), and 67.99 (75th percentile).

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Social (S) Score: The S score averages at 45.14 with a range extending from a minimal 0.0527 to a substantial 97.13. The distribution through quartiles is seen at 24.88 (25th percentile), 45 (median), and 65.41 (75th percentile).

Governance (G) Score: The average G score is relatively higher at 52.08. The values for this score range between 0.101 and 99.34. Quartiles for this metric lie at the 25th, 50th (median), and 75th percentiles being 34.07, 53.12, and 70.71, respectively.

Controversy Score (CS): An intriguing observation is the elevated average CS of 93.52. Remarkably, the majority of firms attain a score of 100, as reflected in both the 25th percentile and the median value.

Rule of Law (ROL): The ROL index, indicative of the adherence to legal enforcement, averages at 80.75. This score spans between 19.23 and 98.56. The

skewness towards higher scores suggests a predominance the sample of firms operating with a higher adherence to the rule of law.

Control Variables

SIZE: Representing the size of the firms, the average SIZE stands at 22.95, with values ranging from 14.15 to 29.34. The quartiles for this variable are 21.87 (25th percentile), 22.88 (median), and 23.94 (75th percentile).

MTB: MTB has an average of 2.073 displays an range from 0.00444 to 16.45, indicating significant variations in the market-to-book ratios among the firms. Quartiles for this metric lie at the 25th, 50th (median), and 75th percentiles being 0.823, 1.292, and 2.248, respectively

LEV: On average, the firms have a leverage ratio (LEV) of 0.538, varying between 0.00702 and 1.226. The distribution across quartiles is captured at 0.371 (25th percentile), 0.533 (median), and 0.696 (75th percentile).

ROA: Reflecting the return on assets, the ROA has an average of 0.0514, with values extending from a low of -0.652 to a high of 0.775. Quartiles for this metric are set at 0.0163 (25th percentile), 0.0405 (median), and 0.0752 (75th percentile).

ASGR: The average asset growth rate (ASGR) stands at 0.0517, with it ranges from -0.938 to 0.719. Quartiles for this metric lie at the 25th, 50th (median), and 75th percentiles being -0.0299, 0.0378, and 0.114, respectively

Developed: This categorical variable indicates whether the firm is from a developed nation or not. The average score is 0.775, with the majority of firms (as indicated by the median and 75th percentile) being from developed countries.

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Table 5 Correlation among variables in hypothesis 1a

Correlation	*VaR*	*ESG combined*	*E score*	*S score*	*G score*	*CS*	*SIZE*	*MTB*	*LEV*	*ROA*	*ASGR*
VaR	1.000										
ESG combined	0.095	1.000									
E score	0.096	0.824	1.000								
S score	0.070	0.888	0.718	1.000							
G score	0.056	0.679	0.400	0.478	1.000						
CS	0.029	0.002	-0.169	-0.187	-0.119	1.000					
SIZE	0.227	0.331	0.424	0.313	0.201	-0.200	1.000				
MTB	0.068	0.044	-0.062	0.073	0.053	0.016	-0.257	1.000			
LEV	0.023	0.143	0.150	0.140	0.129	-0.108	0.560	-0.026	1.000		
ROA	0.141	-0.005	-0.053	-0.001	0.001	0.032	-0.224	0.431	-0.353	1.000	
ASGR	0.059	0.023	-0.013	0.037	0.009	0.047	0.084	0.118	0.043	0.186	1.000

From the table 5, VaR shows a positive correlation with nearly all the variables, suggesting that as the VaR increases (becomes less negative), these variables also tend to rise. The most pronounced correlation is with SIZE at 22.7%, suggesting that larger firms might experience a greater number of VaR occurrences. Given that VaR values are negative, a positive correlation signifies lower downside risk. The relationship between VaR and ESG performance metrics (combined, E, S, G, and Controversy scores) is positive but modest, hinting at a slightly negative relationship between downside risk and ESG performance. This aligns with our initial hypothesis.

For the ESG performance metrics, the combined ESG score has strong positive correlations with both the E score (82.4%) and the S score (88.8%). This suggests that firms with robust environmental and social practices tend to have a higher combined ESG score. However, the relationship with the G score, while positive, is milder at 67.9%. Notably, the correlation with the Controversy Score (CS) is almost negligible at 0.2%, indicating that controversies don't substantially influence the combined ESG score. The ESG combined score is notably correlated with the SIZE of firms at 33.1%. The E score has its strongest correlation with SIZE (42.4%), implying that firms with commendable environmental practices might be larger. The S score mainly correlates with the combined ESG score and the E score, emphasizing that social practices are

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closely related to overall ESG performance and environmental practices. The correlations of the G score with other ESG metrics are positive but less robust than those between the E and S scores, which suggests that governance practices might operate somewhat independently from environmental and social practices.

For the control variables, the SIZE's most pronounced correlation is with LEV at 56%, indicating that larger firms tend to have increased leverage. MTB showcases a notable positive correlation with ROA at 43.1%. This suggests that firms boasting a higher market value compared to their book value might register improved asset returns. LEV has a pronounced negative relationship with ROA at -35.3%, hinting that firms with augmented leverage might experience diminished returns on assets. The inverse correlations of ROA with LEV (-35.3%) and SIZE (-22.4%) suggest that firms with superior asset returns could be smaller or possess reduced leverage. ASGR's correlations with other metrics are fairly mild, with its most significant being 18.6% with ROA. This implies a modest relationship between asset growth and asset returns.

Table 6 Correlation among variables in hypothesis 1b

Correlation	*MDD*	*ESG combined*	*E score*	*S score*	*G score*	*CS*	*SIZE*	*MTB*	*LEV*	*ROA*	*ASGR*
MDD	1.000										
ESG combined	0.086	1.000									
E score	0.091	0.824	1.000								
S score	0.059	0.888	0.718	1.000							
G score	0.048	0.679	0.400	0.478	1.000						
CS	0.029	0.002	-0.169	-0.187	-0.119	1.000					
SIZE	0.187	0.331	0.424	0.313	0.201	-0.200	1.000				
MTB	0.127	0.044	-0.062	0.073	0.053	0.016	-0.257	1.000			
LEV	0.002	0.143	0.150	0.140	0.129	-0.108	0.560	-0.026	1.000		
ROA	0.174	-0.005	-0.053	-0.001	0.001	0.032	-0.224	0.431	-0.353	1.000	
ASGR	0.140	0.023	-0.013	0.037	0.009	0.047	0.084	0.118	0.043	0.186	1.000

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From the table 6, MDD shows a positive correlation with nearly all the variables, suggesting that as the MDD increases (becomes less negative), these variables also tend to rise. The most pronounced correlation is with SIZE at 18.7%,

suggesting that larger firms might experience a greater number of MDD occurrences. Given that MDD values are negative, a positive correlation signifies lower downside risk. The relationship between MDD and ESG performance metrics (combined, E, S, G, and Controversy scores) is positive but modest, hinting at a slightly negative relationship between downside risk and ESG performance. Other notable correlations include those with MTB 12.7%, ROA 17.4%, and ASGR 14.0%. These values underscore the varying relationships between MDD and firm-specific factors. While MDD correlates positively with most variables, its near-zero correlation with LEV 0.2% suggests that there is almost no linear relationship between MDD and leverage. For the ESG performance metrics and the control variables stay the same correlation with table 5.

