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Including an ESG factor in the Fama French model: Evidence from the S&P 500 index.

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Abstract

This thesis offers a comprehensive exploration of the evolution of ethical and sustainable finance, highlighting the crucial role of ESG (Environmental, Social, and Governance) factors in modern pricing models and portfolio construction. The primary objective is to investigate how the Fama-French three-factor model responds to the integration of an additional risk factor that incorporates ESG criteria. To achieve this objective, various pricing models will be thoroughly examined, starting with the Capital Asset Pricing Model (CAPM), proceeding through the Fama-French three-factor model, and culminating in an examination of the five-factor model. These foundational models serve as the basis for constructing the ESG risk factor, which derives inspiration from the HML (High Minus Low) factor introduced by Fama and French in 1995.

Furthermore, the thesis underscores the significance of ESG ratings assigned to diverse companies, as they play a pivotal role in shaping the ESG risk factor. Consequently, we explore major rating agencies, with a particular emphasis on Refinitiv's methodology, as the data utilized in this study is sourced from this agency.

Ultimately, this research endeavor seeks to address the fundamental question of whether it is possible to develop a more robust asset pricing model that incorporates an ESG risk factor.

Chapter 1 – Ethically oriented finance

1.1 Globalisation and the economy

Over the past two centuries, the globalization of economic and financial activities has progressively disrupted environmental balances both locally (through deforestation, desertification, pollution of rivers and seas, smog, etc.) and globally (resulting in atmospheric warming, ozone depletion, loss of biodiversity, and depletion of natural resources). This trend has had its ups and downs, but the negative externalities of globalisation have continued to accumulate.

The acceleration of globalization after World War II, followed by three decades of increasing nationalism and protectionism, brought the severity of environmental degradation into clear focus, highlighting the global concern for environmental sustainability in economic development. The global scarcity of natural resources became increasingly apparent starting from the late 18th century, triggered by the economic and demographic expansion brought about by the first industrial revolution. It became even more evident during the 1820s[1], with the accelerated integration of raw materials and production factors into the market. In those years, in fact, the liberalist ideas expressed by Adam Smith and the other classical economists at the end of the 18th century began to be translated into a systematic policy of relaxation of protectionist measures.

As early as the end of the 19th century, some scholars argued that the global exploitation of natural resources could endanger the continuation of economic growth[2]. The awareness of pollution's global impact gained traction as the population explosion resulting from the industrial revolution connected previously isolated pockets of pollution, eventually enveloping the entire globe.

But as soon as it became clear that the globe's natural resources are limited, it became equally evident that their sustainable exploitation is a prerequisite for the continuation of economic development. The acceleration of the globalisation process after the Second World War was energetically promoted by international institutions, the same institutions that had to become aware of the need to regulate the socio-environmental effects of globalisation.

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[1] The beginning of the current process of market globalisation can be traced back to the second decade of the 19th century, when a clear trend towards convergence of commodity prices began to emerge in international markets (O'Rourke-Williamson, 2000), associated with an epochal movement towards more liberal policies.

[2] One of the first scholars to understand the problem was the great British economist Jevons, who analysed the risk associated with the depletion of coal deposits (1865), the main source of energy for industrial activity, and its potentially catastrophic consequences for continued growth.

Countries committed to implementing sustainable development have had to reorient their policy objectives to establish systems of production and consumption that balance the imperatives of development and economic growth with environmental preservation, security, and social equilibrium. Matured in the wake of the work of the Bruntland Commission, through a long series of significant stages (such as the United Nations Conference in Rio de Janeiro), this process has involved the main institutions, social actors and the business system in the various countries.

In particular, the orientations of the Rio Conference were promptly accepted by the European Community, through the preparation of the Fifth Environmental Action Programme in 1992, which, in addressing for the first time the issue of sustainable development in terms of policy and implementation tools, proposed a new approach based on the empowerment of all stakeholders (authorities, citizens, businesses), stating that: "achieving the desired balance between human activity and development, on the one hand, and environmental protection, on the other, requires a clearly defined allocation of responsibilities with respect to consumption and behaviour towards the environment and natural resources".

Since its conception, therefore, the concept of sustainable development and, above all, the need to translate it into actionable objectives, has called upon economic and financial actors, entrusting them with an active role as partners in sustainability policies, rather than mere recipients of measures aimed at guaranteeing it. The realisation that economic development, in order to be able to contribute to the improvement of living and social conditions, had to include a preventive attention to the conditions of sustainability, guided the commitment of many actors. This awareness has matured hand in hand with the manifestation of development "effects" that, although outside the logic of efficiency and the market, have significantly affected the wellbeing of the community: not only the indiscriminate use of natural resources, or the impacts on the various ecosystems, but also the economic success of activities that run counter to socially shared ethical principles, the exploitation of child labour, discrimination - racial, sexual, religious - in the world of work, etc.

An obligatory reference in this regard is the Green Paper presented by the European Commission (2001) on "Promoting a European Framework for Corporate Social Responsibility". The European Commission proposes to support and promote the voluntary development of corporate social responsibility and places it within the broader framework of corporate social responsibility policies.

Attention to social responsibility is not, however, an exclusive prerogative of the European Commission, but also concerns the UN, ILO, OECD, UNEP (2000).

The process of globalisation of the world economy has been and is in its essence a process of globalisation of markets.

Following the industrial revolution, the internationalisation of trade favoured by the increasing efficiency of means of transport (steamships, railways, cars, aeroplanes, and so on) has progressively influenced the production and distribution of goods over an ever-larger area of the globe. The international mobility of goods has been facilitated by the increasing mobility of capital, and to some extent, of the labour factor. As a result of this process, economic and financial decisions have increasingly become governed by market principles rather than alternative principles that were very influential within local communities, including ethical principles (solidarity, fairness egalitarianism, etc.). The growth in market size and influence has yielded positive outcomes, including enhanced production efficiency, global production growth, increased average per capita income, and improved access to global resources. Nevertheless, it has also given rise to several undesirable phenomena have also manifested themselves, such as growing inequality between and within nations, increasing poverty, a widening gap between the global North and South, a loss of cultural diversity, overexploitation of natural resources and worldwide pollution.

1.2 Sustainable Development

The long march began in 1987, with the Brundtland Report of the World Commission on Environment and Development, which pointed out to the international community the need to reconcile economic development with environmental protection, defining sustainable development as development that can ensure "the satisfaction of the needs of the present generation without compromising the ability of future generations to realise their own needs"[3].

The concept of sustainability, initially focused on environmental protection (as evident in the principles outlined in the Rio de Janeiro Declaration of 1992), has evolved over time. There is a growing awareness that a sustainable economic growth model should consider not only environmental aspects but also social and governance factors involving both public and private decision-makers. In 2004, the term ESG (Environmental, Social, Governance) was officially introduced by the United Nations Global Compact Initiative in their report "Who Cares Wins"[4], thereby establishing the three primary ethical pillars of sustainable development.

[3] In 1987, the World Commission on Environment and Development (WCED), which had been set up in 1983, published a report entitled «Our common future». The document came to be known as the «Brundtland Report» after the Commission's chairwoman, Gro Harlem Brundtland. It developed guiding principles for sustainable development as it is generally understood today.

[4] Global Compact, *Who Cares Wins - Connecting Financial Markets to a Changing World*, https://www.unepfi.org/

The global recognition of the interdependence between sustainable development and environmental, social, and governance aspects has led to various initiatives. In 2015, two significant documents were adopted: the Paris Agreement, which, in order to prevent "dangerous climate change", committed governments to keeping the global average temperature increase below 2°C compared to pre-industrial levels[5], and the United Nations' Agenda 2030, which set 17 Sustainable Development Goals (SDGs)[6] in its three dimensions of economic, social and environmental governance, in line with the targets later recalled in the recent Rome Declaration, followed by the G20 at the end of October 2021.

The European Union, in order to address climate and environmental challenges in implementation of the Paris Agreement and the UN 2030 Agenda, announced in 2019 the European Green Deal, with the aim of defining strategic initiatives in various fields to achieve the goal of climate neutrality by 2050. In the wake of the Green Deal, the extraordinary Next Generation Eu programme was developed, launched in 2020 by the European Union in response to the pandemic shock; in reaffirming the goal of the green transition, it is stipulated that at least 37% of the programme's resources must be allocated to climate and environmental sustainability actions and that projects financed by the programme must not have a negative impact on the environment.

One of the most critical components of the Next Generation EU program is the regulation that establishes the Recovery and Resilient Facility (Rrf)[7], which made resources available to Member States to deal with the consequences of the pandemic, on condition that each state prepared its own Recovery and Resilience Plan with measures focused on six major areas of intervention (pillars):

- Green Transition.
- Digital Transformation.
- Smart, Sustainable and Inclusive Growth.
- Social and Territorial Cohesion.
- Health and Economic, Social and Institutional Resilience.
- Policies for New Generations, Children and Youth.

[5] United Nations, The Paris Agreement, https://unfccc.int/process-and-meetings/the-paris-agreement
[6] United Nations, 17 Goals to Transform Our World https://www.un.org/sustainabledevelopment/
[7] The Recovery and Resilience Facility (RRF) is a temporary instrument that is the centerpiece of NextGenerationEU - the EU's plan to emerge stronger and more resilient from the current crisis.

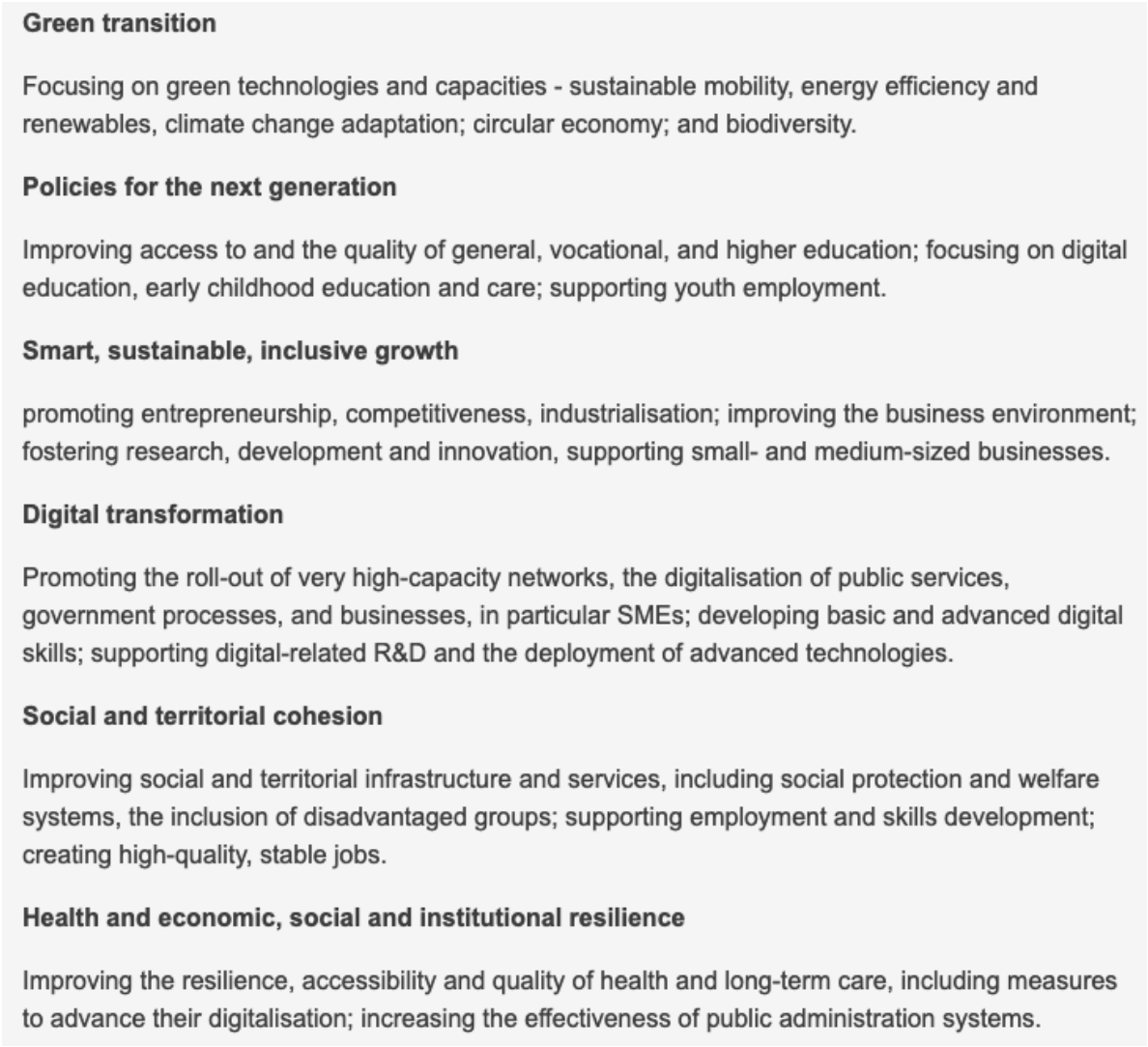

Figure 1 - Legend illustrating the areas of reform and investment supported by the Recovery and Resilience Instrument in the different EU Member States.
Source: European Commission, The Recovery and Resilience Facility.

