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TITLE
Sustainability and cost of equity: focus on the relationship in the US market, the European market and Emerging markets

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Abstract

This master thesis investigates the effect of sustainability performance on the cost of equity financing. Precisely, it analyzes the association between ESG performance of firms and their cost of equity across three different markets: the US market, the European market, and Emerging markets. The main objective of the study is to try to understand whether higher sustainability commitments by firms lead to a lower risk profile, which in turn should decrease their cost of financing. The study, conducted on a panel of ten years, leads to the main results of risk mitigation in the US equity market, a non-clear relationship in the European equity market, and a non-statical association between the two variables in the Emerging market model, in line with expectations. Overall, the main message of this study is that, when priced by the market, corporate social responsibility should be at the forefront of companies' operations, as it can reduce the idiosyncratic risk exposure. Eventually, this analysis opens for further avenues of research with more extensive data availability.

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Chapter 1 – Introduction

The issue concerning the role of sustainability in finance, and the impact of environmental, social, and governance (ESG) factors on financial performance has remained unresolved for a considerable amount of time (Eccles et al., 2014). Many different corporate theories have dominated the scene in the last few decades giving to sustainability matters different degree of importance. Stakeholder-centric theories are becoming more prevalent these days, placing greater emphasis on factors beyond shareholders and profit maximization. Followingly, many corporations are showing an increased interest in the integration of ESG considerations in their business models (Famiyeh, 2017), also in light of the mounting pressures from societal actors to reshape operations (Gonçalves et al., 2022). The result of these integration movements is a more informed decision-making process by financial players, and a more resilient corporate structure to potential adverse market shocks (Wu & Borovkova, 2021).

Although applicable on a general scale, different markets display different levels of ESG integration. While on one hand it is acknowledged that sustainable considerations have become a major part of the western countries' corporate world, much less is the adoption of CSR practices in developing markets (Boubakri et al., 2021). This gap in ESG integration is due to a poorer level of economic development, and to weaker institutions (Nguyen et al., 2021). Nonetheless, recently also the sustainable wave that landed in advanced economies decades ago has widespread in Emerging markets. Also in these economies, growing pressures from main corporate stakeholders are having effect in penalizing companies that are failing to undertake a path towards sustainable growth (Tansan et al., 2023).

Benefits from a higher level of sustainability integration primarily revolve around the concept of ESG as risk smoother. While current literature is still conflicting on the role of sustainability as a driver of returns, it consistently highlights its ability to mitigate investment risk, making companies less vulnerable to market shocks and allowing them to benefit from better financing terms (Sharfman & Fernando, 2008). Among the others, Lee & Faff (2009) and Plumlee et al. (2015) point to a negative relationship between sustainability performance and the cost of equity of firms. The findings are driven by risk mitigation theory, since firms with strong ESG performance present less risky investment opportunities and have higher potential for cash flow generation.

As stated above, sustainability has evolved as one of the prevailing topics in society, and thus qualifies as new influencing factor for fundamental investors' considerations. When investors critically revise their view on how expectations are formed, new foundations for price formation are set requiring models to be adapted to such changing expectations. Practitioners and academics explore various techniques to integrate ESG factors into investment strategies, with factor-based investment being a popular approach to incorporate green factors into investment portfolios (Maiti, 2020).

For this reason, in order to investigate the relationship between ESG performance and equity cost of capital across the US market, the European market, and Emerging markets, three different factor models are developed in this study. Three different samples are gathered over the period of time going from 2012 to 2023, resulting in 2479 daily observations in the US model, 2727 daily observations collected for the European model, and 79 monthly observations for the Emerging market model. Sustainability performance is measured through a return differential between a sustainable index and the corresponding broad market index, as carried out by Derwall et al. (2014). The ESG factor is then regressed alongside the three Fama French (1993) factors on the Fama Mac Beth (1973) factor portfolios to investigate the association with their returns.

The results of this study points to a statistically negative association between firms' cost of equity financing and ESG performance in the US market, suggesting that investors perceive the higher level of sustainability integration as a risk reducing tool, as stated in Hypothesis 1 (See Section 4.3). The result is also in line with El Ghoul et al. (2018)'s study, supporting that sustainable investments do represent a source of value for firms. For what concerns the relationship in the European market, the results are of a more mixed nature. Despite not being possible to identify a negative relationship supporting what stated in Hypothesis 2 (See Section 4.3), the results offer an interesting view point on the issue. The argument set forth is that of a lack of standardization on sustainability disclosure, and on applicability of sustainability scores, which limit the genuineness of ESG ratings. The Emerging markets model does not provide statistically significant results, supporting what stated in Hypothesis 3 (See Section 4.3). Lower ESG performance, weaker institutions, and limited data availability are what explain the results for this model.

Overall, this study offers important contribution to the current literature, while also opening up to further avenues to grasp more significant results. To begin with, the research

emphasizes the increasing significance of recognizing sustainability as a value-driven factor when formulating a business strategy, highlighting the influence of sustainability on the cost of capital. This compels managers to broaden their focus beyond purely financial metrics (Andriof et al., 2002). Secondly, the current work also sheds lights on the limitations of ESG developments and the lack of standardization, which hamper the validity of many of the models that are developed. Lastly, the paper encourages further research on the association between equity financing costs and sustainable integration, through better data availability. This work therefore enriches the literature on ESG and cost of equity (Alareeni et al. 2020; Alessi et al. 2021; Friede et al. 2015; Gianfrate et al. 2018; Gonçalves et al. 2022; Jin 2018; Lee & Faff 2009; Maiti 2020; Ng & Rezaee 2015; Prober et al. 2015), while also presenting a cross comparison with developing countries, that have been heavily under looked by previous works.

The rest of the paper is organized as follows: Chapter 2 provides a literature review on the concept of sustainability applied to finance, with a specific focus on Emerging markets, on the relationship between ESG and cost of equity, and on asset pricing models including sustainable factors. Chapter 3 aims at pointing out the different perspectives under which this study is relevant. Chapter 4 introduces the methodology deployed for the analysis, as well as the hypothesis that are developed. Chapter 5 shows the sample selection process and the description of the dataset. Chapter 6 presents the results of the analysis, with a specific focus on each different market. Chapter 7 tries to understand whether the newly developed model has better statistical power than the conventional ones. Chapter 8 discusses the results of the study, with the scope of looking for some potential societal implications. Lastly, Chapter 9 presents the conclusions, limitations, and future research avenues.

Chapter 2 – Literature Review

The underlying chapter aims at combining the concept of sustainability in finance within the asset pricing theory framework through relevant academic works on the topic. The first section of the chapter deals with the concept of sustainability in the general financial environment. The goal is that of bringing up the main role of Corporate Social Responsibility (CSR) as long-term value creator and risk smoother. The follow up section shifts the focus on the role of sustainable considerations in Emerging markets. The peculiarity of these markets makes sustainability's role slightly different, allowing also to create crucial growth opportunities. The role of stakeholders in such context is also pointed out. The second part of the chapter investigates the relationship between environmental, social and governance factors and the cost of equity using existing literature. Several works are shown with the main aim of understanding what the current literature says about the association. Last section of the chapter incorporates ESG considerations directly into equity estimation models. Also in this case, available literature is used to understand what are the models currently deployed to combine both factors into a unique model.

Hereafter the terms ESG, socially responsible, and corporate social responsibility will be used interchangeably to refer to sustainable considerations.

2.1 The role of sustainability in finance

The puzzle concerning the role of sustainability in finance and the effect of environmental, social and governance (ESG) on financial performance has been unresolved since a long time. Different theories in modern economics place different stakeholders at the hearth of companies' operations. Neoclassical economics together with most management theories position shareholders at the top of the stakeholders ranking, viewing profit maximization as the key corporate goal (Eccles et al., 2014). According to Brown & Caylor (2006) this shareholder-centered vision entails that the satisfaction of other stakeholders of the firms would be detrimental to the overall performance. Other more stakeholders theories centric place greater emphasis on the other constituents of firms' web other than owners, and on the externalities of shareholders' activities (Deegan, 2002). Over the last few decades these theories have started to dominate the financial world with many corporations showing an increased willingness to incorporate ESG considerations in their business models (Eccles et al., 2014). Contrarily to traditional management theories, corporations have started to realize that it is possible for them

to have a solid financial performance, while also being attentive to the impact of their operations (Famiyeh, 2017).

The role of sustainability in the financial environment has been growing at a high pace, grabbing significant attention in recent years because of increasing concern over ESG issues. Compared to the past, companies are now exposed to existing growing pressures from shareholders demanding to shape operations in a more sustainable manner (Gonçalves et al., 2022). These pressures channeled through the integration of ESG principles, affecting decision making processes and steering businesses toward positive outcomes (Khan et al., 2016). A practical example of this increased focus on sustainability in finance is the offering of a varied set of instruments from institutions that aim at providing sustainability-risk adjusted returns (Berg et al., 2016).

Sustainable efforts are not only rewarded by better long-term value creation, but also through credible recognitions by financial institutions. These latter ones acknowledging true commitments of corporations are now more inclined to offer better lending terms to clients (Gianfrate et al., 2018). An interesting example is provided by Danone, who in recent years has shifted its business model toward a more sustainable path with its new mission 'One Planet, One Health'. In 2018 the company was granted a loan with better credit conditions based on the company's effort to improve ESG performance (BNP, 2018). The above mentioned example merely shows how can sustainable concerns be directly linked into financial products.

Nonetheless, the combined efforts to integrate ESG in the financial environment mainly flow into the concept of sustainability as a risk smoother. This is because the aim of sustainable investment strategies is to achieve higher sustainability profile of portfolios, without sacrificing on other more traditional performance measures such as return and risk. Current literature is still conflicting on the role of sustainability as a driver of returns, while instead it clearly evidences that it mitigates investments' risk, especially in the long term. The main takeaway from the several works published on the topic is that sustainable companies may still produce lower returns, but they are less vulnerable to various market shocks and so are considered to be more resilient (Wu & Borovkova, 2021). In this respect, Eccles & Serafeim (2013) developed a performance frontier model through which they demonstrated that incorporating sustainable factors into financial analysis can enhance the accuracy of risk assessments, thus ameliorating financial planning in the long term. Again, this is because reputational risk is reduced when considering ESG issues (Serafeim, 2014).

On the other hand, looking straight to companies not in line with ESG considerations, we can find several empirical studies showing that firms active in industries which are a 'threat' to the environment and to the society, like tobacco, gambling, alcohol, are more sensitive to potential shocks and to future litigations that may arise (Hong & Kacperczyk, 2009). Adverse events could impact the corporations' image hitting the overall risk profile and profitability. The very well-known example of environmental incident caused by British Petroleum in 2010 can help the understanding of how important is for investors to be aware of the potential impact of investing in ESG threatful industries. In 2010 the oil drilling rig 'Deepwater Horizon' exploded in the Gulf of Mexico, causing the death of 11 workers, and resulting in the largest spill of oil in the history of marine oil drilling operations. British Petroleum suffered massive losses arising from litigation and clean-up costs, but most importantly it suffered an incredible loss in reputation. All of this caused the company to see its market capitalization halved in less than two months, resulting in massive losses for investors (US EPA, 2022). The sensitivity to potential shocks caused by investment strategies that overlook at sustainable considerations can be very harmful to investors' portfolios (Konar & Cohen, 2001).