Table 7 Correlation between ROL and variables in hypothesis 2

Correlation	ROL
VaR	0.036
MDD	0.034
ESG combined	-0.014
E score	0.002
S score	-0.061
G score	0.043
CS	0.046
SIZE	-0.184
MTB	-0.152
LEV	-0.163
ROA	-0.055
ASGR	-0.079
ROL	1.000

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From the table 7, ROL shows a very slight positive correlation with VaR 3.6% and MDD 3.4%. These suggest that there might be a minor increase in these risk values as rule of law becomes more pronounced. Given that VaR and MDD values are negative, there is negative relationship between ROL and downside risk. These minimal correlations suggest that the relationship between ROL and both measures of risk is relatively weak. A negative correlation of -1.4% between ROL and the combined ESG score indicates a very weak inverse relationship. This suggests that as ROL increases,

ESG combined scores may decrease slightly, but this correlation is negligible. Among the individual ESG metrics, the ROL correlation is negligible for the E score 0.2% and slightly negative for the S score -6.1%. The G score, however, shows a slightly more positive correlation 4.3%, indicating a minor positive relationship between governance practices and the rule of law. There's a moderately negative correlation between ROL and SIZE -18.4%, implying that in regions with higher ROL, firms might be slightly smaller. A negative correlation of -15.2% suggests that firms in higher ROL regions might have a slightly lower market to book ratio. ROL shows a negative correlation with leverage (LEV) at -16.3%, indicating that firms in regions with a higher ROL might have slightly lower leverage. A negative correlation of -5.5%, though weak, suggests a slight inverse relationship between return on assets and ROL. The correlation of -7.9% implies a minor negative relationship between asset growth rate and ROL. Rule of Law (ROL) demonstrates varied degrees of weak correlations with the given variables.

Table 8 Correlation between Developed and variables in hypothesis 3

Correlation	Developed
VaR	0.032
MDD	0.040
ESG combined	-0.037
E score	0.011
S score	-0.099
G score	0.023
CS	0.051
SIZE	-0.147
MTB	-0.191
LEV	-0.162
ROA	-0.058
ASGR	-0.066
Developed	1.000

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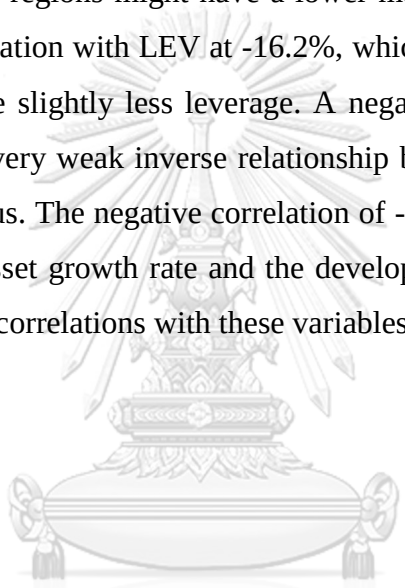
From the table 8, Developed country has a slight positive correlation with VaR 3.2% and MDD 4%. These suggest that there might be a minor increase in these risk values as a country becomes more developed. Given that VaR and MDD values are negative, there is negative relationship between developed country and downside risk

but the relationships are weak. A negative correlation of -3.7% indicates a very weak inverse relationship between the combined ESG score and the developed country. For the individual ESG metrics, the E score shows a negligible positive correlation with Developed country 1.1%. In contrast, the S score has a slightly stronger negative correlation -9.9, indicating social practices might be slightly less prominent in developed regions. The G score has a weak positive correlation of 2.3%. There's a negative correlation between Developed and SIZE -14.7%, suggesting firms in developed regions might be slightly smaller. The negative correlation of -19.1% implies that firms in developed regions might have a lower market to book ratio. Developed shows a negative correlation with LEV at -16.2%, which might suggest firms in more developed regions have slightly less leverage. A negative correlation of -5.8% with Developed suggests a very weak inverse relationship between return on assets and a region's developed status. The negative correlation of -6.6% indicates a minor inverse relationship between asset growth rate and the developed region. Being classified as "Developed" has weak correlations with these variables.



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Regression Result

Table 9 Regression result of ESG performance on value at risk

	(Combined ESG)	(E pillar)	(S pillar)	(G pillar)	(Controversy)
VARIABLES	Model 1	Model 2	Model 3	Model 4	Model 5
ESGcombined	5.33e-05***				
	(1.23e-05)				
Escore		9.73e-06			
		(9.46e-06)			
Sscore			3.22e-05***		
			(1.06e-05)		
Gscore				3.28e-05***	
				(9.97e-06)	
Controversy					6.58e-05***
					(1.20e-05)
SIZE	0.00548***	0.00573***	0.00556***	0.00566***	0.00609***
	(0.000200)	(0.000206)	(0.000203)	(0.000190)	(0.000190)
MTB	0.00136***	0.00141***	0.00137***	0.00139***	0.00141***
	(0.000112)	(0.000111)	(0.000112)	(0.000111)	(0.000111)
LEV	-0.0241***	-0.0242***	-0.0241***	-0.0244***	-0.0240***
	(0.00140)	(0.00140)	(0.00140)	(0.00140)	(0.00140)
ROA	0.0420***	0.0424***	0.0423***	0.0420***	0.0427***
	(0.00396)	(0.00396)	(0.00396)	(0.00396)	(0.00396)
ASGR	0.00271*	0.00241	0.00257*	0.00252*	0.00175
	(0.00152)	(0.00152)	(0.00152)	(0.00152)	(0.00152)
Constant	-0.183***	-0.187***	-0.184***	-0.187***	-0.200***
	(0.00418)	(0.00441)	(0.00426)	(0.00400)	(0.00450)
Observations	10,565	10,565	10,565	10,565	10,565
R-squared	0.386	0.385	0.385	0.385	0.386
Year FE	Yes	Yes	Yes	Yes	Yes
Country FE	Yes	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes	Yes

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

From our hypothesis 1a: ESG performance, measured through combined and individual pillar scores, negatively affects value at risk (VaR).

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Our study primarily aims to understand the relationship between ESG performance and downside risk, specifically focusing on Value at Risk (VaR). The regression results, as illustrated in Table 9, provide insights into the relationship between combined ESG score, ESGC individually pillar scores, and VaR.

It's important to note that our interpretation of positive coefficients indicates a less negative VaR, representing a negative correlation between ESG performance and downside risk.