The regulation goes on to stipulate that any measures included in recovery and resilience plans must be environmentally sustainable and therefore comply, according to Article 17 of the Taxonomy Regulation[8], with the principle of "do no significant harm" (Dnsh)[9] and the six environmental objectives identified in Art. 9 of the same regulation: climate change mitigation, climate change adaptation, sustainable use of water and marine resources, transition to a circular economy, prevention and reduction of pollution, and protection and restoration of biodiversity and ecosystems.

[8] Regulation (EU) 2020/852 of the European Parliament and of the Council of 18 June 2020 on the establishment of a framework to facilitate sustainable investment, and amending Regulation (EU) 2019/2088 http://data.europa.eu/eli/reg/2020/852/oj
[9] European Commission, Integration of environmental dimensions in public finances – *Implementing the 'Do No Significant Harm' (DNSH) principle in public funding programmes.*

The fundamental role of the financial system in the ecological transition has been recognised by the European Union as being capable of channelling capital towards sustainable investments, particularly in a context of insufficient public resources for this purpose.

The European Commission therefore published in March 2018 the Action Plan for Sustainable Finance in which it outlines - also based on the indications of a group of experts commissioned by the Commission itself - the strategy and measures to be adopted for the realisation of a financial system capable of promoting development that is genuinely sustainable in economic, social and environmental terms, thus contributing to the implementation of the Agreement and the UN Agenda 2030.

The European legislator has been concerned, with the regulations on the taxonomy of environmentally friendly economic activities (EU Regulation 2020/852,Taxonomy Regulation), mentioned above, and on the transparency of information on sustainable finance (EU Regulation 2019/2088, Sustainable Finance Disclosure Regulation), to introduce a classification of activities that can be considered sustainable and to impose a special disclosure of information for products that promote environmental and social characteristics (light green products) or that have sustainable investments as their objective (dark green products)[10].

The area of application of the Dnsh principle is declined more broadly in EU Regulation 2019/2088, in which the definition of sustainable investment provides precisely for the use of the Dnsh principle also in relation to social objectives: the fight against inequality, the promotion of social cohesion, social integration and industrial relations, investment in human capital or in economically or socially disadvantaged communities.

An investment can be considered sustainable only if it does not have a negative impact on the environmental and social objectives outlined in the aforementioned regulations. EU Regulation 2019/2088 also emphasizes that companies benefiting from such investments must adhere to “good governance practices”, including sound management structures, staff relations, fair staff remuneration, and compliance with tax obligations. This integration embodies the three ESG dimensions

[10] Regulation 2019/2088 identifies transparency and disclosure obligations for financial market participants and financial advisors in relation to policies on the integration of sustainability risks into investment decision-making processes at the subject and product level, the adverse effects of investment decisions on sustainability factors, and the consistency of remuneration policies with sustainability risks.

1.2.1 Banking sector, ESG principles and governance of climate change risks

Given the importance of the banking sector in the ecological transition, through which funding is channelled towards sustainable activities, European banking supervisory and oversight bodies have also issued guidelines and regulations with the aim of stimulating banks towards the implementation of sustainable strategies[11].

Among the most significant documents on the subject is the Action Plan on Sustainable Finance published by the European Banking Authority (Eba) at the end of 2019, which outlines the Eba's action plan on environmental, social and governance factors and indicates the areas, in relation to ESG aspects, on which banks are expected to take greater action (strategy and risk management; disclosure; scenario analysis and stress tests; prudential treatment). On this topic, the Eba then published guidelines on lending (in 2020) and a report on the measurement and supervision of ESG risks for credit institutions and investment companies (in 2021).

Guidelines on Esg risk were also prepared by the European Central Bank in 2020[12] (Guide on climate - related and environmental risks); the document sets out the ECB's expectations of European banks with regard to the management and supervision of climate-related risks. These documents, in addition to emphasising the governance aspect, a factor that is sometimes neglected in other areas, promote a proactive approach by banks called upon, through appropriate risk management processes, to mitigate climate risks in the dual declination of physical risk (linked to the impact of the increase in the frequency and scale of natural disasters) and transition risk (linked to the cost of policies to reduce greenhouse gas emissions).

With respect to these risks, the financial sector is particularly vulnerable due to its close connection to all economic sectors, including the most exposed ones; in turn, it can spread instability and crises caused by climate shocks.

This is also the context of the climate stress test carried out by the ECB in the course of 2021, which tested the impact of climate change on more than 4 million companies worldwide and 1,600 banks in the euro area with the aim of assessing their global resilience against a range of climate scenarios; the results of the test showed that it is more cost-effective to bear the costs of ecological transition in the short term than to face the costs of unrestricted climate change in the medium to long term. The early adoption of policies to transition to a greener economy would not only bring benefits in terms of investment and implementation of more efficient technologies but would also mitigate the effects of

[11] Alternative mechanisms for financing green initiatives, starting with crowdfunding portals, are not considered here.

[12] European Central Bank, Guide on climate-related and environmental risks, 2020, www.bankingsupervision.europa.eu

future natural disasters that would otherwise significantly and negatively impact on banks and businesses.

In January 2022, the ECB launched climate-specific stress tests for banks considered "as a learning exercise for both the banks and the supervisor"[13]. The new stress test, the results of which will be integrated into the Supervisory Review and Evaluation Process (Srep) using a qualitative approach, comprises three modules:

1. a questionnaire to assess banks' ability to manage climate risk;
2. an analysis to compare the sustainability of business models and how banks are exposed to emissions-intensive businesses;
3. a bottom-up stress test to assess how extreme weather events will affect banks, how vulnerable they are to a sharp increase in the price of carbon emissions, and how they would respond to transition scenarios over the next 30 years.

The state of the art can be examined on the basis of some estimates of the Bank of Italy, summarised in the Annual Report on 2020, although uncertainty remains in the background on the probability of the occurrence of extreme natural events (physical risk) or the adoption of incisive and unexpected climate policies (transition risk). With reference to the stock of bank loans at the end of 2019, the share for households and businesses residing in areas of high physical risk was 28%. For businesses, taking into account the economic sector, 37% of loans were exposed to transition risk, 15% to physical risk only and 13% to both[14]. Given the relevance of this signal and considering that ESG risks do not constitute an autonomous typology but impact on existing risk categories (credit, market, operational, strategic, reputational), the need for a global corporate, organisational and management vision emerges. In particular, the risk management function must involve not only business lines but also top management and corporate governance bodies.

1.2.2 Asset management in the ESG perspective

The growth of sustainable finance is proceeding apace and is affecting global markets and capital-raising players. According to the report by the Global Sustainable Investment Alliance (GSIA)[15], in the markets considered (US, Canada, Japan, Australasia and Europe) sustainable investments grew by 15% in the two-year period 2018/2020 and by 55% between 2016 and 2020 reaching $35.3

[13] For more details: European Central Bank, *2022 Climate risk stress test,* https://www.bankingsupervision.europa.eu/
[14] Banca d'Italia, *"Qualche Cifra per l'Italia: Il Credito Alle Imprese Esposte a Rischi Climatici."*
[15] Global Sustainable Investment Alliance, Global sustainable investment review 2020, 2021

trillion[16]. Total assets under management grew to $98.4 trillion and constituted an impressive 35.9% of the total.

In the Eurozone, assets under management by ESG funds grew from EUR 250 billion in 2015 to EUR 660 billion in 2020. Sixty per cent of the assets are attributable to households, insurance companies and pension funds.

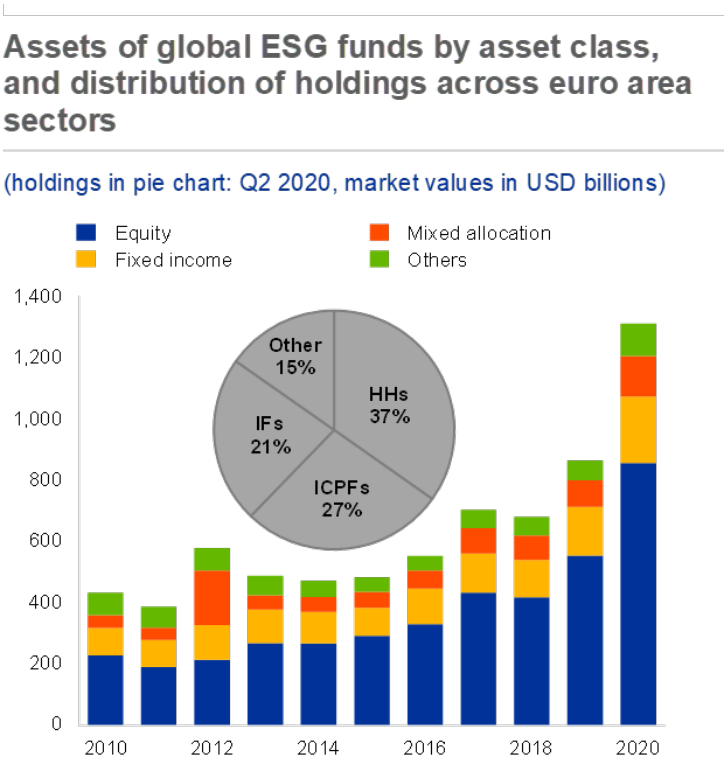

Figure 2 - ESG investment funds in the euro area by asset class and investor type

Sources: Bloomberg Finance L.P., Refinitiv, ECB securities holdings statistics by sector and ECB calculations.

Sustainable investments first developed in the equity segment and then developed into the green debt segment, which is frequently linked to the financing of specific sustainable projects; in addition to loans, green bonds as well as other instruments combining climate objectives with sustainability targets (such as sustainability-linked bonds) have become very popular. A picture emerges of an industry in transition with rapid developments and a positive trend in expectations for sustainable investments.

[16] For Europe, this decline would actually be determined by the change in the definition of sustainable investment in EU legislation in a stricter sense.

At the same time, support for this trend has come from the various forms of "exclusion" that trigger, a priori or a posteriori, the systematic exclusion of a production sector, an asset or a company or an asset manager whose business (e.g., arms, pornography, tobacco and animal testing) is incompatible with ESG criteria or international regulatory standards (Eurosif, 2018).

1.2.3 The relationship with stakeholders and value creation

The concept of value has changed profoundly in recent years. There has been a gradual shift from the identification of value with earnings performance, to the more expansive approach of generating value for the shareholder as a return for risks taken. These concepts have consistently hinged on the need to ensure a return on capital for those who invest it. This is why the shareholder has long been the sole recipient of the value created by the company.
Today, the concept of value cannot be traced solely to the sphere of relations between the company and its shareholders. We are witnessing a growing sensitivity of the business world to the needs and expectations of a range of other stakeholders. Each of them, in their own way, has invested in the company and expects, just as a shareholder would, to see their "capital" rewarded.