In brief, the most important concept to grasp from current research is the mitigation effect that sustainability has on the negative impact of economic activities on the environment and society, whilst also providing long term value creation for investors (Clark et al., 2015).

2.2 Sustainability in Emerging markets

Not surprisingly, corporate sustainability has become a relevant topic also in Emerging markets because of the unique economic, social and environmental challenges that these countries are exposed to. The World Bank highlights the importance of sustainable considerations in Emerging markets by pointing out its economic and demographic relevance. In fact, these economies make up 80% of the world's population and account for almost 70% of the world's GDP growth (Corporate Finance Institute, 2022). Furthermore, the delicacy of the topic is brought up by a study conducted by S&P Global and the Boston Consulting Group. According to them, around 15% of developing countries' GDP is at risk from climate change by 2050, especially in the South Asian region. As such, sustainability's role in these markets cannot be ignored.

The sustainable wave that landed in the corporate world of advanced economies decades ago has now gone further toward Emerging market companies. The main difference between the two is that compared to the developed world, much less is known about the relation of

corporate social responsibility and corporate performance in Emerging markets. What is indeed acknowledged is that developing market companies' adoption of CSR is less in comparison to peers worldwide (Welford, 2005), and that the gap is due to a poor level of economic development (Baughn et al., 2007). Nonetheless, the sustainable boost has been prompted by pressures from main corporate stakeholders that are now penalizing companies that fail to back their commitments with material actions. Companies with strong sustainable standards are instead compensated with more growth opportunities in developing countries, while those lagging behind in the filling of the 'sustainability gap' are at a disadvantage in both domestic and foreign markets (Tansan et al., 2023).

As in more developed markets, corporate sustainability practices are incorporated through the adherence to ESG criteria that allow companies in Emerging economies to create long term value (Shakil et al., 2019). The Boston Consulting Group found that corporate leaders are now starting to understand that the long term value creation advanced by sustainability is imbedded in the building of resilience. The product of resilience is that of benefiting from higher overall performance and handling risk and disruption in today's rapidly evolving international business landscape.

Even more relevant than ESG inclusion in emerging markets is the stakeholders' engagement. Corporate sustainability includes the involvement of local communities, NGOs, financial institutions, and other stakeholders that can direct corporates toward sustainable outcomes. The development of relationships with stakeholders is particularly relevant in these markets, where companies face high social and environmental risk. For this reason, firms that engage with local third parties are more likely to build trust and strengthen their social licenses to operate (Fetscherin et al., 2010).

Nonetheless, the role of sustainability in Emerging markets in not merely limited to risk mitigation. Corporate sustainability can create new market opportunities that are not well rooted in those economies, as for example investments in renewable energies or in sustainable technologies. The product of these initiatives is that in addition to lowering environmental impact, it is also triggered the creation of new cash flow streams (Tansan et al., 2023). This is extremely relevant in Emerging markets, in which there is a growing demand for sustainable products and services. The IMF shows that debt capital markets are dominating the increase in demand, with a volume of sustainability debt issuance increasing by 3800% in the period from 2013 until 2021.

Examples of stakeholders' involvement creating new market opportunities are all the projects in underdeveloped countries that are sponsored by the International Finance Corporation (IFC). The IFC offers 'Sustainability-linked finance' (SLF) in order to mobilize capital toward an increasingly greener future. Because of weak institutions, the IFC not only provides for the structuring of transactions and provision of finance to Emerging countries, but also collaborates with borrowers from the very early stages of projects through a strategic support. This role of sustainability as new market creator is relatively new and fast growing, with volumes of SLF in Emerging markets showing a 386% increase compared to pre-pandemic levels. Thus, it is clear that Emerging markets represent a big opportunity for important SLF projects (IFC, 2022).

Another practical example of sustainability integration in Emerging markets arises from the renewable energy sector. Several Emerging market countries led by China and India have allocated significant amount of capital to renewable energy infrastructure in recent years, with the goal of lessening their carbon footprint. More specifically, China is now market leader in renewable energy production, showing massive investments in wind, solar and hydropower projects (IEA, 2021). Indeed, these investments are not only an important contribution to overall sustainability but also an attractive signal for domestic and worldwide investors for profitable investment opportunities.

Credible signals have also been prompted by market institutions such as Emerging market exchanges through the creation of sustainable indices promoting responsible investing (Boubakri et al., 2021). For example, the Corporate Sustainability Index, including only companies that meet certain ESG criteria, has been launched by the Brazilian Stock Exchange in 2005 (B3, 2022). Likewise, also the South African stock exchange introduced a sustainable investing index, the 'FTSE/JSE Responsible Investing Index', with the objective of shedding lights on those companies that are able to demonstrate robust ESG performance (Johannesburg Stock Exchange, 2021). The result of the creation of the above mentioned indices is an acceleration of the integration of sustainability factors into decision-making, further prompting companies to ameliorate their ESG performance (Boubakri et al., 2021).

Nonetheless, it is important to point out to the heterogeneity among Emerging market companies for what concerns the sustainability integration activity. Some economies have made major steps in the last decade to embrace sustainability factors, while some others are still lagging behind (Lavin et al., 2022). In the Latam world the major developments have been

made by Brazil, which is now at the forefront of sustainability initiatives. As mentioned in the previous paragraph, this has been possible through the very early creation of the Corporate Sustainability Index, which allowed the domestic market to well-establish a sustainable finance market (B3, 2022). Undoubtedly, the pace of development of sustainable finance has not been the same for all economies in the region, with most of them still in the developing phase of their ESG frameworks (White & Case LLP International Law Firm , 2021). Examples of ESG integration that are still far from actual development are offered by Mexico, in which pollution, water scarcity, waste management and governance corruption impact ESG developments. Another example is offered by Colombia, where deforestation due to illegal mining and drug related activities pose threats to ESG developments (Compass Group, 2021).

On a similar note, in the Asian continent economies like the South Korean and the Singapore one have well integrated sustainability considerations in their financial and regulatory environment (ASIFMA, 2020). South Korea for example has recently introduced new ESG rating guidelines to foster transparency on methods and mechanisms used by ESG rating agencies. This will allow to have a more precise comparison among different companies and for investors to make more informed decisions, reducing the risk they bear (Uhrynuk, 2023). On the other hand, other Southeast Asian countries lag far behind in the ESG principles adoption. The example of India show that despite having made good progress on ESG integration, issues like air pollution and governance controversy still pose a threat to the actual state of development (Drishti IAS, n.d.). The examples proposed above remark the growing awareness of sustainability in finance in Emerging markets. Notwithstanding, the advancements in each country varies significantly signaling the needs for additional developments and harmonization of principles (Rajgopal, 2022).

The overall situation of ESG development in Emerging markets needs to be analyzed also in the context of a comparison with western companies. The sustainable gap can be investigated by looking at the average ESG scores of the largest market cap firms in developing countries, and in developed markets. Looking at the largest listed firms in Brazil, China, India, South Korea, Saudi Arabia, Mexico, and Pakistan, we can see an average Sustainalytics ESG score of 35.58, representing an high level of risk. Compared to the ESG scores of the largest firms in USA, Germany, France, Switzerland, Italy, Netherlands, Japan, and New Zealand, this is an increase of almost 20 points in the ESG score. In fact, the average ESG score in these developed markets is 16.3, signaling a low level of environmental, social and governance risk

(Sustainalytics, n.d.). In addition to that, the delay in sustainable integration is also reflected in the production of renewable energies as portion of overall energy production. In Emerging markets the share of renewable energy is 30%, while in western countries it accounts for almost 50% of the overall electricity mix (IRENA, 2023).

In conclusion, corporate sustainability is a crucial factor to consider for companies in developing markets. The adoption of ESG practices, combined with the increased engagement with stakeholders and the embracement of new profitable opportunities can help the overall market in two main ways: it can mitigate risk and create long-term sustainable value (Fetscherin et al., 2010).

2.3 Relationship between ESG and cost of equity

It is important to understand what current literature says about the relationship between sustainability and cost of equity estimation. Starting from there, it will be then possible to incorporate sustainable considerations within models for the estimation of the cost of equity, such as the multifactor model of risk. The extant literature on the topic struggles to find a common point of view on the association between sustainability performance and the cost of equity. The nature of the issue lies in the fact that fundamentals of responsible investing performance remain questioned to date (Gonçalves et al., 2022).

On one hand, most of the current literature points to a negative relationship between sustainable integration and expected equity returns, showing that positive ESG performance leads to lower cost of equity (Sharfman & Fernando (2008); Gonçalves et al. (2022); Lee & Faff (2009)). Further evidence of this sign of the relationship is provided by El Ghoul et al. (2021), finding that a negative relationship between corporate environmental responsibility and cost of equity is driven by both risk mitigation theory and an investor base perspective. The concept of risk mitigation claims that firms performing well on sustainability metrics represent less risky investment opportunities and, thus, will benefit from a lower cost of capital. According to this perspective, there will be a lower probability of negative events happening to responsible firms, and however, even in case they occur, sustainability can be seen as acting as a shield against possible negative consequences.

Gonçalves et al. (2022) showed that the embracement of sustainability may shield firms against adverse events allowing firms with high sustainability scores to display lower idiosyncratic risk. Followingly, Plumlee et al. (2015) found that higher levels of corporate

social responsibility could potentially lead to higher cash flow generation or lower cost of capital, while Friede et al. (2015) showed that pricing ESG factors into financial analysis decreases long-term risk for investors and also has a positive impact on risk adjusted returns. Other findings do not support this view of the relationship. For example, Prober et al. (2015) tried to understand whether investors reward green companies by paying a higher price, in light of the negative relationship between investors' required return and price, or if instead they penalize sustainable companies in such being green increases costs and reduces profits for shareholders. No significant relationship has been identified in the paper.

Additional studies found significant outcomes for the relationship between ESG and cost of equity, but only contingent on some other key variables. The work by Serafeim (2020) shows that investors assign higher discount rates to companies' ESG performance if sentiment is negative because investors expect future reputational, legal or operating costs. The valuation of a corporate ESG performance increases as a function of the public sentiment. There is a substantial differential in pricing for investors in sustainable companies based on public sentiment momentum (Serafeim, 2020).

Overall, based on the majority of the current findings, it can then be said that to the extent that corporate social responsibility affect firm level risk, being sustainable allows to benefit from better financing terms (Bouslah et al., 2013).

2.4 Asset pricing models with ESG factors

Widespread actions by governments all around the world are now concretely combatting climate change. Investors are also responding through an increased demand for sustainable investments (Amel & Serafeim, 2018), and as a consequence ESG risk has finally evolved as a real investment risk for financial assets valuation, causing the standard asset pricing model to adapt (Fink, 2021).