The coefficient for the combined ESG score in model 1 is 0.0000533, and it's statistically significant at the 1% level. This positive coefficient suggests that as the ESG combined score increases, the value of VaR becomes less negative. This essentially indicates that there's a negative relationship between combined ESG score and downside risk, aligning with our hypothesis 1a and the findings from (Lööf and Stephan 2019).

The coefficient for the E pillar in model 2 is 0.00000973 but it does not demonstrate a statistically significant impact, suggesting that while there is a tendency for environmental performance to reduce risk, the relationship is not strong enough to assert a definitive impact on VaR within this dataset. This observation aligns with findings in the broader academic literature, which suggest that the influence of environmental performance on firm value can be inconsistent and context-specific. For instance, previous research has highlighted that environmental performance is generally value-relevant but can lose significance during economic crises. This variation in significance could be influenced by various external factors. (Castro, Gutiérrez-López et al. 2021). Furthermore, empirical evidence on the relationship between firms' stock prices and their environmental performance has been fragmented and inconclusive, indicating that the impact of environmental performance on firm value is a complex phenomenon influenced by a myriad of factors, including industry characteristics and economic conditions (Castro, Gutiérrez-López et al. 2021). Thus, the lack of significant impact of the E score in the regression analysis can be attributed to these broader complexities and context-specific factors that influence the environmental performance-stock price relationship.

The S pillar coefficient in model 3 stands at 0.0000322 and is significant at the 1% level aligning with our hypothesis 1a. This positive coefficient implies a negative

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relationship between the S pillar score and downside risk, suggesting that improved social responsibilities can mitigate downside risks for firms.

The coefficient for the G pillar in model 4 is 0.0000328 and is statistically significant at the 1% level aligning with our hypothesis 1a. Once again, the positive sign indicates a negative relationship between the G pillar score and downside risk.

With a coefficient of 0.0000658, the controversy score in model 5 is statistically significant at the 1% level aligning with our hypothesis 1a. The positive value indicates a negative relationship between controversy score and downside risk. It's worth to know that a higher controversy score signifies less controversy for the firm, making it a beneficial factor in reducing downside risk.

All models 1-5, we use control variables such as SIZE (size of the firms), MTB (market to book of the firm), LEV (leverage of the firm), ROA (return on asset of the firm), and ASGR (asset growth rate of the firm). All these variables are significant at the 1% level, which aligns with our initial expectations. However, an exception is found in ASGR for all models; it displays a coefficient sign opposite to what we anticipated. In the context of study by (Cooper, Gulen et al. 2008), it is observed that firms with low asset growth rates tend to earn higher subsequent annualized risk-adjusted returns on average (decreased downside risk). Conversely, firms with high asset growth rates generally earn lower returns (increased downside risk). Based on these findings, we initially believed a negative coefficient for ASGR would suggest that higher asset growth rates might lead to increased risk.

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But, our regression result in table 9 showed that ASGR has positive sign implying a higher Asset Growth Rate (ASGR) could be associated with reduced risk, contrary to initial expectation. The rationale behind this result can explain through the study by (Lipson, Mortal et al. 2011). Their research demonstrates that the asset growth effect is not only pervasive across various firm sizes but is also significantly correlated with firm-specific idiosyncratic volatility (IVOL). This suggests a more pronounced effect in firms with higher IVOL, while it appears to be absent in those with lower IVOL. Consequently, it can be inferred that an increased Asset Growth Rate (ASGR) might be associated with diminished risk in firms that exhibit higher IVOL. Furthermore, their study suggests a mispricing-based explanation for the asset growth

effect, where arbitrage costs allow this effect to persist. This could imply that higher ASGR does not necessarily indicate higher risk but may reflect market inefficiencies or mispricing leading to higher returns. Additionally, the concentration of the asset growth effect around earnings announcements and its positive correlation with biases in analyst earnings estimates. This observation suggests that a higher ASGR might positively influence market expectations and stock returns, thereby indicating a positive relationship with reduced risk in the regression analysis.

Our regression results in table 9 consistently align with the hypothesis 1a, confirming the negative relationship between ESG performance and downside risk except only E pillar. This research emphasizes the importance of ESG factors in influencing a firm's vulnerability to potential downside risks.

Table 10 Regression result of ESG performance on maximum drawdown

	(Combined ESG)	(E pillar)	(S pillar)	(G pillar)	(Controversy)
VARIABLES	Model 6	Model 7	Model 8	Model 9	Model 10
ESGcombined	0.000231***				
	(6.38e-05)				
Escore		5.98e-05			
		(4.90e-05)			
Sscore			0.000119**		
			(5.51e-05)		
Gscore				0.000121**	
				(5.16e-05)	
Controversy					0.000289***
					(6.23e-05)
SIZE	0.0250***	0.0258***	0.0255***	0.0258***	0.0276***
	(0.00103)	(0.00107)	(0.00105)	(0.000985)	(0.000984)
MTB	0.0105***	0.0107***	0.0106***	0.0107***	0.0108***
	(0.000578)	(0.000577)	(0.000579)	(0.000575)	(0.000573)
LEV	-0.123***	-0.123***	-0.123***	-0.124***	-0.123***
	(0.00727)	(0.00728)	(0.00728)	(0.00728)	(0.00727)
ROA	0.199***	0.201***	0.201***	0.200***	0.202***
	(0.0205)	(0.0205)	(0.0205)	(0.0205)	(0.0205)
ASGR	0.0769***	0.0758***	0.0761***	0.0759***	0.0727***
	(0.00788)	(0.00789)	(0.00788)	(0.00787)	(0.00788)

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Constant	-0.848***	-0.860***	-0.855***	-0.866***	-0.923***
	(0.0216)	(0.0229)	(0.0221)	(0.0207)	(0.0233)
Observations	10,565	10,565	10,565	10,565	10,565
R-squared	0.375	0.375	0.375	0.375	0.376
Year FE	Yes	Yes	Yes	Yes	Yes
Country FE	Yes	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes	Yes

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

From our hypothesis 1b: ESG performance, measured through combined and individual pillar scores, negatively affects maximum drawdown (MDD).

We examine the influence of ESG performance metrics on downside risk, particularly focusing on Maximum Drawdown (MDD). Table 10 elaborates on the dynamics between combined ESG scores, individual ESGC pillar scores, and MDD. For ease of understanding, a positive coefficient implies less downside risk, while a negative one suggests greater downside risk.

The combined ESG score in model 6 has a coefficient of 0.000231, and it's statistically significant at the 1% level aligning with our hypothesis 1b. This positive coefficient implies that as the combined ESG score increases, there is less negative in MDD, suggesting a negative relationship between combined ESG score and downside risk. An increase in combined ESG score are linked to less downside risk. In other words, firms demonstrating comprehensive ESG excellence seem to be buffered against sharp declines in their value.