Of course, it is no longer just a question of financial or economic capital, but of "intangible" capital that the stakeholder invests in the company, e.g., in terms of business continuity, career and professional development, choice of place of residence and life, social relations, trust or ethical and moral guarantees.
A company's ability to create value for stakeholders is becoming the most concrete guarantee of its ability to grow and develop.
Approaches to corporate governance based on the new "stakeholder theory", argue that companies that are better able to reconcile and integrate their economic competencies and capabilities with those of a social nature, relying on the experience of their stakeholders, will be more productive and effective, to the extent that social cohesion is destined to be a necessary condition for competition.

In general, three trends in the evolution of corporate value measurement can be identified:

1. There is a first trend towards the valorisation of intangible assets linked to knowledge and its related dimensions: the capacity to innovate, the ability to learn from a constantly changing context, the ability to relate to external parties (i.e., stakeholders) and to activate cooperative forms, etc. A company's internal competencies are measured in different ways and are

sometimes even considered as one of its assets. Rarely, however, is a dynamic assessment of these assets and how they are valued by the stakeholders concerned conducted.

2. A second trend is related to the attempt to enhance the reputational assets of a company. Investors read the focus on "sustainability" as a proxy for good corporate governance, which can also ensure value in the long run. Investors consider this aspect when deciding to buy the shares of a company. In this sense, one can speak of "reputational" values. How to measure reputation is the knot that every valuer would like to untie. External and independent evaluation systems to which a company may submit have a not insignificant role to play here.

3. Sustainability is also connected to the third trend. Value is commonly expressed, through appropriate indicators, in terms of the company's growth potential. It should also be expressed in the company's ability to realise and control growth and ensure it with continuity over time. In this sense, growth prospects are influenced by the ability to be environmentally "sustainable", socially responsible and, more generally, prepared to face the demands of stakeholders, which may become more concrete and incisive for the company in the future.

In this perspective, there is a need for reference points, systems for evaluating and measuring social and environmental performance, as well as all intangible values, which would allow them to be compared, to "interact" with intangible values. This would make it possible to concretely pursue the so-called triple bottom line[17], i.e., evaluation on the basis of economic, social and environmental performance.

The role of the financial sector is crucial; the quantitative and qualitative characteristics of economic development depend crucially on the process of transforming savings into investment, and the latter depends crucially on the process of financial intermediation between savers and investors exercised by the financial system. If banks manage to incorporate sustainability risks (i.e., environmental and social risks) into their lending criteria, new investments will be more compatible with sustainable development in terms of both production processes and products and services.
Similarly, if asset management gives more weight to environmental and social ethical criteria, the market share of ethical funds feeding Socially Responsible Savings will increase. In other words, the

[17] The principle of the "triple bottom line" states that it is no longer sufficient for a company to pursue economic profits alone, and thus answer only to its shareholders. Economic efficiency must be accompanied by attention and responsibility in the non-economic sphere, so that activities are, at the same time, also socially useful and environmentally sustainable.

financial system has a responsibility to channel savings towards socially responsible uses that are fully compatible with the goal of sustainable development.
A particularly relevant contribution in this direction can be offered by ethical funds, i.e., investment funds that use ethical investment selection criteria, particularly environmental and social ones. In the USA, where ethical funds have been introduced since the 1970s, they have now achieved a considerable market share and are growing further.

1.3 The concept of liability in the financial sector

The private financial sector plays an important role in the discussion on corporate social responsibility (or CSR, an acronym for Corporate Social Responsibility), both in terms of the social and environmental impact of the financing and credit offered and the ways in which financial companies raise, place and leverage capital and how they then hedge risk. The private financial sector plays a key role in the functioning of the business world, acting as an intermediary in the flow of capital between the corporate world, governments, individuals and organisations of various kinds.
The increasing attention paid in recent years to the role played by financial institutions in large projects involving a potential risk of violating environmental, social and human rights standards has brought to the fore the direct responsibility of these companies in ensuring and promoting more "ethical" behaviour, in different areas, and by different actors such as commercial and investment banks, asset management institutions, reinsurance, credit insurance and insurance groups, investment funds and pension funds.

What is ethical finance? There is no unambiguous definition of ethical finance, nor is there an international legislative framework. In particular, very different definitions, products and actors can be brought under the umbrella of ethically oriented finance. This is mainly due to social, legislative and economic differences in different countries.

The first distinction that needs to be made concerns the type of economic and financial instruments that are being considered, and the scope of the actions that are to be taken, which can thus relate to:

- The overall behaviour of a bank. If we consider it as a company, it is first and foremost obliged to apply CSR principles within its own walls, guaranteeing transparency, access to information, fairness towards customers, energy-saving and staff training policies, labour contracts applied, etc.

In assessing the role of banks as providers of capital, the most important consequences of their behaviour are, however, outward, and one must turn to assessing the consequences of the banks' lending and operations in general. This second area of intervention can be subdivided into:

- traditional banking activities (credit activities). This field essentially concerns regulations, codes of conduct and proposals concerning the granting of credit, and primarily project finance, where banks have a more direct responsibility for capital management.
- Financial activities. The whole world of socially responsible investments, ethical funds, pension funds and so on, are nowadays the main activity of banks in terms of economic size.

The importance of the latter can easily be deduced from an analysis of the balance sheet of any large bank: in each of them, financial and intermediation activities now preponderate over the traditional activities of savings collection and lending.

If banks were created to provide funding and lending activities, this is why ethical finance focuses more on lending activities. In this context, probably the strictest definition we can give is the one given in the "Manifesto of Ethical Finance"[18], promoted in Florence in 1998, on the occasion of the conference "Towards a Charter of Intent for Italian Ethical Finance".

As can be seen, the manifesto opens with the problem of access to credit, and more generally focuses on the credit activities of banks, or, as it is sometimes called, "the real economy", as opposed to the activities of the financial markets, which are disconnected from the material production of goods and services. This is obviously not an economically appropriate definition, nor is it a clear-cut distinction between two separate worlds: suffice it to think that the issuing of shares and bonds is necessary for the economic development of production companies and their activities, but also of the fact that various ethical investment and pension funds (so-called directed funds) invest part of their capital in financing particularly socially and environmentally meritorious activities carried out by subjects not listed on the financial markets.

Ethically oriented finance:

1. Believes that credit, in all its forms, is a human right: it does not discriminate between borrowers on the basis of gender, ethnicity or religion, nor on the basis of wealth, thus caring for the rights of the poor and marginalised. It therefore finances activities for human, social and environmental promotion, evaluating projects with the dual criteria of economic viability and social utility. Credit guarantees are another way in which partners take responsibility for the projects they finance. Ethical finance assesses, as well as asset-based guarantees, those

[18] Manifesto of Ethical Finance, Associazione Finanza Etica – 1998

forms of personal, category or community guarantees that allow access to credit also to weaker segments of the population.

2. Consider efficiency as a component of ethical responsibility. It is not a form of charity: it is an economically viable activity intended to be socially useful. The assumption of responsibility, both in making one's savings available and in making use of them in such a way as to preserve their value, is the foundation of a partnership between equal partners.
3. It does not consider enrichment based solely on the possession and exchange of money to be legitimate. The interest rate, in this context, is a measure of efficiency in the use of savings, a measure of the commitment to safeguard the resources made available by savers and to make them bear fruit in viable projects. Accordingly, the interest rate, the return on savings, is non-zero, but should be kept as low as possible, based on economic, but also social and ethical assessments.
4. It is transparent: the financial intermediary has a duty to treat with confidentiality the information on savers that he comes into possession of in the course of his business, but the transparent relationship with the client requires that savings be nominative. Depositors have the right to know the processes by which the financial institution operates and its investment and utilisation decisions.
5. It provides for participation in the important choices of the enterprise not only by shareholders, but also by savers. Forms may include both direct mechanisms for indicating preferences in the allocation of funds and democratic mechanisms for participation in decisions. Ethical finance thus carries a strong and courageous message of economic democracy.
6. It has social and environmental responsibility as criteria for use. It identifies the fields of use, and possibly certain privileged fields, by introducing reference criteria based on the promotion of human development and social and environmental responsibility in the economic appraisal. It excludes as a matter of principle financial relationships with those economic activities that hinder human development and contribute to the violation of fundamental human rights, such as the production of and trade in arms, productions that seriously harm health and the environment, activities based on the exploitation of minors or the repression of civil liberties.
7. It requires a comprehensive and consistent adherence on the part of the manager that guides his or her entire activity. If, on the other hand, the ethically oriented financial activity is only partial, the reasons for the restriction adopted must be explained in a transparent manner. In any case, the intermediary declares itself willing to be monitored by savers' guarantee institutions.

In this context, corporate social responsibility comes into play.

According to general criteria, and which can be applied to the financial and credit sector, CSR standards and initiatives can have these purposes:

- to improve corporate behaviour from a social and environmental perspective;
- identify and communicate a company's decisions, behaviours, activities and performance and/or impacts;
- provide information about a company's economic, social and environmental performance over time and compare it to some pre-determined index (or benchmark);
- provide verifiable data and assurances on the performance in different areas of a given enterprise;
- improving the performance of the company, particularly from the point of view of access to information, relations with all stakeholders inside and outside the company (the accountability of a company);
- improving corporate governance; literally the governance of the company or the administration of the company, which in its broadest sense refers to an idea of responsibility of the company's managers towards all stakeholders.

Specifically in the financial sector, different initiatives can be more or less binding and influence the change and performance of a company at different levels depending on whether the initiatives concern

- the consideration of general principles, i.e., the construction of a system of values and principles on which to base programmes and activities;
- reporting and accountability initiatives to improve transparency and access to information;
- application of internal codes of conduct and certification standards to verify compliance with declared behaviour;
- external evaluation systems, such as stock exchange indices or ethical rating agencies to influence investors and savers and obtain public recognition.

In addition to considering the management of the company, CSR should take into account all behaviours of a company both internally and externally, according to different approaches. for example, In the specific case of a bank or other financial company, the internal environmental impact is generally limited, and initiatives in this direction (waste recycling, energy saving) as well as improving the institution's behaviour have the fundamental advantage of contributing to employee

training on these issues. However, a correct analysis must first consider the environmental impact of the companies and/or projects financed by the bank.

Broadly speaking, the main criteria to be examined concern:

- Workers' rights:
  - labour contracts applied;
  - freedom of trade union association;
  - equal opportunities;
  - child labour;
  - internal conflicts;
  - occupational safety and health;
  - application of the highest international standards on workers' rights;
  - employee training, including on safety issues;
  - transparency and access to information between employees and top management;
  - internal democracy/participation.

- Social criteria:
  - presence of external codes of conduct or certification;
  - internal standards and codes of conduct, their application;
  - Corporate Governance;
  - access to care and medicines;
  - fraud and corruption;
  - money laundering;
  - tax behaviour and presence of branches or subsidiaries in tax havens;
  - community relations; community initiatives; citizens' health;
  - relations with the Global South;
  - relations with countries with oppressive or undemocratic regimes;
  - respect for national sovereignty and local communities;
  - human rights;
  - relations with competitors/presence of monopolistic positions in the market;
  - raw material procurement processes/ relations with suppliers, sub-suppliers and contractors[19];

[19] It should be noted that each of these criteria may be of particular importance and should be specified in detail for each individual situation. With regard to relations with suppliers and subcontractors, for example, in the recent past many major shoe and sportswear manufacturers have been accused of having their products or parts of them made by

- relations with public authorities, lobbying;
- export of know-how to subsidiaries and the global South;
- science and technology, research and development expenditure;
- consumer protection and protection, fair advertising, quality and safety of products;
- security and control measures, emergency management.