Financial incentives targeted at sustainable development modified market expectations about return and risk exposure of firms and their financial assets. These modified expectations of capital market participants on how sustainability considerations systematically determine the price formation process have to be incorporated in theoretical foundations, and in existing models to enhance their accuracy (Wilkens et al., 2021). Practitioners and academicians explore different techniques to integrate ESG factors into their investment strategy. Most

popular of them is the factor-based investment technique to incorporate green factors into their investment portfolios (Maiti, 2020).

The very first study that incorporated ESG performance within an asset pricing model is the one by Sharfman & Fernando (2008). The authors examined the impact of environmental risk management on the cost of equity using the Capital Asset Pricing Model, with firms sorted based on their corporate social performance. Prober et al. (2015) studied the effects of firms' green performance on stock returns using a four-factor multivariate regression model. The green score presented in that study is composed of three different aggregate measures consisting of Environmental Impact Disclosure, Environmental Management Score and Disclosure Score. Wu & Borovkova (2021) also included an ESG factor in a multifactor investment strategy considering the US market and the European market. Starting from the well-known Fama French Carhartt five factor model, they constructed long-short sustainability factor by looking at the December ESG score each year. Through this portfolio factor model, sustainability considerations could be included not necessarily to enhance returns, rather to increase ESG performance of the whole portfolio. Similar work is carried out by Jin (2018) in the use of the conventional four-factor model (market factor, size factor, value factor and momentum factor) with further incorporation of an ESG-related factor. The paper suggests that the financial performance of securities is related with ESG systematic risk, that needs to be priced in since diversification only compensates for overall systematic risk. For the construction of the ESG factor, Jin adopted a return differential between an ESG portfolio and a broad market portfolio, since to date is not fully feasible to form ESG-related factor portfolios by screening subset of securities (Jin, 2018). Furthermore, by taking the difference between two broad portfolios having similar construction it is like measuring the gap between ESG leaders and laggards. Likewise, the sustainable impact on portfolios' return tend to be better revealed using the differential methodology suggested by Derwall et al. (2014).

Ultimately, the increasing importance of sustainable consideration indicates that managerial actions aimed at enhancing corporate social responsibility might be priced by investors, highlighting the importance of being able to include ESG risk factors in asset pricing models (Gianfrate et al., 2018).

Chapter 3 – Relevance of the study

This chapter addresses the relevance of the analysis highlighting the potential gaps in the current literature. The significance of the study is first addressed from a societal perspective, illustrating the importance from an investor's standpoint. Then the relevance is analyzed from an academic point of view, looking at the methodology implemented.

There are different perspectives to be considered when addressing the importance of this study, mainly dealing with the academic content of the paper and the relevance of the methodology. However, it should also be highlighted the positive impact that works like this can have on the academic community in further raising awareness on the topic. This study comes in satisfaction of the increase in the demand for a more sustainable model that can integrate ESG with the financial valuation of the company and portfolio models. It is clear that ESG studies are still in the nascent stages and need further exploration in different dimensions of it (Gibson et al., 2021). Thus, this study provides an important contribution to the existing literature on how stock markets prices corporate sustainability performance.

Before diving in the actual academic contribution of this work, the very first consideration to be made is related to the concept of sustainability itself. Any work developed with the scope of advancing the investment community toward a sustainable direction is relevant for the overall society, as it aims at solving a societal need. It is very important that market players are properly informed about the general environmental situation in order to be able to take the best possible set of actions. In fact, according to the European Commission (2020) to support a long-run sustainable growth, players in the financial environment should be well informed to be actively involved in the transition to a low-carbon, more resource-efficient and sustainable economy. For this reason, the first point of relevance identified for the underlying work is the broad societal community of the planet.

The second relevant point for any work that deals with themes related to sustainability in finance is the overall investment community. Investors in financial markets aim at building profitable investment opportunities that can persist in the long run. For this reason, the advancements in asset pricing models including ESG factors are of much interest for investors, because they could potentially see the overall risk exposure of their investments reduced, while providing potential higher sustainable long run returns (Alareeni & Hamdan, 2020). Khan et al. (2016) showed that the developments in the understanding of the value of corporate sustainable activities have not been supported by sufficient advancements in the understanding

of the price of corporate sustainability. In that respect, Serafeim (2020) pointed out that investors can then exploit sustainable signals by firms if the market has not priced them yet. This is because companies pursuing green activities may not immediately benefit from risk reduction, which is a long-run phenomenon, and thus will not necessarily be able to enjoy better operational performance straight away.

Still on the investors' side, through self-financing portfolio models allocating capital to 'greener' firms at the expense of harmful stocks, it would be possible to avoid that investors misallocate their savings. Again, as previously stressed, in this context sustainability would be seen as a risk mitigator. In fact, investors can get significant amount of information from these sustainable risk factors for making their investment decision and accordingly these risks can be diversified to avoid heavy losses (Maiti, 2020). The avoidance of a potential deadweight investment is a positive thing also from the regulators' perspective, as their main aim is that of minimizing market inefficiencies (Beneish & Vorst, 2021). Furthermore, the relevance of including sustainability considerations within an asset pricing model emerges from the fact that investors' propensity to invest in ESG compliant companies is dependent on the market being able to reward more sustainable companies (Jin, 2018). As such, if the green efforts by companies are properly compensated by the financial environment, the volume of sustainable securities traded could increase massively.

Coming back to the academic relevance of the work, it can be said that it mainly revolves around the fact that as of today there is no clear consensus in the literature on how to measure whether financial markets price sustainability risk (Maiti, 2021). Most of previous studies tend to ignore the inclusion of ESG factors in asset pricing models. Maiti (2021)'s study points out that risk factors are evolving over time since most asset pricing models present some losses in their efficiency. The study also highlights that factors like ESG will be of key relevance for what concerns the future of asset pricing models. For this reason, the inclusion of a sustainable factor model within an asset pricing framework could try to tackle a discussion flared out in the last four decades among market participants, investors, practitioners and academia on how ESG can be integrated within organizations' financial performance.

An even more important point for the actual contribution of this work is that there is not a specific study investigating the relationship between sustainability and cost of equity using a cross market comparison among the US market, the European market and Emerging markets. Most of the current literature focuses on a single market-specific study, like Prober et al. (2015)

who investigated the effect of company green scores on stock returns with a focus on the United States. All of these studies, include at the end of the work open avenues for further comparison among different markets that are indeed explored in this work.

In addition to that, Emerging markets link with ESG performance is a topic not very well covered by existing literature and it deserves some further investigation in order to allow investors to make more informed decisions in those markets (Lavin et al., 2021). Developing new models trying to price sustainable factors in Emerging Markets will then enrich the literature on the topic, adding relevance to the work carried out.

In conclusion, this chapter deals with the relevance of the study from different angles. It recognizes the societal need for advancing the investment community toward a more sustainable path, and the potential benefits of including ESG factors in asset pricing models such as higher risk-adjusted long term value creation. Furthermore, the academic contribution lies in filling the gap in literature by investigating the relationship between sustainability and the cost of equity across different markets, including Emerging markets that have historically received less attention. By enriching the literature and providing insights for more informed investment decisions, this study adds relevance and value to the field.

Chapter 4 – Research Design & Hypothesis Development

In this chapter the theoretical background of the method deployed for the analysis is described, with a short comparison between a single factor model and the notorious Fama French three factor model. Then the actual methodology used in this paper is illustrated together with the rationale of the inclusion of the newly built ESG factor. In the last section of the chapter the hypothesis will be developed, pointing out to the differences that are expected to be found due to heterogeneities in the three different markets under analysis.

4.1 Factor Model: theoretical background

Factor models are a good framework for investigating the cost of financing of firms because in such models the expected return of assets is broke down into systematic and security-specific components. What is relevant to point out is that the systematic component is reflected by factor returns resulting from different sources. The most widely used methods including factors as relevant sources of systematic risk make use of market and firm features that according to available literature are good proxy for systematic risk exposure (Bodie et al., 2014).

The most widely known works estimating the cost of equity using factor models are those proposed by Sharpe (1964) and Litner (1965). They developed the famous Capital Asset Pricing Model (CAPM), which consists of a single market factor that controls asset performance for only a single systematic risk factor (Jin, 2018). Additionally, massive attention by academicians has been devoted to the Fama and French (1993) three-factor model, which extends the CAPM by including a size factor, namely small market cap stock returns minus large market cap stock returns, and a value factor, high book-to-market stock returns minus low book-to-market stock returns.

The decision to use a multifactor model of risk for the analysis in this study rather than a single factor model such as the CAPM, is that covariance with market return is not sufficient to measure the risk of a portfolio. In the work "Multifactor Explanations of Asset Pricing Anomalies", Fama and French (1996) found that the expected return on a portfolio in excess of risk-free rate is well explained by the sensitivity of its return to the three above mentioned factors. Such model allows to capture most of the variation in the cross-section of average stock returns, and also to assimilate most of the anomalies emerging from the CAPM (Fama & French, 1993).

Fama and French also suggested that when you combine value and size with the market factor, this could explain roughly 90% of a properly diversified stock portfolio's return versus the market as a whole. Therefore, the Fama French three-factor model theoretically provides a more accurate approach of estimating the discount rate of a portfolio of publicly traded companies, given that it has two additional risk factors over the CAPM, which only considers beta as its risk factor (Fajasy, 2022). Fama and French (1993) propose the following model to represent the expected return on a portfolio in excess of the risk free rate:

$$E(R_i) - Rf = bi\left[E(R_M) - R_f\right] + s_i E(SMB) + h_i E(HML)$$

where $E(R_i) - Rf$, $E(SMB)$, $E(HML)$ are the factor loadings representing the expected premiums, while bi, si, hi are the slopes of the regression.

Fama and French (1995) explain the rationale of including a book-to-market factor and a size factor. Book-to-market and the slope on the factor High minus Low (HML) are a good proxy for relative distress, because poorly performing firms with constantly low earnings tend to have high book value of equity on market value of equity ratios, and positive slope on the factor HML. For financially performing firms it is the opposite case, having low book-to-market ratios and negative slopes on HML.

Fama and French (1993) use Chan & Chen's (1991) evidence finding that since there is connection between return and relative distress, not captured by market return, this needs to be compensated in average returns through an extra market factor. Based upon this, Fama and French (1994) found that the three-factor model displays higher cost of equity for distressed industries than for healthier ones, explained by higher factor loadings on the HML factor sensitivity. As previously mentioned, the meaning of the average HML return is a premium added to compensate for the risk of relative distress. The premium applied is justified by the fact that low book-to-market firms have persistently strong earnings, compared to the persistently low earnings of high book-to-market firms (Fama and French, 1995). The same mechanisms applies to the Small minus Big (SMB) factor. The covariations of returns of small companies is not embedded in market returns, and so it needs to be compensated through average returns. The rationale to include the SMB factor is that of capturing size effect in stock returns for understanding the sources of risk and return in the equity market (Fama & French, 1992; Fama & French, 1993). The size coefficient is computed as the difference between a portfolio of small-cap firms and a portfolio of large-cap firms, using a market weight. Empirical

research demonstrates that smaller companies tend to display a higher financial performance than bigger companies in the long run. This is because smaller companies are considered riskier and should hence have a higher expected return to compensate for the additional risk burden (Fama & French, 1992).