The coefficient for the E pillar in model 7 is 0.0000598. Although the positive value might hint a potential decrease in downside risk with improved environmental performance, its non-significance prevents us from drawing concrete conclusions. This finding is in line with the explanation given in Table 9 and supports our previous discussion about the E pillar's non-significant impact on downside risk.

The S pillar coefficient in model 8 stands at 0.000119, and it's statistically significant at the 5% level aligning with our hypothesis 1b. Stronger social performance

is associated with lower downside risk, firms that score higher on social criteria are found to be less susceptible to experiencing severe drops in their value.

The coefficient for the G pillar in model 9 is 0.000121, and it's statistically significant at the 5% level aligning with our hypothesis 1b. Stronger governance practices appear to diminish downside risk. Companies with robust governance structures are likely better equipped to navigate market challenges, reducing their susceptibility to severe value drops.

With a coefficient of 0.000289, the controversy score in model 10 is statistically significant at the 1% level aligning with our hypothesis 1b. The positive value suggests that firms with fewer controversies face less downside risk. This reaffirms the intuitive notion that companies embroiled in fewer controversies are deemed more stable and resilient by the market.

Among the control variables, all variables align with our initial expectations and are significant at the 1% level. However, only ASGR has a coefficient sign opposite to our initial predictions with significant at 1% level. The rationale for this is consistent with what we provided in Table 9.

The results from table 10 consistently align with the hypothesis 1b, reveals that specific ESG components, including the combined ESG score, environmental, social, governance and controversy scores, have a tangible negative relationship with MDD, implying lesser sharp downside risks. However, the E pillars present inconclusive evidence. These findings emphasize the importance of breaking down ESG metrics into their individual components to accurately assess their impact on downside risk.

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Table 11 Regression result of ESG performance and ROL on value at risk

	(Combined ESG)	(E pillar)	(S pillar)	(G pillar)	(Controversy)
VARIABLES	Model 11	Model 12	Model 13	Model 14	Model 15
ESGcombined	0.000161***				
	(3.14e-05)				
ROLxESGconbined	-0.00387***				
	(0.00102)				

Escore		3.87e-06			
		(1.29e-05)			
ROLxEscore		0.000447***			
		(0.000144)			
Sscore			6.28e-05***		
			(2.07e-05)		
ROLxSscore			-0.00141**		
			(0.000554)		
Gscore				3.15e-05	
				(2.54e-05)	
ROLxGscore				-0.00135	
				(0.000926)	
Controversy					9.08e-05***
					(3.30e-05)
ROLxControversy					0.000918
					(0.00150)
ROL	0.000213***	0.000147***	0.000177***	0.000176***	0.000140***
	(2.09e-05)	(1.31e-05)	(1.59e-05)	(1.99e-05)	(2.74e-05)
SIZE	0.00572***	0.00573***	0.00589***	0.00600***	0.00633***
	(0.000184)	(0.000195)	(0.000182)	(0.000177)	(0.000176)
MTB	0.00118***	0.00121***	0.00122***	0.00125***	0.00127***
	(0.000116)	(0.000115)	(0.000116)	(0.000115)	(0.000115)
LEV	-0.0219***	-0.0221***	-0.0219***	-0.0220***	-0.0216***
	(0.00146)	(0.00146)	(0.00147)	(0.00147)	(0.00146)
ROA	0.0442***	0.0448***	0.0445***	0.0449***	0.0452***
	(0.00414)	(0.00414)	(0.00415)	(0.00415)	(0.00413)
ASGR	-5.01e-05	-0.000162	-0.000322	-0.000564	-0.00156
	(0.00157)	(0.00157)	(0.00157)	(0.00157)	(0.00156)
Constant	-0.174***	-0.195***	-0.190***	-0.192***	-0.222***
	(0.00717)	(0.00468)	(0.00531)	(0.00682)	(0.00948)
Observations	10,565	10,565	10,565	10,565	10,565
R-squared	0.317	0.317	0.316	0.315	0.321
Year FE	Yes	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes	Yes

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

From our hypothesis 2: The relationship between a firm's ESG performance and downside risk is influenced by the strength of the rule of law (ROL).

We analyze the influence of ESG performance metrics and the Rule of Law (ROL) index on Value at Risk (VaR). Table 11 provides insights into these relationships, incorporating the interaction of ROL with different ESG metrics.

Main effect

The combined ESG score in model 11 has a coefficient of 0.000161, and it's statistically significant at the 1% level aligning with our hypothesis 2. This positive coefficient implies that a higher combined ESG score results in a decrease in VaR, suggesting that firms with better combined ESG score are linked to less downside risk. In other words, firms demonstrating comprehensive ESG excellence seem to have lower potential losses at a given confidence level.

The ROL in model 11 has a coefficient of 0.000213, and it's statistically significant at the 1% level aligning with our hypothesis 2. This positive coefficient implies that as the rule of law index increases, there is less negative in VaR, suggesting a negative relationship between ROL and downside risk. Firms operating in countries with stringent law enforcement and robust legal infrastructure benefit from decreased VaR. This is likely due to such countries offering stable business environments, where sudden risks are more efficiently managed and mitigated. This finding is supported by (Grewal, Riedl et al. 2019) paper's conclusion that equity markets tend to react more favorably to firms with strong ESG performance and disclosure, particularly in environments where such practices are rigorously regulated. In such countries, firms are likely to adhere to higher ESG standards, leading to a more stable and predictable business environment. This stability reduces the likelihood of sudden financial risks and is recognized positively by the market, resulting in a lower perception of risk and thus lower VaR for these firms. Essentially, in countries with strong rule of law, the comprehensive regulatory frameworks that enforce high ESG standards contribute to creating a safer and more predictable financial environment for businesses.

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Marginal effect

The coefficient for the interaction term ROLxESGcombined in model 11 has a coefficient of -0.00387, significant at the 1% level opposite direction with our hypothesis 2. Implied that in countries with stringent law, the relationship between ESG scores and VaR becomes less pronounced. This phenomenon can be attributed to

several factors as explained by (Krueger, Sautner et al. 2021). Their study suggests that regulations mandating ESG disclosure enhance the corporate information environment and positively impact capital markets. In jurisdictions with a strong rule of law, where such regulations are likely more comprehensive and enforced effectively, ESG disclosures are often already extensive and transparent. This robust regulatory environment may lead to ESG scores offering limited additional information to investors, thus explaining the less pronounced relationship between these scores and VaR. Moreover, the paper highlights that the effects of mandatory ESG disclosure requirements are stronger when implemented by government institutions and coupled with enforcement by informal institutions. In countries with a higher rule of law, such government-led initiatives and enforcement mechanisms are likely more effective, leading to a scenario where ESG disclosures are standardized and uniformly applied across firms. This uniformity could result in a diminished differential impact of ESG scores on VaR, as all firms are subject to similar disclosure standards and enforcement mechanisms. Lastly, the finding showed that firms in weaker information environments benefit more from disclosure mandates implies that in stronger information environments (like those with a higher rule of law), the incremental benefit of ESG disclosures on reducing risk as measured by VaR might be less impact. In other words, in jurisdictions with already strong informational transparency and legal frameworks, ESG scores may not significantly alter the risk perception as much as in countries with weaker information environments.