- Environmental criteria:
  - application of environmental laws and the highest international standards;
  - presence of internal codes of conduct or certification codes;
  - air, water and soil pollution;
  - respect for biodiversity;
  - climate change (i.e. consequences of human actions on the climate);
  - environmental impact of production and distribution;
  - productivity of resources and raw materials used;
  - transport;
  - energy-saving policies;
  - use of renewable energies;
  - recycling;
  - employee and management training on environmental issues;
  - environmental management;
  - expenditure on research and development to improve environmental impact;
  - nuclear facilities;
  - use of ozone-depleting substances (production of greenhouse gases);
  - pesticides;
  - waste management, particularly toxic and harmful waste;
  - water management;
  - policies in the field of timber, mining, petroleum and chemical industries, etc.; and
  - use of genetically modified products/genetic engineering;
  - animal testing.

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subcontractors located in the poorest countries on the planet, where workers, often minors and even children under 13, work up to 16 hours a day, in inhuman conditions, without any kind of protection and for starvation wages. Often the same multinationals have declared that they apply strict codes of conduct on social and labour rights, but that they cannot or do not manage to enforce these same codes for all the subcontractors of their products.
Only in recent years, thanks to the denunciation of some NGOs and other associations, are companies beginning to commit themselves, declaring that they apply codes of conduct extended to the entire production chain. The actual application of these codes, which are almost always self-produced and self-monitored, however, leaves many doubts and only confirms the need for full clarity on the real scope and effectiveness of these initiatives.

1.3.1 Financing sustainable development

With a view to financing sustainable development and contributing to countering natural catastrophes triggered by global warming and climate change more generally, and/or to improving the living conditions in which a large part of the world's population lives, it is crucial to intercept capital flows from private investments.

Considering the growing demand for sustainable and responsible investments, the market has opened the door to new investment formulas such as:

- Blended finance[20]: according to the definition released by the OECD, "blended finance", or mixed finance, is the strategic use of finance to mobilise private capital towards projects that contribute to sustainable development while providing financial returns to investors. This innovative approach - developed by the World Economic Forum through the "Redesigning Development Finance Initiative"- contributes to expanding the total amount of resources available to developing countries by complementing gold investment and government grant inflows (ODA) with private sources to bridge their financing gap for the SDGs and support the implementation of the Paris Agreement.
- Sustainable Bonds: Sustainable Bonds are debt securities issued to finance or refinance, in part or in full, exclusively projects that have a concrete positive environmental and/or social impact, such as energy production from clean sources, sustainable use of land and/or water, energy efficiency projects, waste treatment, affordable housing, education, vocational training and microfinance, or activities that contribute to local economic development such as the preservation and creation of jobs for disadvantaged or disabled groups, etc.

  They are generally divided into three categories (Green, Social and Sustainability) depending on depending on the sphere in which the funded project falls, respectively, concerns the environmental, social or even both spheres.

As has been said, the financial sector transfers financial resources from subjects that generate savings (so-called surplus subjects, such as households) to subjects that need to invest or spend more than they have available for current activity (so-called deficit subjects, typically companies and the public administration). In deciding how to invest capital, savers and the financial intermediaries that manage their savings (such as investment funds and pension funds) play a fundamental role in economic

[20] In support of the great potential of blended finance, the OECD recently released encouraging data. Between 2012 and 2018, approximately USD 13.4 billion was mobilised in LDCs, over USD 84 billion in upper middle-income countries and USD 68 billion in lower middle-income countries. In the same observation period, 45 out of 47 LDCs received private funding mobilised from official development financing at least once.

development. Indeed, the various actors operating in the financial markets can actively participate in a better allocation of capital towards financing investments with a positive impact on society in the medium and long term.
Thus, savers can choose to invest in companies that generate, in addition to an economic return, a positive environmental or social impact, e.g. in companies that pay attention to the responsible use of natural resources and the effects on ecosystems, in companies that maintain adequate conditions of safety, health, justice, equality and inclusion among workers, and/or in companies that operate with a focus on compliance with ethical principles and best practices of corporate governance.

Alternatively, one may choose not to invest in companies that do not respect international conventions on workers' rights or operate in sectors that do not comply with international treaties, e.g. the production of controversial weapons (biological and chemical weapons, anti-personnel mines).

One type of investment that contributes to the achievement of the 2030 Agenda Goals is Sustainable and Responsible Investment (or SRI from Sustainable and Responsible Investment), which aims to create value for the investor and for society through a medium- to long-term oriented investment strategy that integrates financial analysis with environmental, social and good governance (ESG) analysis when assessing companies and institutions.
Sustainable investments can be declined according to various strategies - each distinguished by specific objectives and methodologies - which are not self-excluding and can therefore be applied to the same portfolio and different asset classes (shares, bonds, private equity and private debt, etc.).
Below are the most common SRI strategies[21]:

- Exclusions: exclusion of certain issuers, sectors or countries based on certain principles and values (among the most used criteria: arms, pornography, tobacco, etc.).
- Norms-based screening: selection of investments based on compliance with international standards and treaties (the most used are those defined by the OECD, UN and UN Agencies).
- Best in class: selection or weighting of investments in the portfolio according to ESG criteria, favouring the best within a sector, category or asset class. Another approach, the most rigid, is the "Best-in-universe" approach, where certain sectors may be excluded from the initial universe if an issuer's contribution to sustainable development is insufficient compared to its peers. Finally, the "Best-effort" approach seeks to include in the portfolio only those issuers

[21] There is currently no single, agreed classification on SRI strategies; reference will therefore be made to the classification proposed by the Forum for Sustainable Finance.

that have made the most progress in sustainable development, but may nonetheless fall outside the best-in-universe in terms of ESG.

- Engagement and voting on sustainability matters: constructive dialogue with issuers on sustainability issues and the exercise of voting rights associated with equity participation.
- Thematic investing: selection of securities on the basis of one or more ESG themes (e.g. climate change, energy efficiency, health, etc.).
- Impact investing: investments in companies, organisations and funds made with the intention of generating a positive and measurable socio-environmental impact, together with a financial return.[22]

1.4 ESG Rating

An investment is defined as "sustainable" based on indicators, ESG ratings, which express a synthetic judgement on the level of environmental (Environmental), social (Social) and corporate governance (Governance) sustainability of issuers (companies, states, supranational organisations), securities and/or collective investment instruments (UCITS and ETFs).
ESG ratings are assigned by specialised agencies that process them based on analyses conducted from non-financial information published by companies (non-financial disclosure) and obtained from other sources (questionnaires, databases, news). This information concerns the sustainability criteria adopted in their management and investment projects. In addition to ESG ratings, which are summary scores of the degree of sustainability, agencies can also offer data on individual aspects of companies' sustainability (e.g., data on carbon emissions, water consumption, etc.).

However, there is a lack of internationally agreed standards for assessing sustainability. Consequently, pending a regulation establishing uniform criteria on the data and methodologies used for the construction of ESG ratings, different concepts and measures are currently used to define "sustainable" an economic activity.
Nevertheless, ESG scores are used extensively in finance for the selection of financial instruments, the construction of investment portfolios and the creation of market indices that are referred to as "sustainable" or "ESG".

As is frequently the case in contexts of innovation that can change the structure of entire industries, ESG rating has also undergone changes in bad faith in favour of the phenomenon known as

[22] For more details: Eurosif, European SRI Study 2018.

greenwashing[23], which is discussed in more detail. The new financial paradigm stems from the need for investors to pay attention to the long-term effect of their money, placing less importance on short-term returns and more on the environmental and social effects of their investments.

The intention of Dhaheri and Nobanee[24] in their analysis of financial stability is to highlight the inherent power of making bad financial choices that can generate irreparable consequences on a nation's wealth and productivity. Contextualising this preliminary discussion, the authors focused on the ESG risks currently impacting corporations, categorising them as significant and no longer negligible variables worldwide. Climate factors and their associated variability affect a country's economic performance and stability, significantly affecting its institutions. In the last decade, in fact, banks and insurance companies have been heavily involved and obliged to cover themselves against these physical risks[25].

The objective of sustainable finance is to teach investors and creditors ethics in their financial choices, incentivising them to share in the circular economy and protect the last remaining resources as much as possible. It is with this perspective that rating takes over, to disclose reliable and certain data that can guide these financial agents towards more responsible choices. Thus, multiple aspects make this ambition complex to implement, not least in terms of obtaining ESG ratings, the timeframe for which is exaggeratedly long.
Investors, aware of the economic and temporal difficulties of sustainable transition, are demanding an increasingly accurate and, above all, clear valuation based on consistent corporate reporting. Considering these requirements and the competitiveness inherent in this emerging sector, it is necessary to ensure the veracity of the ratings themselves, sometimes accentuated for opportunistic purposes.

Although CSR was already widespread in the past, the focus on social, environmental and governmental aspects only materialised when three credit rating agencies (Moody's, S&P, Fitch) included ESG factors within their ratings. Precisely, as previously mentioned, in 2004 in a report of the UN Global Compact Initiative named "Who Cares Wins", the term ESG was conceived and

[23] A communication campaign by some companies, organisations or political institutions aimed at portraying a careful and responsible profile of environmental issues and impacts associated with them, misleading about the negative effects of their value chain on the environment.
[24] Al Dhaheri, Ahmed and Nobanee, Haitham and Nobanee, Haitham, Financial Stability and Sustainable Finance: A Mini-Review (February 14, 2020).
[25] The financial impact following the manifestation of climate change, including more frequent extremes and gradual changes in climate, as well as environmental degradation, i.e. air, water and soil pollution, water stress, loss of biodiversity and deforestation. *Guide on climate-related and environmental risks*, 2020, Bankingsupervision.europa.eu

coined to summarise what would be the three pillars of sustainable finance in the following decades. With this event, economic science too, as previously discussed, took up this information gap in its research, analysing ESG effects on financial markets, on the profitability of portfolios and the performance of companies and credit agents downstream of ESG ratings.

Literature and finance has defined the following for each pillar.

- E - Environmental: this first aspect refers to climate change, loss of biodiversity, depletion of resources, extinction of animal species and other negative externalities caused by intensive production and the pollution of air and water they produce. Environmental performance is therefore measured in terms of energy efficiency, sustainable waste disposal and reuse, construction of a green value chain, and attention to the greenhouse effect by minimizing gaseous pollutant emissions.
- S - Social: the social aspect focuses on employee satisfaction and issues that may arise in work contexts. It monitors that employees are protected by policies safeguarding human and gender rights, ensures that labour regulations are respected and that the environment complies with laws on the safety of people and products. The importance of this factor is expressed in the positive relationship between employee satisfaction and long-term stock performance.
- G - Governance: finally, this last foundation represents those aspects internal to companies and concerning the dynamics arising from conflicts of interest and agency issues between stakeholders. It relates to the independence of the board of directors, the degree of shareholder protection, the separation of ownership and control, the incentive systems of agents and their remuneration. It thus stands on the objective of enforcing the law and ensuring that anti-competitive practices are avoided.

  From this perspective, well-designed governance is able to bring positive influences within companies and ultimately greater profitability.

To expose the potential of rating, it is necessary to premise the shortcomings and weaknesses involving it: in particular, heterogeneity. This concept alludes to the discordance between ratings, data collection methodologies, evaluation criteria, and associated final scores. What has hitherto been underestimated is the benchmark between these aspects and the disagreement that arises between rating agencies, which can shake the credibility and reliability of the ratings they issue among investors.

The Dow Jones Sustainability World Index[26] (later DJSWI) attested the effect between:

- ESG scores;
- Companies' market value for listed companies.

The ESG acronym alone was found to be more significant than the CSR acronym. The DJSWI index confirms this influence in terms of more sustainable valuations, improved profitability, reduced capital costs and reduced exposure to tail risk, favouring the stability of current share and asset prices. Similarly, from the KLD Research & Analytics dataset[27], the DJSWI also attested the effect between:

- ESG scores
- equity returns;

which also showed that:

1) there is a positive and significant correlation between the two variables;
2) sustainable investors achieve a higher financial return than conventional investors;
3) the performance of ESG funds is high, particularly in contexts of economic, political, social crisis;
4) abnormal returns are particularly high in contexts of buying stocks with high ESG ratings and selling those with low ESG ratings.