In conclusion, SMB and HML factors represent the combination of two very important risk factors of special concern to investors (Fama & French, 1995), and for that reason they should be included in models estimating the cost of equity of a portfolio.

4.2 Methodology

The model developed for the analysis is a panel data regression which takes into account the three Fama French systematic variables with the addition of a sustainability factor. Following Fama and MacBeth (1973) procedure, the factors are then regressed on the 25-Fama French factor portfolios formed on size and value for the US and European market and on the 6-Fama French factor portfolios formed on size and value in Emerging markets.

The model is developed based on Berk & DeMarzo's (2019) work that showed that it is possible to estimate the expected return of an asset or portfolio as a linear function of some factor betas and their respective risk premiums. As such, the methodology implemented in order to address the research question is a multifactor linear model using the factors market, size, and value alongside the sustainable factor described above.

The ESG factor incorporated in the Fama French three factor model is formed according to the methodology carried out in Jin (2018)'s. Since it is not feasible to form an ESG-related factor portfolio by screening a subgroup of securities, the method used is a return differential between a market representative index and the ESG version of the same index. The validity of this technique is shown by Derwall (2014) who demonstrates that the return differential between a ESG index and the corresponding broad market index highlights the performance of ESG leaders. Furthermore, the effect of sustainability tends to be emphasized more distinctly when measured through the gap between ESG leaders and laggards (Jin, 2018). In the following chapter, the construction of each ESG factor using different market indices for the three market under analysis is described (See Sections 5.4, 5.5 and 5.6).

The rationale of performing a return differential between a sustainable index and its corresponding broad market version, is that of pointing out to the risk mitigation tool of ESG. As previous literature remarkably demonstrated, the primary driver in the financial landscape for considering ESG sustainability issues is the risk mitigating effect that it has on the cost of

equity (PwC, 2014). Hence, including a factor built on such return differential could potentially highlight the role of ESG factors as risk smoothers.

The final model will be an extension of the Fama French three factor framework with the inclusion of a sustainable factor for each different market:

$$r_i = \alpha_i + ß_i MKT + s_i\, SMB + h_i HML + g_i ESG + \varepsilon$$

4.3 Hypothesis Development

The development of hypothesis is based on current available academic works pointing out that ESG performance develops paths to adjust firm-level financial risk, that in turn would lead to a superior economic performance and a consequent cost of equity reduction (Ng & Rezaee, 2015). Motivated by prior research already discussed in Chapter 2 and Section 4.2, the main hypothesis of this research paper is that firms with positive ESG performance benefit from a lower cost of equity. Any disclosure of information that goes hand in hand with higher ESG performance allows investors to make more informed decisions, decreasing their risk exposures and allowing them to be satisfied with a lower potential return. In addition to that, also from an equity valuation perspective, better ESG disclosure makes investors more accurate in their estimation of future cash flows, reducing their required risk premia (Leuz & Wysocki, 2008).

Even though this is applicable on a general level, for the sake of this research work it is necessary to develop different hypothesis for the three different markets under analysis, in order to take into account heterogeneities. In the US context historically ESG factors were perceived as a secondary consideration to financial performance (Eccles et al., 2017). This could be mainly attributed to a corporate governance framework very shareholder centric, where profit maximization is considered to be the most important corporate objective to pursue (Zattoni, 2020), but also to political reasons with republican states being highly critical on ESG integration (Meager, 2022). However, it must be said that in the last few decades there has been an increasing recognition of the long term effects of sustainable considerations on investment decision-making. In fact, it can now be said that the ESG factors have evolved at a steady pace, with regulators now enforcing primarily principle-based ESG frameworks rather than specific mandatory disclosure (Eccles et al., 2017).

Furthermore, companies that are listed on the US Stock Exchange are required by law to disclose material ESG information that are instructional to the investment community (SEC, 2021). The Center for Audit Quality published a work on ESG disclosures of the S&P 500

companies showing that more than 95% of companies publicly disclose ESG reports on a standalone basis, and not in an SEC filing. The remaining 5% still publish some general information about their sustainability operations on their website, signaling the overall raising awareness on the topic (Goelzer, 2021).

Accordingly, the argument put forward is that since most of the S&P 500 companies have broad ESG disclosure policies that signals superior quality disclosure from an investor perspective, their decision-making will be more informed and less risky, thus reducing the cost of equity financing for firms in the index. This leads to the first hypothesis:

> ***H1**: The ESG Factor in the US market has a negative relationship with portfolio cost of equity, as ESG performance mitigates firm level risk.*

In the European context the scenario is different when we talk about ESG considerations because of a long-lived history of integration. Since the 1972's European Council, the EU environmental policy has been active to the point that it produced the need for a community-wide environmental action. Only a decade afterwards the very first action programme began, with the first legal basis for a common environmental policy settled down. The scope was that of protecting the environmental quality, ensuring high level human health, and an efficient use of natural resources. In 1993 the Treaty of Maastricht rendered the environment one of the official EU policy areas (European Parliament, n.d.).

Furthermore, this rapid development of sustainable practices has been possible thanks to the role of the European Union through the establishment of several regulatory frameworks (CFA Institute, 2021). Just to name a few, the most relevant and new regulations have been the EU's Sustainable Finance Disclosure Regulation (SFDR), the EU Taxonomy, the Corporate Sustainability Reporting Directive (CSRD) and the Corporate Sustainability Due Diligence Directive. The SFDR has the goal of improving transparency of sustainable investment products in order to allow investors to be more confident with firms' sustainability claims and thus prevents greenwashing. In addition to that, the EU Taxonomy Regulation has also been a very relevant development in the sustainable field because it established an EU-wide classification system providing the business community with a common language to truly understand the breadth with which economic activities can be defined environmentally sustainable (The Harvard Law School Forum on Corporate Governance, 2023).

More specifically to corporate sustainability reporting, the EU mandates to large and listed companies to disclosure regular reports on the ESG risk to which they are exposed and on the

extent to which their operations affect people and the environment. Very recently, the Corporate Sustainability Reporting Directive (CSRD) entered into force strengthening the rules related to ESG reporting for companies, with the objective of ensuring that investors and other major stakeholders have access to the material aspects that they need in order to properly appraise the investment risks coming from sustainability related matters (European Commission, n.d.).

As a result, the argument on which the second hypothesis is built on is that historical reasons, as well as frameworks developed by the European Union, did play a significant role in the development and integration of ESG factors in Europe. In light of the fact that ESG integration and disclosure reduce firm level risk, the second hypothesis is phrased such that there is a cost of equity reduction in firms with high level ESG, as it was the case of the US hypothesis. All of this leads to the second hypothesis:

> ***H2**: The ESG Factor in the European market has a negative relationship with portfolio cost of equity, as ESG performance mitigates firm level risk.*

For what concerns Emerging markets there is a whole different story to argue about. As already discussed in Chapter 2, being in a phase of potentially high growth, and representing a huge portion of world's population and of GDP production, Emerging markets really are something to keep an eye on for future sustainable developments. The greatest issue to look at is the historical link between GDP growth and the volume of emissions, which made growth unsustainable in the long term (Nguyen et al., 2021).

The general picture of the market in Emerging economies is that of less transparent institutions, which in turn command less disclosure at firm level, translating in a much slower flow of information. All of this entails that market structures are less developed and efficient, providing a lower investor' protection and limited active market access (Tansan, 2023). Not surprisingly, the general conditions of the market also reflect the situation of ESG integration in these economies. While developed economies took major advancements toward a more sustainable future, most Emerging economies kept their policies focused on growth rather than reshaping it considering the impact towards the environment. As of now, regulatory frameworks and government intervention with respect to climate action are less mature (Tansan, 2023).

The 'sustainable gap' mentioned in Section 2.2 referred to the fact that EM companies are behind their peers for what concerns sustainable ratings in almost every ESG factor. A study

conducted by the Boston Consulting Group compared the average ESG score of companies representative of the G20 nations and the ten most important Emerging economies, showing that the latter one lag behind in every ESG pillar. The comparison was made taking an environmental index from the data provider Refinitiv and the results were on average almost 20 points higher for companies in developed economies. This delay is mostly explicable by the level of carbon emissions and the inefficient use of natural resources (BCG, 2023).

In addition to structural characteristics, also the asset class composition makes the sustainable analysis of securities in EM very complex. In fact, the equity asset class in Emerging markets is more diverse than in western larger equity markets (Nguyen et al., 2021).

All of the evidence here presented comes in support of the development of the hypothesis that for Emerging markets the situation is different with respect to the European market and the US market. General market underdevelopments, lower transparency of institutions, higher emissions and overall less ESG disclosure are not indifferent from an investor's perspective. In this case, there is no supportive evidence of a risk smoothing of ESG performance and so the argument of risk mitigation, and subsequent cost of equity reduction, cannot be brought forward. This leads to the third hypothesis of the study:

> ***H3:*** *The ESG Factor in the Emerging market has no significant association with portfolio cost of equity.*

Chapter 5 – Sample Selection & Data Analysis

In this chapter the sample used for the analysis is described in detail with a focus on the sources of the relevant data. The first part of the section deals with the selection and construction of the Fama French predictors used, while the second part will deal mostly with the selection of the dependent variables in each specific market and the construction of the sustainable factor. The very last part of the chapter is devoted to a brief analysis of the dataset.

The period under analysis for the study begins in March 2013 and goes until the end of January of the current year. This period has been considered because it is not possible to obtain data for the S&P 500 ESG, or other sustainable indices, before that month. The sample consists of three different sub-groups for the three different markets under analysis. The relevant data for the Fama French factors are gathered from Kenneth R. French data library, while the indices returns are obtained from several different data providers including Investing. All the data are collected on a daily basis, apart from the EM indices and factors that are monthly observations.

5.1 Factors Description

Kenneth French presents the market factor as the excess return of each market over the one-month Treasury Bill taken as proxy for the risk free rate. The market returns consist of value-weighted returns of listed firms on the NYSE, AMEX and NASDAQ for the US, and on regional stock exchanges in Europe and in Emerging markets. Countries that are included for the estimation of factors in Europe are Austria, Belgium, Switzerland, Germany, Denmark, Spain, Finland, France, Great Britain, Greece, Ireland, Italy, Netherlands, Norway, Portugal and Sweden, while in developing countries are Brazil, Chile, China, Colombia, Czech Republic, Egypt, Greece, Hungary, India, Indonesia, Malaysia, Mexico, Pakistan, Peru, Philippines, Poland, Qatar, Saudi Arabia, South Africa, South Korea, Taiwan, Thailand, Turkey, United Arab Emirates (Kenneth R. French - data library, n.d.).