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Main effect

The coefficient for the E pillar in model 12 is 0.00000387 and is not statistically significant, indicating an ambiguous relationship between environmental performance and VaR.

With a coefficient of 0.0000628, the S pillar in the model 13 is significant at the 1% level aligning with our hypothesis 2 reaffirms that organizations focusing on social welfare enjoy reduced VaR. This suggests that societal goodwill might reflect on the operational stability of the firm.

The coefficient for the G pillar in the model 14 is 0.0000315 and is not statistically significant, leaving the connection between governance practices and VaR inconclusive.

The controversy score coefficient in model 15 stands at 0.0000908, significant at the 1% level aligning with our hypothesis 2. Lower controversy levels are associated with reduced VaR, implying that firms with fewer controversies are potentially less volatile and therefore face less financial risk.

The ROL in model 12-15 have coefficient of 0.000147, 0.000177, 0.000176, 0.000140, and it's statistically significant at the 1% level aligning with our hypothesis 2. This positive coefficient implies that as the rule of law index increases, there is less negative in VaR, suggesting a negative relationship between ROL and downside risk. In other words, firms where located in country that has high standard of law enforcement seem to be alleviated against declines in their value.

Marginal effect

This interaction term ROLxEscore in the model 12 has a positive coefficient of 0.000447, significant at the 1% level aligning with our hypothesis 2. This suggests that in countries with a stronger rule of law, better environmental performance leads to a further decrease in VaR.

With a negative coefficient of -0.00141, the interaction term ROLxSscore in the model 13 is significant at the 5% level opposite direction with our hypothesis 2, it indicates that the marginal effect of the social score on VaR diminishes in countries with a higher rule of law.

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Both interaction terms ROLxGscore & ROLxControversy in the model 14 and 15 are not statistically significant, implying that the relationship between governance and controversy scores with VaR is consistent across varying levels of rule of law.

All control variables align with our initial expectations and are significant at the 1% level, with the exception of the ASGR variable is insignificant.

The result from table 11 underscores the important role of the rule of law in reducing downside risk and the complex relationship between ESG metrics, the rule of law and VaR. While certain ESG metrics, such as the combined ESG score, the E pillar,

the S pillar, the G pillar and Controversy score, show a clear negative relationship with VaR aligning with our hypothesis 2, the interaction with the rule of law still unclear for this relationship. A concept studied in the literature by (Chouaibi, Chouaibi et al. 2022), who highlighted the aspect of ESG engagement may have varying impacts on financial performance depending on the strength and nature of the rule of law in different jurisdictions contribute to the complex relationship between ESG metrics, the rule of law, and VaR, as observed in the regression results. In addition, it is important to consider the broader regulatory and legal frameworks when assessing the impact of ESG performance metrics on financial risk.

Table 12 Regression result of ESG performance and ROL on maximum drawdown

	(Combined ESG)	(E pillar)	(S pillar)	(G pillar)	(Controversy)
VARIABLES	Model 16	Model 17	Model 18	Model 19	Model 20
ESGcombined	0.000403**				
	(0.000161)				
ROLxESGconbined	-0.00841				
	(0.00519)				
Escore		4.57e-06			
		(6.59e-05)			
ROLxEscore		0.00239***			
		(0.000735)			
Sscore			-2.85e-06		
			(0.000106)		
ROLxSscore			-0.000788		
			(0.00283)		
Gscore				-4.07e-06	
				(0.000130)	
ROLxGscore				-0.00217	
				(0.00473)	
Controversy					0.000268
					(0.000169)
ROLxControversy					0.0111
					(0.00767)
ROL	0.000936***	0.000775***	0.000825***	0.000855***	0.000633***
	(0.000107)	(6.69e-05)	(8.15e-05)	(0.000102)	(0.000140)
SIZE	0.0274***	0.0269***	0.0284***	0.0284***	0.0297***

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	(0.000940)	(0.000995)	(0.000932)	(0.000902)	(0.000902)
MTB	0.00955***	0.00957***	0.00981***	0.00982***	0.00986***
	(0.000592)	(0.000590)	(0.000594)	(0.000589)	(0.000586)
LEV	-0.114***	-0.114***	-0.114***	-0.114***	-0.112***
	(0.00749)	(0.00748)	(0.00750)	(0.00750)	(0.00747)
ROA	0.213***	0.215***	0.215***	0.216***	0.217***
	(0.0212)	(0.0212)	(0.0212)	(0.0212)	(0.0211)
ASGR	0.0601***	0.0605***	0.0582***	0.0582***	0.0540***
	(0.00802)	(0.00804)	(0.00803)	(0.00801)	(0.00800)
Constant	-0.898***	-0.938***	-0.957***	-0.949***	-1.100***
	(0.0367)	(0.0239)	(0.0271)	(0.0349)	(0.0485)
Observations	10,565	10,565	10,565	10,565	10,565
R-squared	0.324	0.325	0.323	0.324	0.328
Year FE	Yes	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes	Yes

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

From our hypothesis 2: The relationship between a firm's ESG performance and downside risk is influenced by the strength of the rule of law (ROL).

We analyze the influence of ESG performance metrics and the Rule of Law (ROL) index on Maximum Drawdown (MDD). Table 12 provides insights into these relationships, incorporating the interaction of ROL with different ESG metrics.

Main effect

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The combined ESG score in model 16 has a coefficient of 0.000403, and it's statistically significant at the 5% level aligning with our hypothesis 2. This positive coefficient implies that a higher combined ESG score results in a decrease in MDD, this means that firms with superior ESG practices tend to experience a reduced MDD. In simpler terms, companies that perform well in ESG are less likely to see sharp drops in their value.

The ROL in model 16 has a coefficient of 0.000936, significant at the 1% level aligning with our hypothesis 2. This positive coefficient implies that as the rule of law index increases, there is less negative in MDD, a positive coefficient suggests that as the rule of law index goes up, the MDD decreases. This indicates that companies operating in

countries with strong legal systems are less prone to steep value declines. The rationale for this is consistent with what we provided in Table 11.

Marginal Effect

The interaction term ROLxESGcombined in Model 16 shows a coefficient of -0.00841, though it's not statistically significant. This means that while there might be an interaction between ROL and ESG scores regarding MDD, the evidence isn't strong enough to make a concrete statement.

Main Effect

The E pillar and the controversy score in Model 17 and 20 have positive coefficients but neither is statistically significant, making its relationship with MDD ambiguous.