The presence of ESG ratings is far from insignificant in the context of financial investment decisions, so much so that they contribute to the growth of returns. Although the origin of organisations collecting, analysing and classifying data according to ESG performance dates back to around 1970, the demand for ESG ratings that are comparable and of high quality is current and growing rapidly. In those years, environmental and social issues entered the capital market to spread knowledge about the disastrous consequences that consumerism and intensive production were causing. It was NGOs that were concerned with the dissemination of this type of information, which also began to be shared among some investors. Although there was a strong commitment to promote accountability campaigns, the development of universal standards and reports has been severely limited over the years due to information asymmetry and the diverse metrics that exist in terms of indicators, methodology used and weights applied.

[26] The Dow Jones Sustainability World Index evaluates and compensates the best performing companies based on economic, environmental and social criteria out of a basket of 2500. It was created in 1999 and operates through a strategic partnership between S&P Dow Jones Indices and RobecoSAM, an international investment company focused on financial sustainability.

[27] KLD Research & Analytics: is an independent investment research company that provides investment management tools used by professionals to serve clients who require investment strategies based on social and environmental responsibility. It is associated with MSCI ESG Research.

1.4.1 Main ESG rating providers

In the absence of regulation, several companies - including the major rating agencies - have adopted methodologies according to two approaches. The first follows a quantitative approach, assessing company performance based on publicly available data compiled according to international standards. The second, on the other hand, follows a qualitative approach, consisting of collecting information through ESG questionnaires that assess companies using differentiated methodologies.
Three different ESG rating methodologies belonging to the most notable providers on the market in terms of issuers covered and ESG focus (MSCI, Morningstar, Refinitiv) will be described below, with a focus on Refinitiv's methodology, also used for the purposes of the analysis conducted.

The MSCI ESG Ratings are designed to help investors understand ESG risks and opportunities and integrate them into portfolio construction and management.
This rating model is based on medium to long-term considerations of the exposure to and management of issues that can translate into costs or opportunities for companies, assessed against the standards and performance of their peers in the industry.

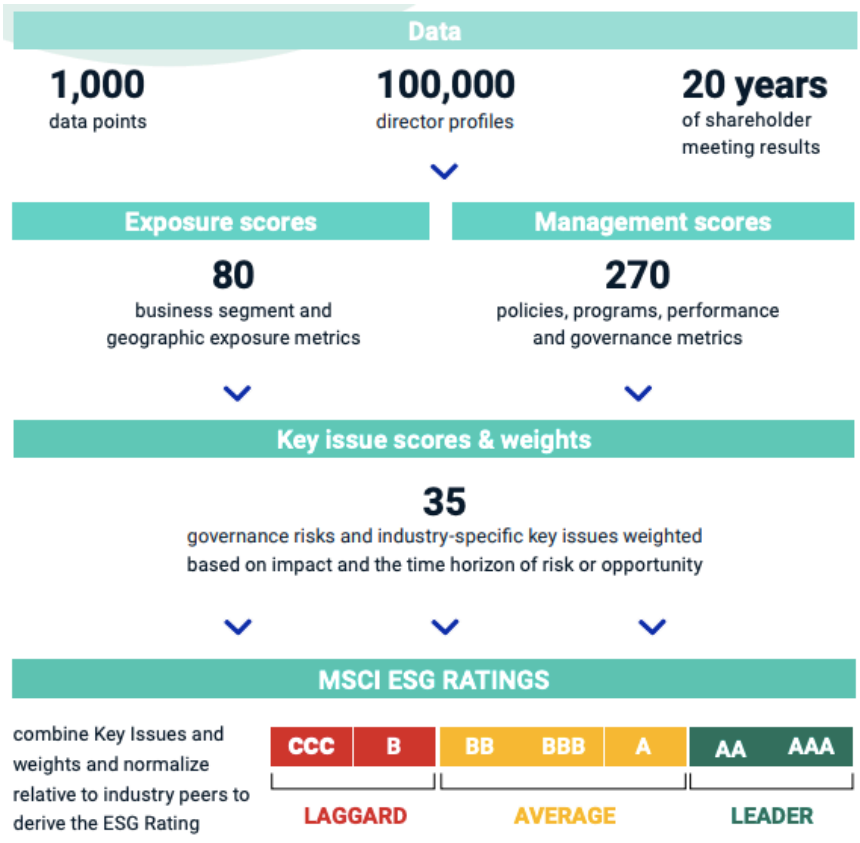

Figure 3 – MSCI ESG Rating.

Source: MSCI.com

Information is gathered through specialised datasets from governments, NGOs, or other disclosure bodies, as well as through any sustainability reports published by companies. The three ESG pillars are identified from which ten general themes are deduced and subdivided in turn into 35 key factors (or key issues).

The methodology is structured based on the GICS (Global Industry Classification Standard) classification, which defines the weights relative to the key issues considering the issues that characterise each sector and the time interval required for a negative or positive impact to materialise. Each company's exposure to key ESG risks on its business allocation is calculated on a 0-10 scale. Next, the analysis considers the extent to which a company has developed strategies and demonstrated a strong track record of performance in managing its specific level of risk or opportunity.

Management is scored on the same scale. The risk exposure score and the risk management score are combined such that a higher level of exposure requires a higher level of demonstrated management capability to achieve the same overall key factor score.

MSCI ESG Ratings involves more than 8,500 companies and more than 680,000 equity and fixed-income securities globally to create ESG scores and metrics for about 53,000 mutual funds and multi-asset class ETFs across a range of ESG exposure categories.[28]

MSCI ESG Fund Ratings, on the other hand, is designed to assess the resilience of a fund's aggregate holdings to ESG risks and opportunities over the long term. Highly rated funds are comprised of issuers with a management leading or improving management of key ESG risks.

Gathering information from corporate reports, media, NGO reports, or other multi-sector information sources, the ESG Risk Rating from Sustainalytics, a Morningstar company, intercepts the issuer's exposure and management to sector-specific ESG risks.

The rating provides investors with an overall score of the company based on an assessment of how unmanaged its ESG risk exposure is. Therefore, a high rating score will correspond to poor ESG risk management.

Exposure is assessed through 138 sub-sector classifications, analysis of the potential impact of 20 "Material ESG Issues" (MEIs)[29] for each sub-sector, and subsequent selection of the ten most relevant MEIs that always involve corporate governance as it is deemed relevant and applicable to all issuers. An issuer's final exposure score includes company-specific adjustments such as excluding a MEI if it is deemed not relevant to the issuer.

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[28] "How does MSCI ESG Ratings work?", MSCI.com

[29] For more details: Sustainalytics (Morningstar company) "The esg risk ratings definitions of material esg issues and corporate governance"

Each issuer receives a rating called “issue beta” for each MEI that can change the sub-sector’s exposure score on each MEI.
Disputes, which are divided into five ascending categories (1-5) based on the magnitude of the incident, are also assessed at the MEI level and are considered a management flaw. This results in a decrease in the management score according to the severity of the dispute. Each issuer faces the possibility of an idiosyncratic risk, i.e. driven by an event that emerges due to a serious ESG controversy, related to an issue that is not considered material to the company, resulting in a decrease of the overall risk management score.

A special feature of Sustainalytics assessments is the introduction of the concept of manageable and unmanageable risk. Unmanageable risk is the part of the exposure score that, regardless of management practices, remains a risk for the company. Think of companies that cannot eliminate health risks associated with their products as is the case with tobacco companies. Manageable risk, on the other hand, is the part of the risk exposure score that can be mitigated by company policies and strategies.
Each category encapsulates a level of relevant financial impact arising from ESG factors. For each MEI assigned to an issuer, exposure is typically rated on a range (0-20) to indicate the lowest and highest exposure, respectively. Each MEI exposure score represents a portion of the overall exposure score, which varies between 0 and 100. The weights are determined by the contribution of the individual ME’s manageable risk score.
For each MEI, the management score is the sum of each weighted score of the management indicator, and the weights of the latter, within an MEI, are based on on the relative ability of the indicator to reflect management performance related to that theme. Each management indicator has a raw score between 0 and 100, and the company’s overall managed risk score is the sum of all the managed risk scores of the MEIs, determined by multiplying the individual theme’s management score by the theme’s manageable risk score.

1.4.2 Refinitiv ESG Scoring

Refinitiv is a company offering financial services since 2018, based in New York. It is a subsidiary of London Stock Exchange Group, which bought it in 2019 for $27 billion from its previous shareholders Blackstone Group, which owned 55 per cent, and Thomson Reuters, which owned the remaining 45 per cent.

Refinitiv remains committed to promoting transparency on ESG information to reduce opacity in this critical area. Making companies' ESG scores freely available on Refinitiv's public website allows anyone to see the ESG footprint, based on a public dataset, of more than 10,000 companies.

Refinitiv's ESG scores on companies are designed to measure a company's ESG performance, commitment and effectiveness transparently and objectively on 10 major themes, based on a publicly available and verifiable dataset. The scores are derived from Refinitiv's database of more than 450 ESG indicators, of which a subset of 186 factors, which contain comparable and material data, become the subject of a company's overall assessment and scoring process. The measures are based on considerations of comparability, impact, data availability and sector relevance, which varies within each industry group.

The data is mostly derived from public sources and information released by the companies themselves and consists of more than four hundred ESG metrics, manually processed within a standardised process to ensure uniformity of assessments.
Although the database is updated on an ongoing basis and the scoring on a weekly basis, the data undergoes the most significant changes on an annual basis, coinciding with the publication of ESG reporting. In fact, more frequent updating of the data is only done in extraordinary cases, such as, for example, significant changes in the type of ESG reporting standard or corporate structure during the year.
The main sources of data are annual reports, company websites, market and stock exchange perceptions, news and, above all, corporate social responsibility reporting.
Thomson Refinitiv's ESG analysis is structured according to the three canonical pillars - Environment, Society and Governance - by identifying 10 categories and their 186 metrics, broken down as illustrated in Figure 4. The pie chart shows the number of metrics for each category, which, as we shall see, will be an important parameter in defining the weights of the indicators.

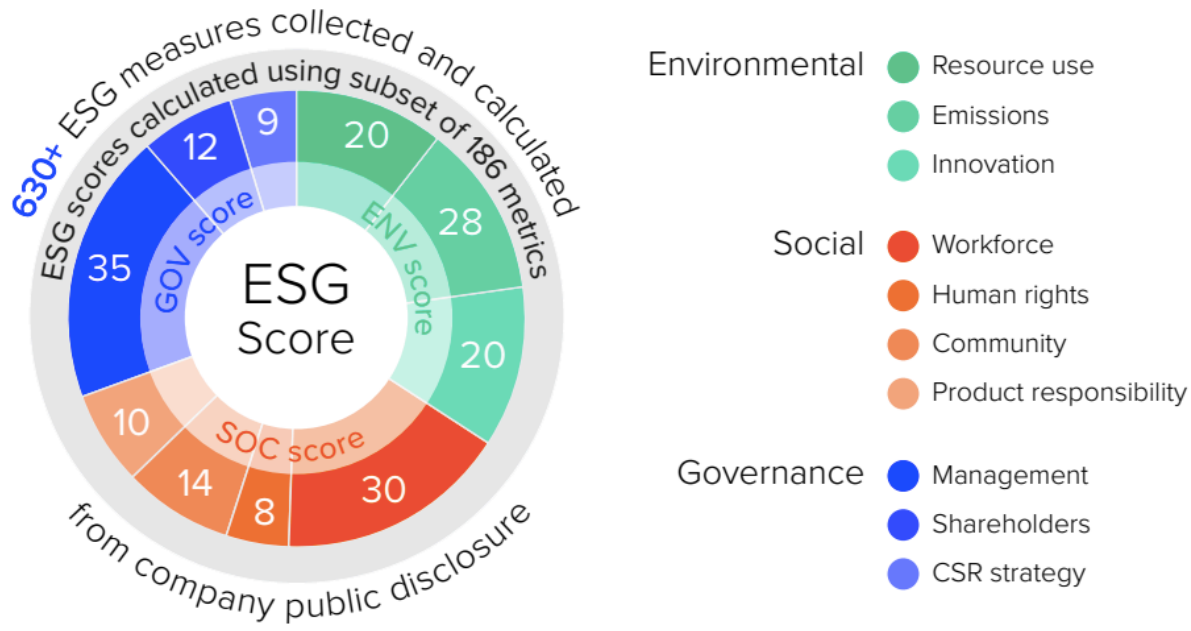

Figure 4 – Refinitiv's ESG score.