The value and size factors are built according to a double sorting methodology working in the same way for all the three markets under analysis. For this reason, below is presented the explanation from the Fama and French (1993) work on how the factors are actually built in the US market only, since the procedure is the same in the other two. Stocks listed on the NYSE, AMEX, and Nasdaq exchanges are categorized into two groups: small (S) or big (B). This categorization is based on whether the market equity (ME), calculated by multiplying the stock price by the number of shares outstanding, is below or above the median ME for NYSE stocks in June. Additionally, these stocks are independently sorted into three groups based on their

book-to-market equity (BE/ME) ratios: low (L), medium (M), or high (H). The breakpoints for these groups are determined by the bottom 30 percent, middle 40 percent, and top 30 percent of the BE/ME values for NYSE stocks (Fama & French, 1993). To form the portfolios, the BE/ME ratio is calculated using the book equity for the fiscal year ending in the previous calendar year divided by the market equity at the end of December of the previous year (t-1). The Small Minus Big (SMB) factor is computed each month as the difference between the average returns of the three small-stock portfolios (S/L, S/M, and S/H) and the average returns of the three big-stock portfolios (B/L, B/M, and B/H). On the other hand, the High Minus Low (HML) factor is calculated as the difference between the average returns of the two high-BE/ME portfolios (S/H and B/H) and the average returns of the two low-BE/ME portfolios (S/L and B/L).

5.2 Dependent Variables

The dependent variables used for the three models follow the rationale of Fama & MacBeth (1973) that used 25 factor portfolios as outcome variables in their study. The reason for including these portfolios as dependent variable was that of providing a more detailed representation of cross-sectional variation in stock returns. Furthermore, categorizing stocks based on two accounting variables, such as market capitalization and BE/ME, allows to more precisely differentiate between strong and distressed stocks, producing larger spreads in average returns (Lakonishok et al., 1994).

The Kenneth French data library provides access to 25 portfolios sorted on size and value for the US market, as well as for the European market, while it only supply data for 6 portfolios using such double sorting for Emerging markets. Below the description of how these portfolios are formed.

The portfolios used in the US model are created annually in June and are formed by combining five portfolios based on market equity (ME) and five portfolios based on the ratio of book equity to market equity (BE/ME). The size breakpoints for each year are determined by dividing the NYSE-listed stocks into quintiles based on their market equity at the end of June. To calculate the BE/ME ratio for June of a specific year (t), the book equity from the previous fiscal year ending in (t-1) is divided by the market equity in December of (t-1). The BE/ME breakpoints are also determined based on the quintiles of NYSE-listed stocks (Kenneth R. French - data library, n.d.).

For what concerns Europe, stocks in each region are classified into five market cap and five book-to-market (B/M) buckets at the end of each June. Size breaks and book-to-market breakpoints are used for every region to allocate region's stocks to the developed portfolios, resulting in 25 value-weighted size-B/M portfolios product of the intersection of the independent 5x5 size and B/M sorts (Kenneth R. French - data library, n.d.).

For the Emerging Markets the mechanism is the same, but the double sorting is slightly different since there are only 6 factor portfolios. Also in this case size and B/M are used as breakpoints for each country in order to create country portfolios. The difference is that in this case the sorting is done on a 2x3 basis producing six value-weighted portfolios: small growth (low B/M), small neutral, small value (high B/M), big growth, big neutral and big value (Kenneth R. French - data library, n.d.).

5.3 US Sustainable Factor

As described in Section 4.2 the ESG factor is built as the return differential of a sustainable index and the corresponding market-wide index. For the case of the US market, the S&P 500 ESG Index and the S&P 500 have been chosen as best proxies for the construction of the factor. Here can be found a detailed description of the S&P 500 ESG Index.

Steadman & Perrone (2019) provide a detailed description of the index, that is offered by a division of S&P Global. The S&P 500 ESG Index has been created with two main objectives: 1) Ensuring that investors avoid companies that are not running their businesses in accordance with ESG principles, and at the same time 2) Providing similar risk/return profile of the S&P 500. The methodology for the index composition is very straightforward. It consists in two steps, the first one being the exclusion of some companies, and the second the weighting of stocks per industry. S&P's companies that are screened out have to be either involved in the tobacco industry, produce controversial weapons or do not comply with the UN Global Compact. In addition to that, another criteria for exclusion is the relative ESG score of a given company with respect to its industry peers, with companies having low scores compared to comparable firms in their industry also excluded from the index composition.

After the exclusion, companies are ranked according to their S&P DJI ESG Score and subsequently chosen by S&P DJI ESG Score until 75% of the market cap of that given industry group within the standard S&P is reached. As previously touched upon, industry weighting is done in order to respect one of the key objectives of the index of trying to replicate the

risk/return profile of the standard S&P. As a result, the ESG score for the S&P 500 ESG Index is around 75, while that of the S&P 500 is around 60. The implication of such differential can be done by reading S&P DJI Scores as percentiles, implying in this case that the average of companies within the S&P 500 ESG Index has higher score than 75% of industry peers, while for the S&P 500 the average is 60% higher.

5.4 European Sustainable Factor

For the European Market the STOXX Europe 600 ESG-X Index is used to construct the sustainable factor. Qontigo (n.d.) describe the index composition and its main characteristics. The STOXX Europe 600 ESG-X uses the STOXX Europe 600 index as benchmark for the composition and it applies an ESG exclusionary screening. The exclusion of some companies is performed with the scope of having within the ESG index companies that are keen on responsible policies and on reduction of reputational and idiosyncratic risk. Similarly to the US version of the index, the screening method adopted by the STOXX Europe 600 ESG-X drops out stocks that are either non-compliant with the Global Compact Principles, deal with controversial weapons, produce tobacco related products, and that derive revenues from fossil fuels extraction and exploration.

Even though the composition of the ESG version of the STOXX 600 is very similar to that of the standard index, it is interesting to note that the turnover of the ESG index is on average higher, meaning that the screening methods frequently adjusts to make sure that investors are informed just-in-time about potential risk-reducing stocks to add to their portfolios. The geographical breakdown of the index allows to see that one fourth of the index composition comes from the UK, followed by France with almost 20% of holdings, Germany with 15% and Switzerland with 13%. Most represented industries are the Health Care sector, Industrials Goods & Services, Banks, and Food & Beverage.

5.5 Emerging Markets Sustainable Factor

While for the US model and European model there was no need to discuss in detail the benchmark market-wide indices chosen, for Emerging markets it might be relevant to briefly also touch upon that.

The market index chosen for the factor differential is the MSCI Emerging Markets Index. The index includes holdings from 24 Emerging market countries, with the Asian region covering slightly more than half of the overall composition. In addition to that, the index captures large

and mid-cap stocks in order to boost up the risk return exposure. In fact, low size companies are underweighted in the index at the benefit of low volatility and high quality holdings (MSCI, n.d.).

For the sustainable index, the one used to construct the ESG factor in Emerging Markets is the iShares MSCI EM IMI ESG Screened UCITS ETF. The fund has been chosen as proxy for ESG performance in EM for several reasons, including the fact that it is one of the few ESG indices in Emerging Markets that publicly disclose performance. Also in this case the fund adopts a screening mechanisms, but it doesn't mimic a specific market-wide index as it was the case for the US and European model. The adopted screening mechanism is made on controversial weapons, nuclear weapons, tobacco, fossil fuels, as well as companies that violate the UN Global Compact principles. What makes this fund similar to the two sustainable indices described in the previous sections is that the main objective is maintaining a risk return profile in line with traditional benchmarks, while avoiding to sustain the future growth of companies involved in controversial business areas (BlackRock, n.d.). The fund exposure is dominated by the APAC region, with 30% of the holdings being Chinese, 15% Taiwanese and 14% Indian. Financial industry stocks represents one fifth of the index holdings, followed by Information Technology and Consumer Discretionary goods.

5.6 Data Analysis

Descriptive Statistics

Table 1 shows the descriptive statistics for all the variables in the US Model. The daily average for all factor factors is approximately zero, while the standard deviation is slightly above one percent for the market factor, while below for the small minus big and high minus low factors, as well as for the sustainable factor. The range of observations is 21% for the market factor, 9% for the SMB factor, 11% for the HML factor and 0.8% for the sustainable factor.

[INSERT TABLE 1]

Table 2 displays the summary statistics for all the variables in the EU Model. Daily averages for all factor factors is approximately zero also in this model, while the standard deviations are marginally lower than in the US Model. By consequence, also maxima and minima observations are lower in absolute terms, implying that the observations follow a somewhat more linear pattern.

[INSERT TABLE 2]

Table 3 presents the results for the Emerging Market Model. In this scenario, the number of observations is much lower compared to the previous two models, as observations are available only on a monthly basis as previously discussed. Monthly averages for the market factor and the HML factor is 0.5%, while approximately zero for the other two. The dispersion of the observation seems not to wide, with monthly standard deviation all below 5%.

[INSERT TABLE 3]

Correlation Matrices

The correlation tables in the appendix present the distribution of each variable on the diagonal of the graph, the correlation coefficients with significance level as stars on the top of the diagonal, and bivariate scatterplots with fitted lines on the left of the diagonal.

Overall, for the US Model there seems to be a statistically significant correlation between independent variables as visible in **Table 4**. There is significant correlation for all variables in the model, apart from the abnormal ESG coefficient.

[INSERT TABLE 4]

For the European Model, it can be seen from **Table 5** that the market variables shows a statistically significant correlation both with the SMB factor and the HML factor. Same applies for the SMB and HML, with a statistically significant correlation of -0.24. The ESG coefficient does not have a statistically significant correlation with any of the other variables.

[INSERT TABLE 5]

Table 6 shows the correlation matrix for the Emerging markets Model. None of the independent variable has statistically significant relationship with the others. Some implications for the result section can already be deducted, matching the hypothesis laid down in Chapter 4.

[INSERT TABLE 6]

Chapter 6 –Results

This chapter is devoted to the analysis of the results of the various models that are run. The outcome in each different market will be discussed in a separate section in order to emphasize the main findings. The focus of the analysis of the results will be on the coefficient of the ESG factor, since the interpretation of the Fama French factors is not the focus of this study. All the results presented below are estimated using a standard Ordinary Least Square method.

6.1 US Market

Table 7 presents the main results from the US model regression. The dependent variables are the 25 factor portfolios sorted on size and value. For this reason, the output of the model will be a coefficient for each combination of market cap and book-to-market portfolios.

[INSERT TABLE 7]

Regarding the association between the sustainability factor and the 25 factor portfolios, **Table 7** shows a negative and statistically significant relationship for 21 out of the 25 portfolios used as outcome variable, confirming hypothesis number one (See Section 4.3). Overall the sustainable factor plays an important risk mitigating role, allowing companies that embrace sustainable practices to lower their cost of equity financing. Section 8.1 focuses on a more detailed interpretation of these findings.