The S pillar and the G pillar in Model 18 and 19 have negative coefficients, but neither is statistically significant, suggesting that their individual impacts on MDD are not clearly determined.

In Model 17-20, the ROL coefficient stands at 0.000775, 0.000825, 0.000855 and 0.000633, significant at the 1% level aligning with our hypothesis 2. This reiterates that strong rule of law correlates with reduced MDD.

Marginal Effect

The ROLxEscore interaction in Model 17 is significant at the 1% level aligning with our hypothesis 2 with a coefficient of 0.00239. This implies that in countries with a stronger rule of law, the benefits of good environmental practices in reducing MDD become even more pronounced.

The coefficients for the ROLxSscore, ROLxGscore and ROLxControversy interactions in Model 18, 19 and 20 aren't statistically significant, implying that social, governance and controversy scores' effects on MDD don't vary much with the strength of the rule of law.

All control variables align with our initial expectations and are significant at the 1% level, with the exception of the ASGR variable is significant with the opposite sign from our initial predictions.

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The result from the table 12 emphasizes the relationship between ESG practices, rule of law, and MDD. It's evident that good ESG practices, particularly in the environmental domain, tend to more reduce the likelihood of sharp value declines in jurisdictions with stronger legal frameworks. However, the strength of a country's laws, shown by the ROL score, is very important as explained by the study from (Grewal, Riedl et al. 2019). This is particularly noticeable in the significant role of ROL in reducing firm risk across all models.

Table 13 Regression result of ESG performance and Developed country on VaR

	(Combined ESG)	(E pillar)	(S pillar)	(G pillar)	(Controversy)
VARIABLES	Model 21	Model 22	Model 23	Model 24	Model 25
ESGcombined	0.000208***				
	(2.58e-05)				
DevelopedxESGcombined	-0.000190***				
	(2.81e-05)				
Escore		0.000104***			
		(2.04e-05)			
DevelopedxEscore		-8.65e-05***			
		(2.17e-05)			
Sscore			0.000118***		
			(2.01e-05)		
DevelopedxSscore			-0.000125***		
			(2.23e-05)		
Gscore				0.000117***	
				(2.12e-05)	
DevelopedxGscore				-0.000147***	
				(2.40e-05)	
Controversy					0.000148***
					(2.32e-05)
DevelopedxControversy					-5.66e-05**
					(2.69e-05)
Developed	0.0146***	0.00941***	0.0118***	0.0133***	0.0108***
	(0.00145)	(0.00113)	(0.00122)	(0.00137)	(0.00255)
SIZE	0.00575***	0.00562***	0.00590***	0.00597***	0.00616***
	(0.000184)	(0.000194)	(0.000183)	(0.000176)	(0.000175)
MTB	0.00116***	0.00121***	0.00121***	0.00123***	0.00126***

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	(0.000116)	(0.000116)	(0.000117)	(0.000116)	(0.000115)
LEV	-0.0225***	-0.0222***	-0.0224***	-0.0223***	-0.0217***
	(0.00146)	(0.00147)	(0.00147)	(0.00147)	(0.00146)
ROA	0.0424***	0.0434***	0.0427***	0.0442***	0.0448***
	(0.00415)	(0.00415)	(0.00416)	(0.00415)	(0.00414)
ASGR	-0.000201	-0.000465	-0.000490	-0.000837	-0.00187
	(0.00157)	(0.00157)	(0.00157)	(0.00157)	(0.00157)
Constant	-0.195***	-0.187***	-0.194***	-0.197***	-0.209***
	(0.00439)	(0.00452)	(0.00434)	(0.00423)	(0.00474)
Observations	10,565	10,565	10,565	10,565	10,565
R-squared	0.317	0.314	0.315	0.315	0.318
Year FE	Yes	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes	Yes

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

From our hypothesis 3: The association between ESG performance and downside risk differs between developed and emerging countries.

We analyze the influence of ESG performance metrics and the Developed country (Developed) on Value at Risk (VaR). Table 13 provides insights into these relationships, incorporating the interaction of Developed with different ESG metrics.

Main Effect

The combined ESG score in Model 21 has a coefficient of 0.000208, and it's statistically significant at the 1% level. This positive coefficient implies that a higher combined ESG score results in a decrease in downside risk (VaR). In simpler terms, companies that perform well in ESG are less likely to see drop in their value.

The "Developed" variable in Model 21 has a coefficient of 0.0146, significant at the 1% level aligning with our hypothesis 3. This positive coefficient suggests that firms in developed countries tend to have decrease in downside risk (VaR) compared to those in emerging countries.

Marginal Effect

The interaction term DevelopedxESGcombined in Model 21 shows a coefficient of -0.000190, and it's statistically significant at the 1% level opposite aligning with our hypothesis 3. This indicates that in developed countries, in developed

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country, increasing ESG performance has less pronounced effect in reducing downside risk.

Main Effect

The E pillar, the S pillar, the G pillar and the controversy scores in Model 22, 23, 24 and 25 have coefficients of 0.000104, 0.000118, 0.000117 and 0.000148 respectively. They are statistically significant at the 1% level. This implies that higher environment, social, governance and controversy scores lead to a decrease in downside risk (VaR).

The "Developed" variable in Model 22-25 has a coefficient of 0.00941, 0.0118, 0.0133 and 0.0108 also significant at the 1% level aligning with our hypothesis 3, reinforcing the idea that firms in developed countries are associated with decreased downside risk (VaR).

Marginal Effect

The interaction terms in Model 22-25 like DevelopedxEscore, DevelopedxSscore, DevelopedxGscore, and DevelopedxControversy indicate how the relationship between each ESG component and VaR changes in developed countries. Only DevelopedxControversy has statistically significant at the 5% level. DevelopedxEscore, DevelopedxSscore and DevelopedxGscore interactions are statistically significant, each at the 1% level, suggesting that in developed countries, the associations between these specific ESG components and decreased VaR differ compared to emerging countries.

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All control variables align with our initial expectations and are significant at the 1% level, with the exception of the ASGR variable is insignificant.

The result from table 13 showed the relationship between ESG metrics, the developed country, and VaR. The presence of developed country is important for reducing risk. The interaction with the developed country makes the impact of ESG performance less pronounced on VaR which opposite direction with our hypothesis 3. This finding aligns with (Naeem, Cankaya et al. 2022) observation of differing impacts between developed and emerging countries. However, our results show a contrasting

trend to their finding, which indicated a more pronounced effect of ESG on financial performance in developed countries. We can reasonably explain our findings with the insights from (Krueger, Sautner et al. 2021), as previously discussed in Table 11.