Source: refinitiv.com

Refinitiv's ESG ratings are sorted into 12 classes (A+ to D-) as shown in Figure 5:

Score range	Grade
0.0 <= score <= 0.083333	D -
0.083333 < score <= 0.166666	D
0.166666 < score <= 0.250000	D +
0.250000 < score <= 0.333333	C -
0.333333 < score <= 0.416666	C
0.416666 < score <= 0.500000	C +
0.500000 < score <= 0.583333	B -
0.583333 < score <= 0.666666	B
0.666666 < score <= 0.750000	B +
0.750000 < score <= 0.833333	A -
0.833333 < score <= 0.916666	A
0.916666 < score <= 1	A +

Figure 5: Refinitiv ESG Scoring Conversion Scheme.

Source: refinitiv.com

"The "A" score indicates excellent relative ESG performance and a high degree of transparency in publicly reporting relevant ESG data.
Score "B" indicates good relative ESG performance and an above-average degree of transparency in publicly reporting relevant ESG data.
Score "C" indicates satisfactory relative ESG performance and a moderate degree of transparency in publicly reporting relevant ESG data.
The score "D" indicates poor relative ESG performance and an insufficient degree of transparency in publicly reporting relevant ESG data."[30]

The scores are constructed through the analysis of over 630 key performance indicators (KPIs) to make the assessment as uniform as possible.
The rating model consists of two associated ESG indicators:

- The ESG score measures the company's ESG performance with data that is reported and verifiable because it is in the public domain.
- The ESGC score overlays the ESG score with ESG controversies to provide an assessment of sustainability over time.

[30] The methodology presented is taken from "Refinitiv ESG company scores" from refinitiv (May 2023) https://www.refinitiv.com/

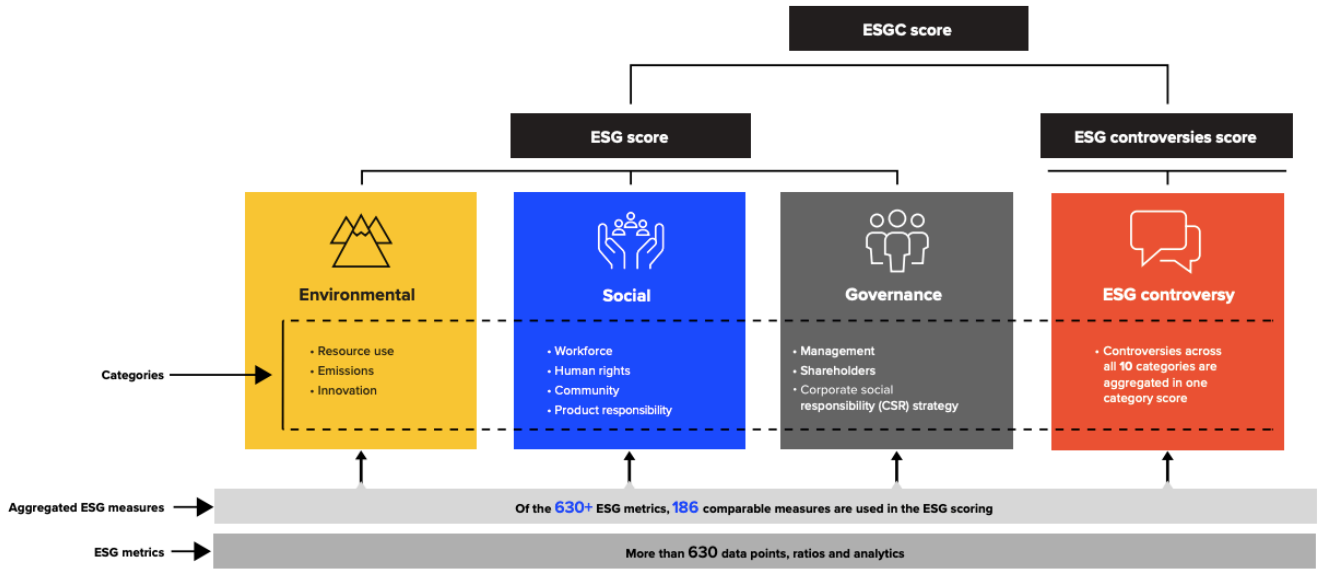

Figure 6 – The ESGC score.

Source: refinitiv.com

Again, the 630 KPIs are grouped into 186 subgroups (ranging from 70 to 170 relevant to the sector in question), which in turn are divided into 10 categories that make up the three pillars (environmental, social and governance). The ESG score is a summary of the various category scores, weighted by the importance within the relevant sector for the environmental and social pillars, while the weight of the governance categories remains unchanged.

The environmental pillar score is built on the categories of resource use, emissions and innovations. The social pillar score is calculated based on employees, human rights, local communities and product responsibility, while governance is assessed through the analysis of corporate governance, shareholders and CSR strategy.

Scores are awarded considering the industry benchmark for the first two pillars while the third is considered transversal.

1.4.3 The risk of greenwashing

The scenario of recent years has thus been characterised by the gradual spread of a collective awareness that has led to an exponential growth in the supply, in various sectors and markets, of products and services with the sustainability label. But the reliability of many of the offers is certainly not guaranteed. The strong commercial attractiveness of sustainable products leads many operators

to propose, through special marketing strategies, a green or social image of the products they offer on the market that is not corresponding to the truth or, at least, is not verifiable.

On several occasions, the EU has considered the phenomenon of greenwashing with reference to financial and insurance products, describing it as the practice of unfairly gaining an advantage over competitors by marketing a financial product as environmentally friendly even though it does not meet basic environmental standards[31].

The prevention of greenwashing is among the basic objectives of any European sustainability regulation to prevent investors from being misled and resources being diverted to truly deserving initiatives.

A sweeping survey of websites focusing on greenwashing practices by the European Commission, released in January 2021, found that 42% of green claims contained dubious, exaggerated or misleading statements, which could amount to unfair commercial practice. In the same vein, research[32] from last year assessed 723 equity funds that are marketed using EGS and climate-related keywords, with over $330 billion in total net assets. In the overall EGS category (593 equity funds with over $265 billion in total net assets), 71% of funds have companies within their portfolios that are misaligned from global climate goals (Paris Agreement and fossil fuel intensity). Even among climate-themed funds (130 funds with over $67 billion in total net assets), most are not aligned (72, about 55%), continuing to hold companies in the fossil fuel chain fossil fuels.

The European Financial Market Supervisory Authority (Esma) in its Annual Statistical Report published in April last year, however, stated (inferring this from an indirect assessment of the costs of Esc funds) that there was no systematic greenwashing by producers of sustainable funds. In February 2022, Esma did, however, publish a Sustainable Finance Roadmap 2022/24 indicating as (somewhat generic) priorities in the field promoting transparency; building the capacity of Esma and national authorities; analysing markets and ESG risks.

It is generally agreed that the phenomenon of greenwashing can be countered through the definition of useful and standardised data and information that can be compared with each other and the identification of a common measurement methodology for the various ESG dimensions.

In fact, in the absence of such elements, companies tend to privilege qualitative and self-reported information with the risk of not representing to the investor the real effort in sustainable investments and policies and not allowing comparison with other realities.

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[31] EU regulations 2021/1257, EU 2021/1255 and EU 2020/852

[32] InfluenceMap*, The truth about "climate" funds – most are misaligned with the Paris Agreement,* 2021

According to another survey in 2021[33], 20 of the 50 largest managers globally use at least four different ESG data providers, and 30 of the managers have developed their own ESG ratings. This confirms the considerable problematic nature of the ESG information, the lack of common rules on measurement and sustainability indicators, and on how to be certified by a third party. Even ESG rating companies use very different methodologies for their ratings; for the analysis of environmental, social and governance profiles they consider the most diverse factors and rely on equally diverse indicators. All this inevitably results in often very divergent ESG judgements.

The EU Consumer Agenda of December 2020 also identified among its priorities the need for a legislative initiative on green claims and activated a pilot project in this direction, the Green Consumption Pledge; adherence to the project, which is on a voluntary basis, requires that adhering companies undertake certain commitments, including calculating the carbon footprint of the company and its flagship products and preparing, in a clear and concise manner, the relevant information to be provided to consumers.

On 3 November 2021, at the UN Climate Change Conference (Cop26) in Glasgow, Erkki Likannen, the chairman of the trustees of the International Financial Reporting Standards (Ifrs) Foundation - the independent organisation that authored the well-known International Financial Reporting Standards Ifrs - announced the formation of the International Sustainability Standards Board (Issb)[34], which will focus on climate-related reporting.

The Issb will establish a global baseline of minimum standards to be met in reporting on climate-related risks to enable investors to compare such risks among companies globally and make informed decisions. The Issb standards, which will take into account all ESG aspects, including governance, will not, however, integrate public policies, which are to be assessed separately, as they are country-specific. Starting from a fragmented reality, progress is therefore being made towards the identification of common sources and methodologies for the definition and quantification of sustainability characteristics in the various sectors concerned; it goes without saying that only with a full convergence of information will it be possible to offer the market a coherent vision and thus a full comparability and assessment of the real ESG characteristics of initiatives and products.

To prevent and counteract greenwashing, there are some general guidelines that companies and sustainable finance practitioners can follow. First, in order to be able to define oneself as "sustainable", it is necessary to intervene in depth on corporate culture and production processes: it is not enough to integrate sustainability only in communication. Secondly, it is better to communicate

[33] SquareWell survey of 2021

[34] For more detailts: IFRS Foundation, International Sustainability Standards Board

less, but be sure of what you communicate, starting with reliable data and sound sustainability policies. The key word to counter greenwashing is transparency: communication must be effective and, at the same time, correct, truthful and verifiable. Finally, to improve ESG performance at all levels, it is important to dialogue with stakeholders. For example, companies can dialogue with organisations that assign sustainability ratings (including NGOs) to better understand the methodologies used and identify priority areas for improvement. For sustainable finance actors, dialogue with invested companies is useful to gather information, to clarify any controversial situations and, finally, to urge more virtuous ESG behaviour.

Here are some recommendations for developing effective sustainability policies and communication free of greenwashing:

1. Identify sustainability goals and transparently communicate both the general principles to which they refer and the reasons that led to the choice of each specific goal.
2. Detail the path to reach the set objectives, making explicit the timeframe, methods, and intermediate objectives.
3. Explain the methodologies for measuring the Key Performance Indicators (KPIs) chosen to monitor the achievement of the objectives, clarifying their pros and cons.
4. Define the methods for obtaining ESG data, detailing the sources, the type of data, the methodologies for collecting the information, and, finally, the degree of reliability and verifiability of both the data and the sources.
5. Verify the disclosed ESG data and the progress made in achieving sustainability objectives by using an independent (preferably public) third party.
6. Engage in dialogue with stakeholders (including NGOs and local communities) and publish detailed reports on who was involved, how the dialogue process was conducted, and the results achieved.
7. Communicate accurately, paying particular attention to content selection and verifiability of all information disclosed.