On the economic implications of the coefficients it can be said that statistical power of estimated coefficients goes hand in hand with economic relevance. The magnitude of the estimates are in a range between -1.6 to 0.96, implying that the risk smoothening effect of ESG could have a lowering impact on cost of equity of almost 200 basis points, on the basis of the sample used.

Other relevant results are for example the portfolio with the highest market capitalization, but lowest book-to-value having a positive and statistically significant coefficient. This means that the cost of equity financing for this type of firms is on average higher. Same case applies for firms with highest book-to-market and smallest market cap, and highest book-to-market and second lowest market cap. The reason for a higher cost of equity in the scenarios described above might be that portfolios composed of big market value companies and low book value

of equity perceive such firms as being risky, with the sustainable factor not able to mitigate such exposure. The overvaluation or the size of these companies pose a threat that dominates the risk mitigation effect of ESG integration. For the portfolios having high-book to market and low market cap the reasoning still focuses on the risk premium that investors are expecting to receive because small companies with high book to market ratio may signal financial distress risk. Also in this case, sustainability is not able to play its risk reduction role.

Interestingly, the portfolio composed of both highest BM and highest size does not have a significant relationship with the ESG factor. A reasonable interpretation of this may be that since these firms already signal high quality and stability, due to their stable market positions coming from large market cap and strong financial health that could be associated with high book-to-market, the effect of ESG does not go any further what companies' fundamentals already signal. The cost of equity of these firms may already be on the lower side because of the low risk profile they signal to investors.

It is also relevant to investigate any potential pattern of the coefficients on the ESG factor. As it can be seen from the heatmap in **Figure 1**, the coefficients with highest magnitude are on the top left and bottom right. Another interesting thing to notice is the fact that when we move to the right of the graph there is an increase in the negativity of the sign of coefficients, until last size sorting. To be clearer, if we take the average values of each column we see that until the column sorted including the biggest market cap firms, the coefficient on ESG becomes more negative. Investors seems then to be rewarding sustainable integration alongside the size of the firm until a given extent. To some extent it is similar also the pattern of coefficients analyzed in rows representing the value sorting. The main difference is that on average the rows sorted on book to market tend to become more negative when the ratio is low.

[INSERT FIGURE 1]

It is also relevant to mention the statistical significance of the intercepts, because in asset pricing models the interpretation of the intercept changes with respect to statistical models. The intercept term, usually referred as alpha, is the excess return of a portfolio that is not explained by the predictor factors included in the analysis (Reed, 2022). **Table 7** shows that all but one intercept term are not statistically significant at the 5% level, meaning that the return of 24 out of 25 factor portfolio can be adequately explained by the size, value and ESG factor. This results is not surprising as most of the relevant data are gathered by the Kenneth French data

library. The only significant intercept is that of the portfolio having the largest market cap and lowest book-to-market ratio. Even though statistically significant, its economic significance is negligible, since the coefficient is 0.000117 meaning that the on average the cost of equity for such portfolio is 0.000117% higher.

6.2 European Market

Table 8 presents the main results from the European model regression. Also in this case the dependent variables are the 25 factor portfolios sorted on size and value.

[INSERT TABLE 8]

The relationship between the ESG factor and the dependent variable is much more complex in this scenario. **Table 8** doesn't allow to really infer a strong and ascertained directionality of the relationship because of the mixed evidence of the coefficients on the ESG factor. Only eight out of the 25 factor portfolios have a statistically significant ESG coefficient at the 5% level, while if we move the confidence level at the 10% threshold the number of portfolios increases to ten. It is evident that such results do not support the second hypothesis laid down (See Section 4.3) and somehow go against it. This is because out of the eight statistically relevant coefficients, five points toward the opposite direction implying higher cost of equity for those portfolio of firms. In Chapter 8 the results coming from this model are discussed in more details to understand the nature of the outcome.

Analyzing the coefficients more in depth, it can be noticed that for example for the portfolio Big/High the coefficient on ESG is positive at the 1% level, implying higher cost of equity for those portfolio firms. The coefficient is 0.2334 which means that on average when the other predictors are held constant, the cost of equity increases by 0.23%. On the other, considering the portfolio Big/Low we would observe a 0.14% reduction of cost of equity for these firms.

Overall it can be said that for those coefficients that are statistically significant, also the economic significance can be derived. The range of coefficients is in between -0.141 and 0.337, with a mean of 0.1%, a median of 0.15% and a standard deviation of 0.18. This means that sustainable practices have an impact in absolute terms on the cost of equity of 15 to 40 basis points over the estimated period of the sample.

Figure 2 shows the heatmap for the sustainable coefficients for the EU Model. In this case is more difficult to properly identify a pattern in the sign of the coefficients. What can be said is that the more negative column of ESG coefficients is the one having the smallest market cap, while the row with the highest negative average is the third row in the value sorting.

[INSERT FIGURE 2]

For what concerns the intercept term, in this model it is possible to observe from **Table 8** three alphas that are statistically significant. Again, the interpretation is pretty straightforward with 22 out of the 25 factor portfolio return well explained by the factors included in the model. Also in this case the statistical power of these three alphas don't go hand in hand with economic significance since the magnitude of the coefficients is still negligible.

6.3 Emerging Markets

The context is different for Emerging market in such the analysis is carried out using 6 factor portfolios. **Table 9** presents the results of the model where it could be seen a coefficient for each combination of market cap and book-to-market portfolios.

[INSERT TABLE 9]

Not surprisingly the six coefficients on the sustainable factor are not statistically significant and do not allow to look for a directionality of the relationship. All the p-values have not statistical power at the 10% level, meaning that the ESG factor has no impact in the cost of equity financing in Emerging markets and does not act as powerful risk mitigating tool as proposed with Hypothesis 3 (See Section 4.2). Section 8.3 discusses in more details the implication of these results.

Three alpha terms are statistically significant at the 1% confidence level, with their coefficients being respectively -0.0029, 0.003582, 0.004858. It is clear that despite statistical power, there is no actual implication to draft here.

Chapter 7 – Robustness Checks

In this chapter the reliability of the models estimated are analyzed. In order to check the statistical validity and the relevance of developing a three factor Fama French model adding a sustainable factor, a three factor model without the inclusion of the ESG factor is also run. Below there is a section comparing the adjusted R-squared and the standard error of the two different models for the three markets under analysis.

7.1 US Model

Table 10 show that the values of Adjusted R-squared for the four factor model are always higher than the three factor model. It can be then said that by including a sustainable factor, the variance of the returns of the 25 factor portfolios are always better explained.

[INSERT TABLE 10]

Same major conclusion can be drawn from reading the standard error table. The model including the additional ESG factor results in less errors in the estimation of coefficients.

[INSERT TABLE 11]

7.2 European Model

Same reasoning can be drawn for the European model. Also in this case, **Table 12** displays higher values of Adjusted R-squared for the sustainable model than for the standard three factor model. The inclusion of the ESG factor allow to explain a higher proportion of variance of the 25 factor portfolio returns.

[INSERT TABLE 12]

The same can be said for the standard error, in such being lower allow to have a more accurate estimate of the coefficients when including the sustainable factor.

[INSERT TABLE 13]

7.3 Emerging Markets

For Emerging Markets the situation is slightly different. While the average Adjusted R-squared for the four factor model is just slightly higher, 0.9768 versus 0.9764, the accuracy of the estimation of the predictors is lower for the ESG model.

Standard Errors are lower for the six models that do not include the sustainable factor. The mean of the standard error for the non-ESG model is 0.0077640000, while for that including also the fourth factor is 0.007764667. The implication of this result is that adding the statistically insignificant ESG factor there is no contribution in explaining the variation in the dependent variable beyond what the three factors already in the model could do. Another interpretation comes from the principle of model parsimony. In some cases, higher standard errors for models having extra variables indicate that the less complex model is preferrable (Vita, 2019).

Chapter 8 – Discussion

This final chapter is devoted to a high level discussion of the idea of the work itself, as well as to some potential implications of the results presented in the previous section (See Chapter 6). The first part of the chapter comes back to the relevance of the work and qualitative practical implications, while the second part discusses the main findings of the regression analysis.

Several implications can be drafted from this kind of study. First of all, this work supports the growing importance of considering sustainability as value-relevant when defining a business strategy, as its impact on cost of capital urges managers to think beyond just financial measures (Andriof et al., 2002). Indeed, the study is innovative and important as it offers practical implications for managers and policymakers. This claim is supported by Waddock (2017) as ESG strategies of firms do contribute to the establishment of a more sustainable business context. Any work allowing to make statistical inference between ESG integration and required return of firms has practical implications for the investment community. Through an increase availability of information, investors must consider these green factors while making investment decisions. By pricing the greenness in the expected return for investors, they can understand to what extent the incorporation of ESG affects the portfolio risk return performance. Investors or marketers can get significant amount of information from these risk factors for making their investment decision and accordingly these risks can be diversified to avoid heavy losses (Maiti, 2020).

8.1 US Market

In the US market the implications of the model run would be that of integrating sustainability consideration with daily business activities in order to be rewarded by the market with a lower cost of financing. This suggests that ESG integration can also lead to an improved risk management meaning that companies can in this way be better equipped to cruise potential risks and uncertainty, thus enhancing financial performance.

These results have to be analyzed keeping in mind that according to corporate governance literature the Anglo-American model is considered to be the dominant one, in which the market itself is very important, dominates every transaction, and it is efficient (Zattoni, 2020). Thus, developing a sustainable factor using the S&P 500 model builder provides meaningful results and in this case indicates that the market does value sustainable practices. With green

awareness further growing, companies that are able to signal high ESG performance may engage a wider investor base and access to capital. The risk mitigation tool then leads to the creation of competitive advantage in terms of capital attraction at a lower cost of capital.

Lastly, a possible explanation of why the hypothesis is being supported might be the operational efficiencies and cost savings associated with ESG integration. Sustainable firms show higher investments in energy efficiency, waste reduction and employee-related programs that decrease operating costs and improve profitability. These positive financial results may then translate into a reduced cost of equity.

8.2 European Market

For the European market the implications of the results are far more delicate to draft. As already discussed in Section 6.2, it is not possible to infer a direct relationship between ESG integration and cost of equity. The results are of miscellaneous nature, mixed in the sign of the relationship, and mostly without statistical power, thus disconfirming hypothesis two.

It is not necessarily easy to draw a representation on why the findings do not support hypothesis two. The strongest argument set forward is about the actual current development of ESG criteria. The problem that may emerge is that since the harmonization among countries and industries across Europe is not well established, the validity of the analysis may be impacted. As of now the development of ESG standards is still vague and lacking of market-wide regulated measures. In fact, it is safe to say that the most relevant weaknesses related to ESG implementation arise from lack of standardization on ESG data, greenwashing, and limited disclosure by companies. In addition to that, the recent expansion of the ESG market horizon triggered a more intensive flow of ESG data jointly with the establishment of many new rating agencies, which only created a wave of chaos in an already undefined portion of the market (Porter at al., 2019). The complications become bigger when looking at the inconsistency of the supply of ESG data across companies and industries. If the flow of information is not regular and its distribution is very skewed in some specific areas of the world, money managers encounter big obstacles in the investment allocation and client advisory (Greenbiz, n.d.). Here the paradox is perfectly observable. As previously mentioned the desire for ESG implementation in retail and institutional portfolios is increasing, while the volume of ESG investments is on a delayed schedule with respect to the will of investors because investment allocators around the globe have to deal with conflicting and inconsistent

data across assets. The irregular availability and quality of ESG data raise high barriers to the amalgamation of ESG into the investment process (Porter at al., 2019).