Table 14 Regression result of ESG performance and Developed country on MDD

	(Combined ESG)	(E pillar)	(S pillar)	(G pillar)	(Controversy)
VARIABLES	Model 26	Model 27	Model 28	Model 29	Model 30
ESGcombined	0.000685***				
	(0.000132)				
DevelopedxESGcombined	-0.000619***				
	(0.000144)				
Escore		0.000381***			
		(0.000104)			
DevelopedxEscore		-0.000276**			
		(0.000111)			
Sscore			0.000301***		
			(0.000103)		
DevelopedxSscore			-0.000390***		
			(0.000114)		
Gscore				0.000456***	
				(0.000108)	
DevelopedxGscore				-0.000638***	
				(0.000122)	
Controversy					0.000539***
					(0.000119)
DevelopedxControversy					-8.09e-05
					(0.000138)
Developed	0.0636***	0.0462***	0.0534***	0.0679***	0.0416***
	(0.00742)	(0.00577)	(0.00623)	(0.00701)	(0.0130)
SIZE	0.0272***	0.0264***	0.0281***	0.0282***	0.0290***
	(0.000939)	(0.000991)	(0.000934)	(0.000898)	(0.000896)
MTB	0.00964***	0.00973***	0.00990***	0.00987***	0.0100***
	(0.000595)	(0.000593)	(0.000597)	(0.000592)	(0.000589)
LEV	-0.115***	-0.114***	-0.115***	-0.114***	-0.112***
	(0.00749)	(0.00749)	(0.00749)	(0.00749)	(0.00748)
ROA	0.207***	0.210***	0.208***	0.213***	0.215***
	(0.0212)	(0.0212)	(0.0212)	(0.0212)	(0.0211)
ASGR	0.0594***	0.0593***	0.0577***	0.0572***	0.0527***

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	(0.00802)	(0.00804)	(0.00802)	(0.00800)	(0.00800)
Constant	-0.927***	-0.892***	-0.933***	-0.946***	-0.990***
	(0.0224)	(0.0231)	(0.0222)	(0.0216)	(0.0242)
Observations	10,565	10,565	10,565	10,565	10,565
R-squared	0.324	0.324	0.323	0.324	0.326
Year FE	Yes	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes	Yes

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

From our hypothesis 3: The association between ESG performance and downside risk differs between developed and emerging countries.

We analyze the influence of ESG performance metrics and the Developed country (Developed) on Maximum Drawdown (MDD). Table 14 provides insights into these relationships, incorporating the interaction of Developed with different ESG metrics.

Main Effect

The combined ESG score in Model 26 has a coefficient of 0.000685, which is statistically significant at the 1% level. This positive coefficient suggests that a higher combined ESG score is associated with an increase in MDD value. In simpler terms, while companies with better ESG performance generally have lower downside risk as indicated by MDD. They might experience larger magnitude under extreme conditions.

The "Developed" variable in Model 26 has a coefficient of 0.0636, and it is significant at the 1% level aligning with our hypothesis 3. This positive coefficient indicates that firms in developed countries are likely to experience lower downside risk (MDD) compared to those in emerging countries.

Marginal Effect

The interaction term DevelopedxESGcombined in Model 26 shows a coefficient of -0.000619, and it's statistically significant at the 1% level opposite aligning with our hypothesis 3. This suggests that in developed countries, the positive relationship between the combined ESG score and increased MDD weakens. It could even imply that high ESG scores might reduce MDD in developed markets.

Main Effect

The E pillar, the S pillar, the G pillar and the controversy scores in Model 27, 28, 29 and 30 have coefficients of 0.000381, 0.000301, 0.000456 and 0.000539 respectively. They are statistically significant at the 1% level. This implies that higher environment, social, governance and controversy scores are associated with decreasing in downside risk (MDD).

The "Developed" variable in Model 27-30 have coefficient of 0.0462, 0.0534, 0.0679 and 0.0416 significant at the 1% level. This corroborates the finding from Model 26, suggesting that firms in developed countries tend to have decrease in downside risk (MDD) compared to those in emerging markets.

Marginal Effect

The interaction terms in Model 27-30 like DevelopedxEscore, DevelopedxSscore, DevelopedxGscore, and DevelopedxControversy indicate how the relationship between each ESG component and MDD changes in developed countries. Only DevelopedxControversy has no statistically significant. DevelopedxEscore, DevelopedxSscore and DevelopedxGscore interactions are statistically significant, at the 5%, 1% and 1% level consecutively, suggesting that in developed countries, the associations between these specific ESG components and decreased MDD differ compared to emerging countries.

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All control variables align with our initial expectations and are significant at the 1% level

The results from Table 14 emphasizes a clear relationship between ESG practices, the status of a country as developed, and MDD. It is clear that good ESG practices can diminish the probability of steep declines in value. And, the influence of a country being developed is important. This becomes apparent when observing how a developed country interacts with the individual components of the ESGC pillar scores. In developed countries, an increase in the E, S and G pillar scores has a less pronounced impact on MDD, which is significant and opposite sign to our Hypothesis 3. The

rationale for this is consistent with what we provided in Table 13. Meanwhile, the Controversy are not significant in the context of developed countries.

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CONCLUSION

This academic special project has contributed significantly to the understanding of the relationship between Environmental, Social, and Governance (ESG) aspects and downside risk in the Asia-Pacific (APAC) region. The research findings have important implications for investors, governments, and policymakers.

This research delves into an examination of the impact of ESG performance among companies operating in the Asia-Pacific region. The study evaluates ESG performance using the ESG Combined Score and ESGC Score, assessing its relationship with downside risk in terms of value at risk and maximum drawdown. Our analysis centers on publicly traded companies listed on the stock exchanges of thirteen APAC countries, spanning a period from 2012 to 2021. These countries include Australia, China, Hong Kong, India, Indonesia, Japan, South Korea, Malaysia, Philippines, Russia, Singapore, Taiwan, and Thailand.

Our study focused on the APAC region, addressing a research gap by providing valuable insights into how ESG factors relate to downside risk in emerging economies. The comparative analysis with developed markets highlights that ESG aspects may have a different impact on downside risk in APAC due to varying legal frameworks and cultural considerations.

The results of our regression analysis support several hypotheses. Firstly, we found evidence (H1a) that ESG performance, measured by combined ESG scores and ESGC pillar scores, negatively affects Value at Risk (VaR). However, the Environmental (E) pillar had no significant impact in the APAC region, possibly due to differences in environmental regulations and penalties.

Secondly, the analysis supported H1b, indicating that ESG performance negatively affects Maximum Drawdown (MDD) in the APAC region. Again, the E pillar had no significant impact, possibly reflecting regional differences in environmental standards.

Moreover, the study revealed that the strength of the rule of law (ROL) in each country influenced the relationship between ESG performance and downside risk, as hypothesized in H2. The interaction with the rule of law still unclear for this relationship due to vary across levels of rule of law. However, firms in countries with stringent legal

enforcement benefit more from high ESG scores, particularly in environmental performance.