Chapter 2 - The theoretical context: from CAPM to Fama – French model

2.1 The capital asset pricing model: basic assumptions and concept

The Capital Asset Pricing Model (CAPM) is a model first proposed in 1964 by financial economist and Nobel Prize-winning economist William Sharpe and later developed independently by Lintner[35] (1965) and Mossin[36] (1966).
The CAPM model explicitly drawing on the fundamental contributions underlying modern finance theory about efficient portfolio frontier and diversification benefits, links the expected return on a security or investment project to its relevant risk component, that is, one that cannot be further eliminated by resorting to portfolio diversification[37]. This risk component can thus be viewed as the contribution of a security to the risk of the entire portfolio held by each individual investor.

Before continuing with the discussion, it is useful to dwell on the description of the set of assumptions underlying the report in question, since too often in practice we see improper applications of it, not preceded by adequate verification of the applicability to the concrete case of those assumptions that underlie the CAPM and, more generally, the "mean-variance" world in which much of finance theory moves.
In particular, CAPM hinges on the following assumptions:

1) individuals are rational in choosing their investment portfolios, having as their goal the maximization of the expected utility associated with their future wealth;
2) investors, being risk-averse, choose efficient portfolios based solely on the average and variance of the returns of different securities (portfolios);
3) information circulates freely among investors;
4) investors have homogeneous expectations about the future evolution of the returns of different stocks;

[35] John Virgil Lintner, jr. (Feb. 9, 1916 - June 8, 1983) was a professor at the Harvard Business School in the 1960s and is among the creators of the Capital Asset Pricing Model
[36] Jan Mossin (1936-1987, Oslo) was a Norwegian economist and visiting professor at the University of California, Berkeley (1969-1970), New York University (1973-1974), Columbia University (1976), the University of Texas, Austin (1978-1979) and the University of Washington, Seattle (1983-1984). In 1973, he was elected a fellow of the Econometric Society, and one of the most important articles dates from his Ph.D. days and concerns a contribution to the Capital Asset Pricing Model (CAPM). The article is entitled "Equilibrium in a Capital Asset Market." Econometrica, 34, 1966, pp. 768-783.
[37] Cfr. Markowitz H. (1959), Sharpe W.F. (1964), Lintner J. (1965)

5) there is a risk-free interest rate at which individuals can give and borrow any amount of funds;
6) there are no taxes or transaction costs and also bankruptcy costs are negligible;
7) all assets are liquid, perfectly divisible and therefore "tradable".
8) the market is competitive, so that investors cannot, by their actions, influence the prices of individual assets, the amount of which is given.

Based on these assumptions, it is possible to determine the expected return that investors require as compensation for bearing any level of systematic risk-that is, risk that cannot be further diversified by adding new securities to their portfolio-associated with any asset in an equilibrium and perfectly competitive market[38]. If the market is efficient (offers the highest expected return for a given level of risk), there must be a linear relationship between the expected return of each asset and its contribution to portfolio risk.
In formal terms, the above relationship can be represented as follows:

$$E(r_i) = r_f + \beta_i * [E(r_m) - r_f] \quad (1)$$

Specifically, the beta parameter, which - as anticipated precisely represents the nondiversifiable risk component associated with any security, measures the standardized covariance between the security's return and the market return, thus providing an indication about the responsiveness of an individual security's return to a percentage change in the market portfolio return. In more formal terms, beta can be expressed as follows:

$$\beta_i = \frac{\sigma_{i,m}}{\sigma_m^2} \quad (2)$$

where:
$\sigma_{i,m}$ = covariance between the expected return of the i-th security and the expected return of the market portfolio

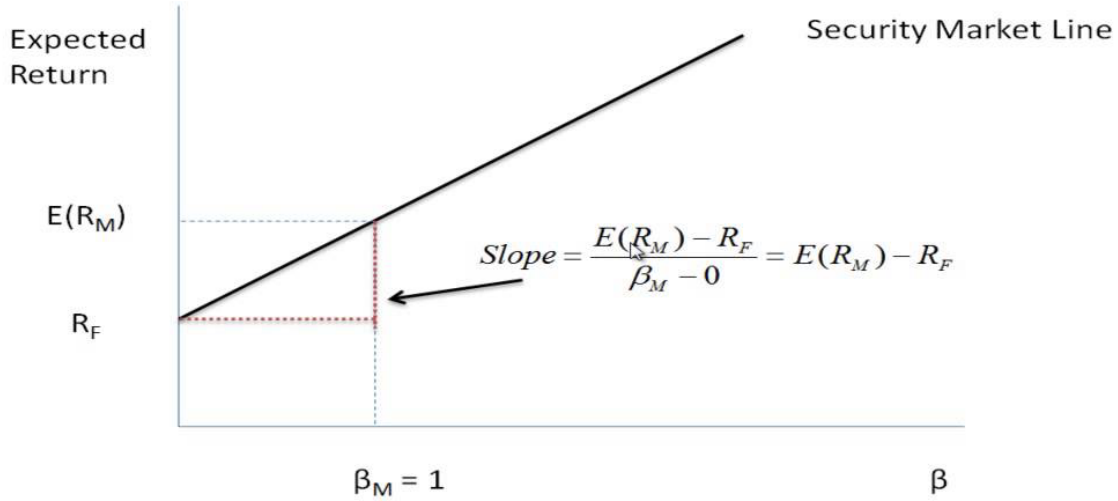
σ_m^2 = variance of the expected return of the market portfolio

[38] From a qualitative point of view, the CAPM assumes that the risk of a financial instrument can be distinguished between systematic risk and diversifiable risk, also known as idiosyncratic risk. Diversifiable risk is stock-specific, i.e. it is not related to other risks, and can therefore be diversified by introducing other instruments into a portfolio. The portfolio constructed according to market capitalisation is the most diversified and has no exposure to stock-specific risk. Systematic risk, on the other hand, cannot be diversified and is represented by an indicator called Beta, which measures the exposure of a security to the portfolio constructed according to market capitalisation.

Thus, (1) allows us to show that:

a) if beta = 0, then E(ri) = rf. Since a security with zero beta has no risk, its expected return should be equal to the risk-free rate.
b) if beta = 1, then E(ri) = E(rm). If a security has the same risk as the market portfolio, it seems reasonable to think that it should have an expected return equal to that offered by the market portfolio.

The CAPM can also be expressed graphically: Graph 1 shows the relationship between expected return and beta of a single security. As can be seen, postulating the existence of a positive linear correlation between the variables in question means that all risky assets must be positioned along the straight line passing through the points rf and M, the market portfolio, characterised - as is now understood - by a unit beta. This straight line is known as the investment market line (SML). Like any straight line, the SML has both a slope and an intercept. Rf, the risk-free rate, is the intercept. Since the beta of a security is plotted on the x-axis, [E(Rm)- Rf] represents the slope of the SML: it follows that the line is positively sloped if the expected market return is greater than the risk-free rate.



Graph 1: Security Market Line

In this respect, since the market portfolio is a risky asset (with unit beta), theory, which is also confirmed by empirical evidence, suggests that its expected return must necessarily be higher than

the risk-free rate. On the contrary, it is possible to consider the difference between the expected return of the market portfolio and the risk-free rate as a real risk premium that investors require for investing their resources in an asset characterised by a non-zero beta. Conversely, only for investments characterised by a zero beta do investors expect a return equal to the risk-free rate.
The message should therefore be clear: the expected return on a security (or portfolio or investment project) depends positively and linearly on its beta, which measures the security's contribution to the risk of a broadly diversified portfolio.

2.2 The shift towards other economic models

The CAPM turns out to be one of the most popular models in the financial markets literature. This model, assuming a linear relationship between the profitability and riskiness of financial securities, stems from the need to show that not all the risk of a security is rewarded by the market in the form of higher returns, but only that part that cannot be eliminated through diversification.
Since its inception, the CAPM has been the subject of numerous empirical tests[39], the results of which have not always agreed with each other, thus raising the doubt that the model does not provide a complete picture of the expected risk-return relationship.
After an initial period in which studies substantially confirmed the validity of the model [e.g., Black F., Jensen M., Scholes M. (1972), Fama E., MacBeth J. (1973), Gibbons M.R. (1982), L. Caprio (1989), M. Murgia (1989), and F. Caparrelli, A. Viviani (1990)], the literature has highlighted its inadequacy by showing the existence of potential other factors besides β that are able to influence stock returns [e.g: Chan K. C., Chen N. (1988), Brown S. J. (1989), Fama E., French K. (1993), Fama E., French K. (1995), Loughran T. (1997), and Cambell J. Y., Voulteenaho T. (2004)].

The latter circumstance thus led to the emergence of alternative models that, in some cases, are extensions of the CAPM. Others include: the Arbitrage Pricing Model by Ross S. A. (1976), the Multi Beta CAPM by Merton R. C. (1973) and the Consumption CAPM by Breeden D. T. (1979).
The result is that the international debate about the validity of the CAPM is still very much alive today[40] even though some of the literature has turned to statistical-mathematical and econometric models with elegant formulations, but often conditioned by assumptions so stringent as to make their verification a very difficult task.

[39] See for example just to mention a few contributions: Black F., Jensen M. and Scholes M (1972), Caprio L. (1989), Fama E., F. MacBeth (1988), Fama E. F., French K. (1982), Scotti A (1979), and Shanken J., Spring (1992).
[40] Among others: Ang A. Chen J. (2005), Chen M. H. (2003), Gonzalez F. M. (2001), Ravi J., Fletcher J. (1997), A. C. MacKinlay (1995), Jagannathan R. (1993) and Zhenyu W. (1993).

Based on these considerations, S. Ross (1976)[41] developed the Arbitrage Pricing Theory (APT), an equilibrium model in which multiple sources of risk determine the returns on a stock. APT implies that the risk of a financial asset can be decomposed into idiosyncratic risk, which, as in the CAPM, can be diversified, and a systematic risk that determines the returns of a security and which, unlike the CAPM, is determined by several factors that cannot be identified a priori (e.g., GDP growth, interest rate fluctuation, oil prices, etc.).

The main hypothesis of the model states that returns on financial assets are influenced not by a single risk factor, such as the risk represented by the volatility of the reference market, but by a number of significant risk factors that cannot be eliminated, despite diversification. Investors, by virtue of this aspect, demand compensation in the form of a higher expected return than that guaranteed by non-risky assets. Before proceeding further in the description of the model, however, it is appropriate to clarify the concept of "arbitrage", which in the literature is subdivided into pure or risk.

Pure arbitrage consists of taking advantage of possible inefficiencies in the financial system by buying and selling goods and/or assets of equal intrinsic value but traded at different prices in different markets. This form of arbitrage is, in principle, safe and risk-free, but nowadays it is difficult to implement due to new technologies that facilitate and speed up trading and cause prices to adjust in continuous time. Risk arbitrage, on the other hand, consists of making forecasts on the dynamics of an asset or commodity and exploiting future price differences, thus looking not at different markets but at time. This second type of arbitrage is not risk-free but is the concept referred to in the APT model.

The assumptions underlying the latter are mainly twofold:

- it is possible to sell securities short, taking bearish or bullish positions in order to execute an arbitrage;
- the returns of equities are described by a factorial model; the latter has two objectives: on the one hand, it defines the components linked to the actual historical returns of a risky asset; on the other hand, it allows us to estimate the expected equilibrium returns (returns that should be realised in the period t + 1, are associated with the i-th security).

Formalising what has just been described, the returns R_{it} of a stock are linearly related to a set of k-factors:

[41] S. Ross," The arbitrage theory of capital asset pricing", Journal of Economic Theory, 1976, 13, 3.

$$R_{it} = a_i + \sum_{j=1}^{k} b_{ij} F_{jt} + \varepsilon_{it} \quad (3)$$

where b_{ij} are the weights of the F_{jt} factor.

Since the publication of S. Ross (1976), several multifactor models have been proposed. In fact, the idea that stock returns may exhibit a certain level of predictability, and may therefore not be totally random, gained some credibility from 1993 onwards, when E. Fama and K. French show that equity portfolios overweighted on value or small-cap stocks tend to outperform the market portfolio over the long term.