In addition, according to S&P Global (2020) the absence of consistent, robust, verified and widely accepted data standards makes it difficult to compare the ESG characteristics of a company that is a potential investment target against another. It also makes it difficult for asset managers to comply with regulatory obligations around disclosure and assessing sustainability risks and opportunities. Due to the absence of a standardized disclosure of data, investors do not have the possibility to accurately evaluate companies' ESG performance and then struggle to understand which are the risks that have a material impact for organizations.

For this reason, despite statical power of some of the factor portfolios, the results emerging from the European model should be analyzed in more depth rather than inferring that ESG integration does not mitigates the risk profile of firms. This analysis leaves open avenues to correct the misspecification of the model such that it become statistically valid, and with meaningful results.

8.3 Emerging Markets

The implications of this study in the context of Emerging markets have to be developed after having laid down a couple of important concepts. First of all, the biggest limitation of the EM model was the data availability. The sample consisted of monthly observations starting only from July of 2016, resulting in 79 observations per variable in the model. Indeed, access to a wider dataset including daily observations could enhance the statistical validity of the model and provide more meaningful implications. Also, the other two models developed were regressed on 25 factor portfolios, while for Emerging market countries the only option was to use 6 factor portfolios. The second very important point to touch upon is the applicability of ESG scores to Emerging market countries. The issue lies in the fact that Emerging market companies, as a group, face significant underperformance compared to companies in developed markets across all three ESG pillars, as indicated by widely accepted rankings from various agencies. It may result in being unfair to impose identical ESG criteria on high-income and low-income nations, given their different stages of economic development and distinct social challenges (Tansan et al., 2023). It is evident that a more comprehensive model including future developments of ESG criteria will be of great importance to capture to the full extent the growing demand of sustainable products and to investigate in the best possible way the risk mitigating tool of ESG in EM.

To conclude, it is relevant to stress again the fact that most of the previous studies have ignored the ESG factor in asset pricing models, and no one really tried to make a cross market comparison including the three most relevant areas in the world. This work could then be a starting point to develop more sophisticated models pricing ESG into cost of equity financing of companies across the US market, the European market and Emerging markets. Certainly, the mixed nature of the findings in this work, combined with potential future developments in the sustainable sector open to the possibility for future research on the topic to derive stronger policy implications.

Chapter 9 – Conclusion

The study had as main objective that of investigating the relationship between corporate sustainability performance and the cost of financing across three different markets: the US, Europe, and Emerging markets. The analysis comes in support of the extant literature having troubles in identifying a shared association between ESG and cost of equity, due to the still questioned nature of responsible investing (Gonçalves et al., 2022). While some works argue that higher level of sustainability integration leads to better financing terms (Bouslah et al., 2013), some others do not support this view of the relationship (Prober et al., 2015).

In satisfaction of this long-lived riddle, three different samples have been used, with frequencies of observations based on data availability. The first and second sample gathered consisted of daily observations of Fama French factors, ESG factor, regressed on the 25 Fama Mac Beth portfolios, for the US model and EU model. The third sample was formed of monthly observations regressed on 6 factor portfolios for the Emerging market model.

Consistently with Sharfman & Fernando (2008), and El Ghoul (2018), this investigation found a negative association between ESG performance and the cost of equity in the US market. In this model, firms are able to benefit from an almost 200 basis point reduction over the estimated time horizon. When analyzing the relationship in the European market, it is harder to properly identify a direction of the relationship, raising the issue of lack of standardization of ESG principles, and therefore questioning the validity of the model. Less surprising are the outcomes of the Emerging market analysis, where none of the six estimated coefficients have statistical validity. This last finding is coherent with the third hypothesis developed (See Section 4.3), as developing countries suffer from a weaker institutional framework, and lower ESG integration.

Following the outcome of the analysis, some implications can be drafted. In the US market, integrating sustainability considerations into daily business activities can result in a lower cost of financing. This suggests that ESG integration improves risk management and enhances financial performance, enabling companies to navigate potential risks and uncertainties more effectively. In the European model, a key argument centers around the current development of ESG criteria. The lack of harmonization among countries and industries may impact the validity of the analysis, raising concerns about the consistency and comparability of ESG data. Moving to the Emerging market model, it is important to note

that the availability of data posed a significant limitation for the study. Additionally, as a group, Emerging market companies tend to underperform their counterparts in developed markets across all three ESG pillars, as highlighted by widely recognized rankings from various agencies.

In conclusion, this analysis is somewhat innovative in his genre under several perspectives, and it also offers practical implications for market participants. First, it is one of the few studies on sustainable asset pricing theory trying to compare three different markets in the same setting. Other studies tend to ignore the inclusion of ESG criteria in factor models, or focus on one specific market at a time. Second, it raises the awareness on the importance of taking into account sustainable considerations within strategy definitions of firms, as supported also by existing literature (Waddock, 2017). All of this would result in a risk mitigation, from which investors can benefit, as a more extensive availability of information would be guaranteed. Marketers are then able to diversify their risk exposure and make more informed decisions to avoid substantial losses (Maiti, 2020). Moreover, the outcomes from the models developed also show the limitation of this study, advancing the need to develop a more comprehensive analysis comparing the three different markets all at once.

Appendix

Table 1.

Summary Statistics US Four Factor Model

Color	Count	Mean	Median	Min	Max	Range	Std Dev
Mkt.Rf	2479	5e-04	7e-04	-0.1200	0.0934	0.2134	0.0114
SMB	2479	0e+00	-1e-04	-0.0357	0.0548	0.0905	0.0061
HML	2479	0e+00	-4e-04	-0.0500	0.0674	0.1174	0.0086
abnormal_ESG	2479	0e+00	0e+00	-0.0047	0.0041	0.0089	0.0007

Table 2.

Summary Statistics EU Four Factor Model

Color	Count	Mean	Median	Min	Max	Range	Std Dev
Mkr.Rf	2727	3e-04	6e-04	-0.1197	0.0846	0.2043	0.0108
SMB	2727	0e+00	1e-04	-0.0331	0.0191	0.0522	0.0043
HML	2727	0e+00	-3e-04	-0.0300	0.0438	0.0738	0.0055
abnormal_ESG	2727	-1e-04	-1e-04	-0.0239	0.0119	0.0359	0.0009

Table 3.

Summary Statistics EM Four Factor Model

Color	Count	Mean	Median	Min	Max	Range	Std Dev
Mkr.Rf	79	0.0054	0.0071	-0.1709	0.1255	0.2964	0.0482
SMB	79	-0.0009	0.0012	-0.0336	0.0350	0.0686	0.0150
HML	79	0.0056	0.0025	-0.0690	0.0606	0.1296	0.0248
abnormal_ESG	79	-0.0003	0.0007	-0.0421	0.0231	0.0652	0.0122

Table 4.

Correlation Matrix US Four Factor Model

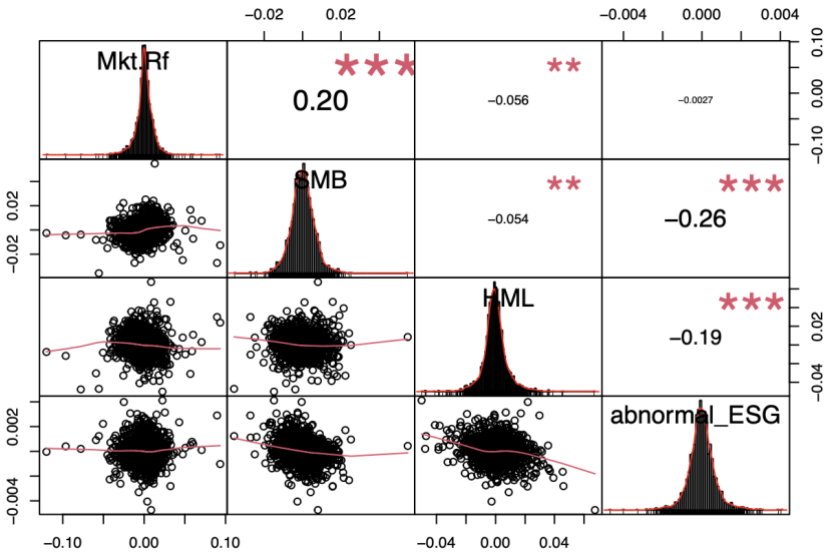

Table 5.

Correlation Matrix EU Four Factor Model

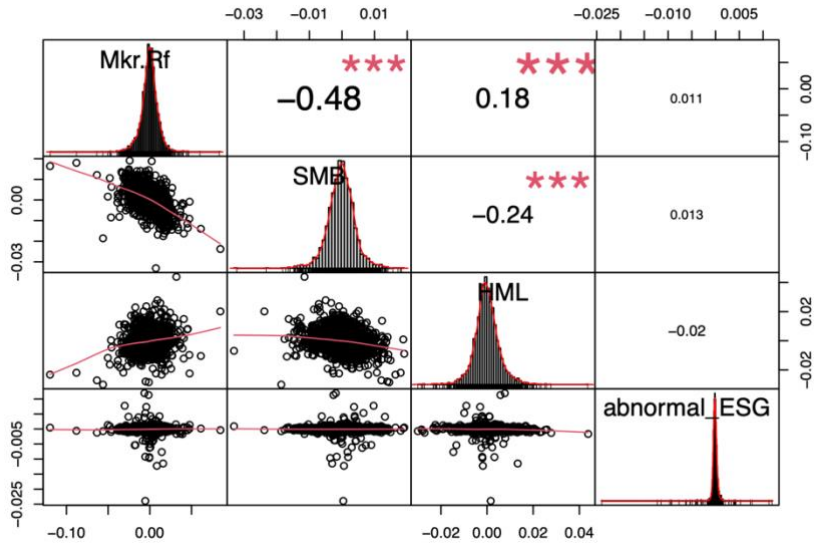

Table 6.