Lastly, the analysis showed differences between developed and emerging countries, confirming H3. In developed countries, the impact of ESG aspects on downside risk was generally less pronounced, possibly due to already stringent legal frameworks and regulations. Conversely, in developing countries, increasing the E, S, G, and C aspects had a more significant impact on reducing VaR and MDD.

These findings have several important implications. For investors, the study provides guidance on managing risk exposure by considering ESG factors, especially in emerging economies during market shocks. Governments should use this information to understand the impact of legal frameworks on market integrity and take steps to enhance law enforcement. Policymakers should consider strengthening legal frameworks and promoting market transparency to foster a favorable environment for responsible investment.

In summary, this research enhances our understanding of the complex relationship between ESG aspects, legal frameworks, and downside risk in the APAC region. It underscores the need for investors, governments, and policymakers to consider these factors when making investment decisions and shaping regulatory policies to promote sustainable and resilient financial markets in both developed and emerging economies.

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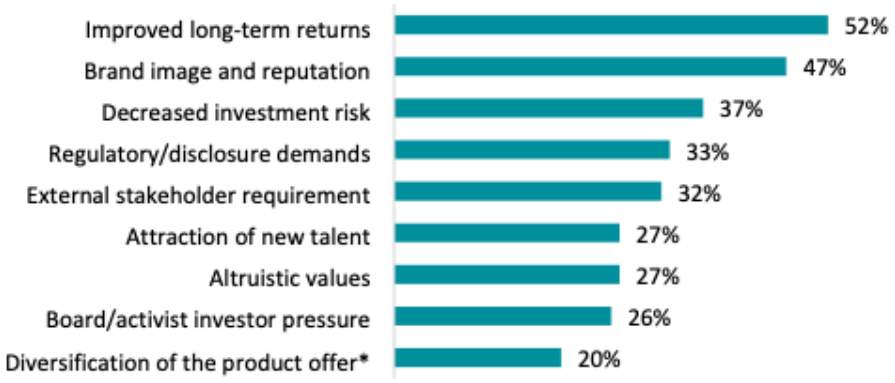
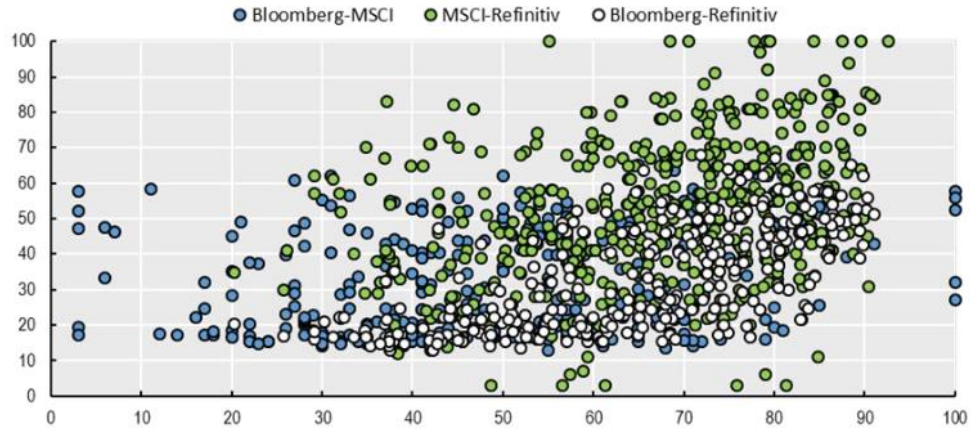
APPENDIX

Figure1: Drivers of ESG integration



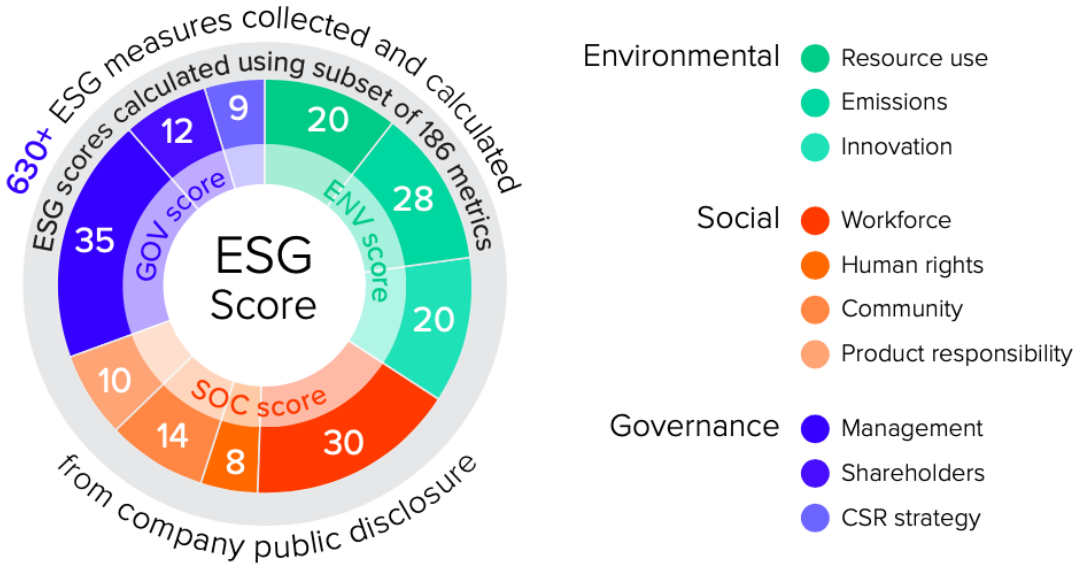
Source: BNP

Figure2: S&P 500 ESG ratings correlation for different providers, 2019



Note: Providers' names in the legend correspond to the Y axis when at the left and to the X axis when at the right (e.g.: Bloomberg-MSCI; Bloomberg = Y axis, MSCI = X axis).
Source: Bloomberg, MSCI, Refinitiv, OECD Staff calculations

Figue3: ESG Score of Refinitiv



Source: ENVIRONMENTAL, SOCIALAND GOVERNANCE SCORES FROM REFINITIV May 2022

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Table3: ESG criteria – major index provider

Pillar	Thomson Reuters	MSCI	Bloomberg
Environmental	Resource Use	Climate Change	Carbon Emissions
	Emissions	Natural resources	Climate change effects
	Innovation	Pollution & waste	Pollution
		Environmental opportunities	Waste disposal
			Renewable energy
			Resource depletion
Social	Workforce	Human capital	Supply chain
	Human Rights	Product liability	Discrimination
	Community	Stakeholder opposition	Political contributions
	Product Responsibility	Social opportunities	Diversity
			Human rights
			Community relations
Governance	Management	Corporate governance	Cumulative voting
	Shareholders	Corporate behaviour	Executive compensation
	CSR strategy		Shareholders' rights
			Takeover defence
			Staggered boards
			Independent directors
Key metrics and submetrics	186	34	>120

Source: Refinitiv, MSCI, Bloomberg, FTSE; OECD assessment.

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