Correlation Matrix EM Four Factor Model

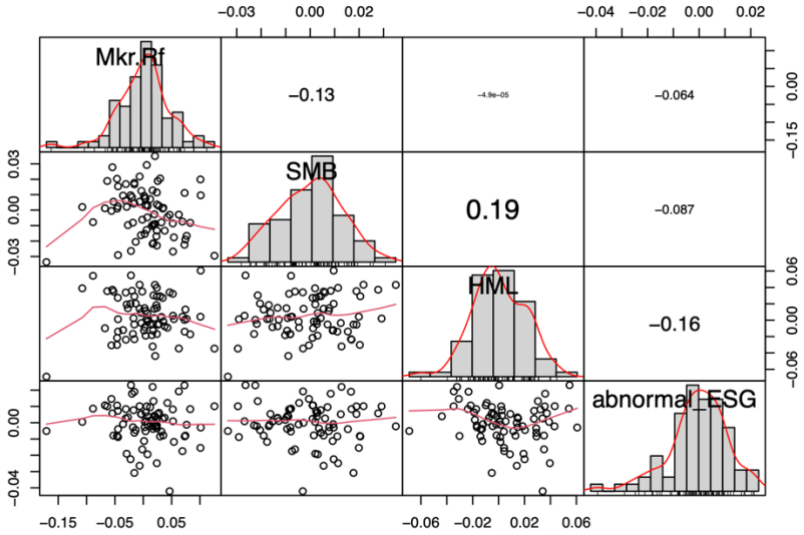

Table 7.

US Four Factor Model Regression

	Low	2	3	4	High
Alpha					
Small	-0.00014	4e-05	3e-05	5e-05	0.00025*
2	3e-05	7e-05	1e-05	2e-05	5e-05
3	-4e-05	8e-05	1e-05	4e-05	-3e-05
4	8e-05	8e-05	1e-04	-3e-05	-1e-05
Big	0.00012**	4e-05	2e-05	-3e-05	1e-05
b					
Small	1.02079***	0.99577***	0.92953***	0.92488***	0.79836***
2	1.09736***	1.05154***	1.00633***	0.99291***	1.02956***
3	1.102***	1.04374***	1.01281***	1.03793***	1.12597***
4	1.01198***	0.99869***	0.99383***	1.03408***	1.13145***
Big	1.03107***	0.92675***	0.92963***	0.96096***	1.20337***
s					
Small	1.3349***	1.27893***	1.12441***	1.04908***	1.1326***
2	1.20041***	1.01289***	0.93114***	0.89472***	0.94844***
3	0.81992***	0.65795***	0.56141***	0.65247***	0.74206***
4	0.31142***	0.2747***	0.24847***	0.31398***	0.30911***
Big	-0.14096***	-0.19689***	-0.11389***	-0.11399***	0.03353*
h					
Small	-0.26165***	-0.1342***	0.21328***	0.51024***	0.63205***
2	-0.36338***	0.05556***	0.36529***	0.65779***	0.78262***
3	-0.29163***	0.13662***	0.37992***	0.65655***	0.96412***
4	-0.29145***	0.11554***	0.3501***	0.59438***	0.85536***
Big	-0.2945***	-0.02179***	0.29783***	0.61125***	0.90557***
g					
Small	-0.9377***	-0.17335	-0.17672	-0.02758	0.96891***
2	-0.93703***	-0.47323***	-0.38081***	-0.25805**	0.2704**
3	-1.17564***	-0.76382***	-0.57182***	-0.69936***	-0.48062***
4	-1.45366***	-1.30404***	-1.28985***	-1.60975***	-0.84818***
Big	0.73498***	-0.53564***	-0.77463***	-0.64366***	-0.24761

Figure 1.

Heat Map for ESG coefficients – US Model

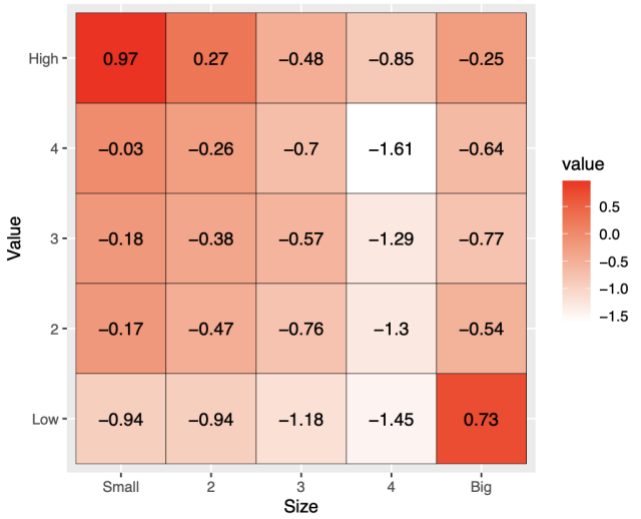

Table 8.

European Four Factor Model Regression

	Low	2	3	4	High
Alpha					
Small	-0.00013*	2e-05	6e-05	8e-05	0.00014**
2	4e-05	6e-05	1e-05	1e-05	5e-05
3	0	1e-04	-4e-05	1e-05	6e-05
4	1e-04	1e-04	-2e-05	0	0
Big	1e-04*	6e-05	-2e-05	-3e-05	4e-05
b					
Small	0.93098***	0.89498***	0.85392***	0.80726***	0.7792***
2	1.14415***	1.10056***	1.04092***	0.99484***	0.96811***
3	1.20048***	1.12636***	1.10256***	1.04556***	1.04139***
4	1.0992***	1.0796***	1.0536***	1.08042***	1.10609***
Big	0.90836***	0.90841***	1.01699***	0.98812***	1.1405***
s					
Small	0.98999***	0.97725***	0.91434***	0.88747***	0.85918***
2	1.06908***	1.06664***	0.92007***	0.91034***	0.84482***
3	0.81671***	0.69918***	0.71583***	0.6691***	0.63926***
4	0.39703***	0.31951***	0.33834***	0.3844***	0.30618***
Big	-0.25526***	-0.28015***	-0.16545***	-0.14663***	-0.13398***
h					
Small	-0.05573***	0.00584	0.04943***	0.15238***	0.29528***
2	-0.3487***	-0.2021***	0.07468***	0.20468***	0.45419***
3	-0.39322***	-0.21563***	0.05574***	0.19399***	0.57358***
4	-0.56341***	-0.22874***	0.02553**	0.25386***	0.6196***
Big	-0.67301***	-0.39498***	0.05742***	0.38406***	0.92357***
g					
Small	0.0011	-0.07012	-0.01172	-0.00209	-0.0875
2	0.12468*	-0.07376	-0.08179	-0.07396	-0.04359
3	0.06182	0.23284***	-0.06824	-0.01444	0.01963
4	0.33745***	0.09982	-0.01202	-0.09424	0.15847*
Big	-0.1412***	-0.09478*	-0.07725	-0.07879	0.23343***

Figure 2.

Heat Map for ESG coefficients – EU Model

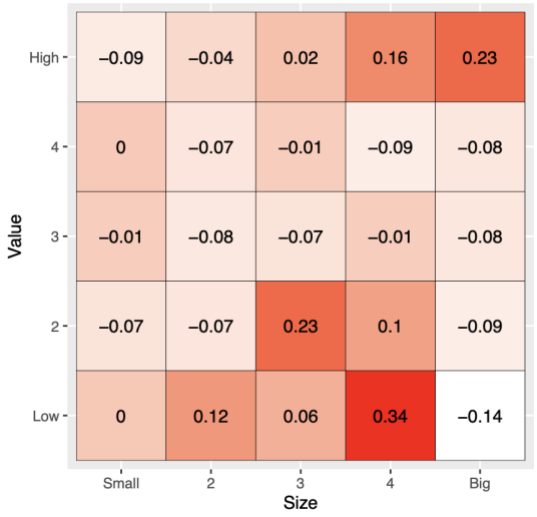

Table 9.

Emerging Markets Four Factor Model Regression

	Low	2	High	Low.1	4	High.1
alpha	-0.00292**	1e-05	0.00358***	0.00486***	-0.00126	-0.00163
beta1	0.99509***	1.02541***	0.98003***	0.97795***	1.03974***	0.99324***
beta2	1.00573***	0.93137***	0.78429***	-0.26286***	0.01224	-0.04106
beta3	-0.3416***	-0.06453*	0.35029***	-0.67237***	0.2591***	0.63506***
beta4	0.07899	-0.007	-0.05671	-0.10497	0.1104	0.03262

Table 10.

US Adjusted R-Squared

Three Factor Model

R Squared					
Small	0.862285	0.890584	0.925623	0.939509	0.824527
2	0.934810	0.958706	0.960062	0.962373	0.958545
3	0.940210	0.956770	0.949275	0.953820	0.948749
4	0.935812	0.937910	0.932085	0.917992	0.932509
Big	0.976303	0.946513	0.920476	0.943678	0.915152

Four Factor Model

R Squared					
Small	0.863621	0.890636	0.925691	0.939511	0.826530
2	0.936185	0.959156	0.960379	0.962512	0.958681
3	0.942830	0.958169	0.950101	0.954866	0.949121
4	0.941467	0.942951	0.936877	0.924105	0.933846
Big	0.977923	0.947633	0.922637	0.944927	0.915258

Table 11.

US Standard Error Comparison

Three Factor Model

s.e.					
Small	0.006376	0.005336	0.003914	0.003515	0.006073
2	0.004321	0.003036	0.002861	0.002842	0.003162
3	0.003762	0.002844	0.003002	0.003113	0.003781
4	0.003280	0.003065	0.003252	0.003949	0.004036
Big	0.001883	0.002479	0.003148	0.002896	0.004712

Four Factor Model

s.e.					
Small	0.006346	0.005336	0.003913	0.003516	0.006040
2	0.004276	0.003020	0.002850	0.002837	0.003157
3	0.003679	0.002798	0.002978	0.003078	0.003768
4	0.003133	0.002939	0.003136	0.003800	0.003997
Big	0.001817	0.002453	0.003105	0.002864	0.004710

Table 12.

Europe Adjusted R-Squared

Three Factor Model

R Squared					
Small	0.900859	0.908943	0.880393	0.927372	0.923924
2	0.927765	0.853321	0.949967	0.954599	0.957369
3	0.920648	0.933470	0.933932	0.947448	0.948098
4	0.918228	0.928612	0.942972	0.936387	0.927132
Big	0.962947	0.960781	0.949560	0.955064	0.965911

Four Factor Model

R Squared					
Small	0.900859	0.908998	0.880395	0.927372	0.924029
2	0.927872	0.853359	0.950022	0.954648	0.957385
3	0.920671	0.933839	0.933965	0.947449	0.948100
4	0.918969	0.928679	0.942973	0.936444	0.927264
Big	0.963104	0.960853	0.949598	0.955103	0.966130

Table 13.

Europe Standard Error Comparison

Three Factor Model

s.e.					
Small	0.002924	0.002688	0.002999	0.002177	0.002213
2	0.003039	0.004325	0.002301	0.002115	0.002087
3	0.003411	0.002925	0.002880	0.002458	0.002602
4	0.003317	0.003035	0.002655	0.002944	0.003485
Big	0.002026	0.002071	0.002634	0.002518	0.002725

Four Factor Model

s.e.					
Small	0.002925	0.002688	0.002999	0.002178	0.002212
2	0.003037	0.004325	0.002300	0.002115	0.002087
3	0.003411	0.002917	0.002880	0.002458	0.002603
4	0.003302	0.003034	0.002655	0.002943	0.003482
Big	0.002022	0.002070	0.002634	0.002517	0.002717

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