2.3 Three factor model

This model is named after Eugene Fama and Kenneth French, who proposed it in 1992 as a viable alternative to the CAPM model.
The three-factor model allows the expected return on a security or portfolio to be estimated as the sum of three different components:

- the market risk premium, the same as already analyzed in the CAPM model;
- the average size of investment companies, measured as the difference between the expected return of a portfolio composed of small-cap stocks and the expected return of a portfolio of large-cap stocks (in the equation: SMB, small minus big);
- the degree of over-undervaluation of investment companies, measured by the BE/ME ratio; it is calculated as the difference between the expected return of a portfolio composed of securities with high BE/ME (value securities) and the expected return of a portfolio of securities with low BE/ME (growth securities) (HML, high minus low).

The size factor used by Fama and French had already been discovered by Banz and Reinganum[42] and refers to the fact that securities of small-capitalisation companies tend to have a higher risk premium than securities with high capitalisation. Banz showed that there is a consistent premium when the smallest and the largest 50 companies on the New York Stock Exchange are compared, with a higher return of about 1% per month for smaller capitalisation companies. This finding has since been

[42] The size effect was discovered by Banz (1981) and Reinganum (1981), while the value effect can be found in Basu (1977) or in the value investing theories of Graham and Dodd dating back to the 1930s.

replicated in many other countries. For example, Dimson and Marsh (1986) study the size factor in the UK based on a historical period extending back to 1955. This type of anomaly is generally attributable to the so-called "distress risk"; in fact, smaller capitalisation companies suffer less liquidity and greater economic problems than larger companies, and offer lower returns precisely when investors' marginal utility is high, i.e. during recessions.

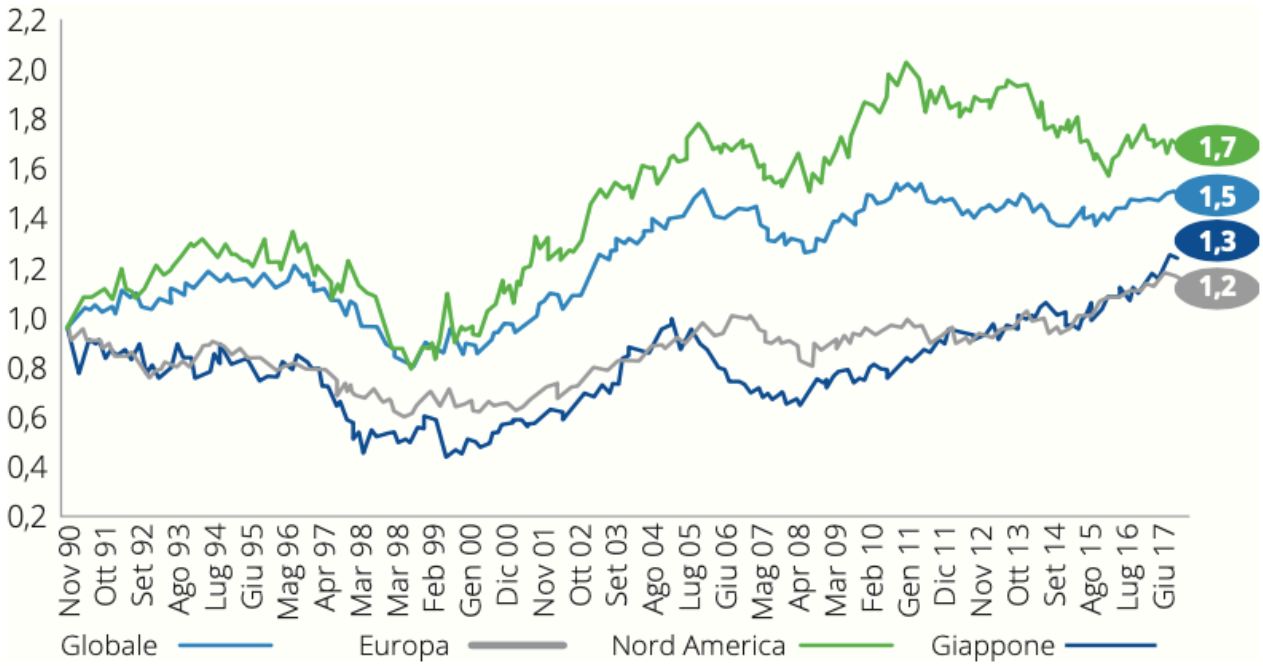


Figure 7 - Cumulative performance of the Size factor

Source: Kenneth R. French database

However, as can also be seen from Figure 7, the risk premium is not always significant. Black (1993) states that the disappearance of the anomaly can be explained by two reasons: the first, is that the size effect never existed but was a consequence of "data mining"[43]; the second, is that the trading activity of economic agents caused the price of lower capitalisation securities to rise until the risk premium was eliminated by arbitrage (Schwert, 2002).

In addition to the size effect, there has historically been a relationship between the orientation of an investment strategy and its long-term performance. Value stocks can be bought at a relatively low

[43] Data mining summarises the process used in uncovering patterns in very large datasets. In the context of factor investing, the term refers to the fact that there is a very high risk in confounding true risk rewards from spurious relationships that may only exist in the data sample under study and without economic significance.

multiple of EPS, equity or dividends. They are usually mature businesses with a future or may have a depressed price that reflects or anticipates issues. Growth shares can be bought at a relatively high price, reflecting the prosperous future of the business or anticipating growing cash flows in the future. There is an extensive literature documenting this. The first was Basu (1977), who noted that companies with high earnings to price (E/P) have returns in excess of what the CAPM predicts.
Much subsequent research has shown that companies with high dividend-yields-to-price (D/P) or book-to-market (B/M) exhibit abnormal returns. Fama and French (1993, 1995) state that this is due to the fact that value stocks are usually associated with companies in financial distress or with lower business prospects than growth companies.
Another line of research states that this factor can be explained by behavioural anomalies of economic agents. Lakonishok, Shleifer and Vishny (1994), for example, state that investors tend to extrapolate past growth rates into the future. On the one hand, growth stocks have had high growth rates, so the prices of these stocks are too high because they reflect excessive optimism; on the other hand, value stocks are priced low because investors underestimate future growth prospects.

Consequently, considering the other two factors and adding them to the CAPM model, we obtain the formulation proposed by Fama and French. The expected return of an i-th security or portfolio, at time t, is equal to:

$$E(r_{i,t}) - r_{f,t} = \alpha^{3F} + \beta_{mrkt} * [E(r_{m,t}) - r_{f,t}] + \beta_{SMB} * SMB_t + \beta_{HML} * HML_t \qquad (4)$$

where:

- $E(r_{m,t}) - r_{f,t}$, indicates the risk premium associated with the difference between the market portfolio return and the return on risk-free securities.

- α^{3F} is the intercept, referred to as “three-factor alpha”.

- SMB (Small Minus Big) indicates the size factor (Size); it represents the historical excess return of small cap stocks over large cap stocks.

- HML (High Minus Low) represents the historical excess return of stocks with high BE/ME ratios (Value stocks) relative to stocks with low index values (Growth stocks)[44].
- β_{mrkt}, β_{SMB} , β_{HML} are derived from the time-series regression of the returns of the market portfolios, SMB and HML; these coefficients can take positive and negative values.

The results found by Fama and French show that stock returns are best explained by considering the three factors specifically. For expected return analysis, in fact, it is important to understand whether the stocks considered are value or growth stocks, and the size of the company observed. Regarding the first aspect, the BE/ME ratio finds importance because it is a factor related to the firm and its managerial/operational difficulties: it tends to be the case that firms with high BE/ME (value firms) have steady but lower profits than other firms; conversely, firms with high profits but which are not distributed periodically tend to have lower BE/ME ratios (growth firms).
The second aspect, on the other hand, related to the difference between small and large companies, states that publicly traded companies that have small market capitalization manage to generate better returns than their larger competitors. There can be two reasons for this:

- if the market is efficient, the outperformance is due to the greater risk in corporate terms and cost of capital that small firms bear;
- if the market is inefficient, the outperformance is related to a mispricing of the value of smaller companies, which only adjusts over time.

The three-factor model takes the CAPM and adds the "Value" and "Size" factors as it also considers the BE/ME ratio and market capitalization. Later, the original formulation was further expanded, adding other factors.

2.4 Four factor model

Welcomed by Fama and French[45], Carhart[46] proposed extending the previous three-factor model to include not only market, size and value but also the momentum factor, the so-called momentum factor. First presented by Jegadeesh and Titman (1993) and more commonly known as the Monthly

[44] The size factor is defined as the share price multiplied by the number of securities on the market. BE/ME is calculated by comparing the book value of equity (BE) with the market value of equity (ME); it aims to identify undervalued (if the index is greater than 1) and overvalued (if the index is less than 1) stocks.

[45] Eugene F Fama and Kenneth R French. Size, value, and momentum in international stock returns. Journal of financial economics, 105(3):457–472, 2012.
[46] Mark M Carhart. On persistence in mutual fund performance. The Journal of finance, 52(1):57–82, 1997.

Momentum Factor (MOM) is the tendency of a security to replicate, in the period following observation, the performance of the previous 3-12 months. And so, therefore, that stocks with positive performance will tend to prolong their outperformance, while stocks with negative performance will tend to continue downward. In practice, momentum measures how fast a stock's price changes, and the strategy behind using this factor is that a stock's returns, over the medium-period, do not change. The explanation for this phenomenon is sought by behavioral finance[47] behind the so-called "herding behavior and return chasing behavior", which are respectively the tendency of investors to replicate the strategies of the masses at approximate times, buying and selling stocks without any centralized correlation, but mere emulation, and the tendency of investors to react in the same way to market news, opposing their initial position. The model just described thus appears formalized with the following formula:

$$E(r_{i,t}) - r_{f,t} = \alpha^C + \beta_{mrkt} * [E(r_{m,t}) - r_{f,t}] + \beta_{SMB} * (SMB_t) + \beta_{HML} * (HML_t) + \beta_{UMD} * (UMD_t) \quad (5)$$

Where in addition to the three-factor model we have:
- UMD (Up Minus Down trend stocks) is the momentum factor, obtained through the difference of the average of the returns of the best performing stocks and the average of the returns of the lowest performing stocks. Performance referring to a time frame of the previous year.
- β_{UMD} relates to the sensitivity of portfolio returns to the momentum factor.
- α^C is the intercept, referred to as the four-factor alpha.

There was no lack of subsequent studies by other economists who analyzed and/or criticized the model. Some positively grasped the entire Fama and French model, while others welcomed the momentum factor, substituting it for the size dimensional factor, going on to modify the model.

2.5 Five factor model

Criticisms about the limitation of three factors for investigating returns led Fama and French to expand their "three factor model" with two more factors: profitability and investiment. This led to the creation of the "five factor model", a five-factor asset pricing model explicated by the following formula:

(6)

[47] Field of economic study that analyzes financial market behavior by including cognitive psychology for understanding investor choices.

$$E(r_{i,t}) - r_{f,t} = \alpha^{5F} + \beta_{mrkt} * [E(r_{m,t}) - r_{f,t}] + \beta_{SMB} * (SMB_t) + \beta_{HML} * (HML_t) + \beta_{UMD} * (UMD_t) + \beta_{RMW} * (RMW_t) + \beta_{CMA} * (CMA_t)$$

Where in addition to the previous three-factor model we have:

- RMW (Robust Minus Weak) is the profitability factor), which is the difference in returns between high (more robust) and low (slimmer) profitability firms. The factor is based on the idea that firms with higher future earnings earn higher returns.
- CMA (Conservative Minus Aggressive) is the investiment factor, derived from the difference in returns between firms that invest conservatively and those that invest aggressively. The factor is based on the idea that firms that direct their investments toward large growth projects face greater losses in the stock market.
- β_{RMW}, β_{CMA} concern the sensitivity of stock portfolio returns to profitability and investiment factors.
- α^{5F} is the intercept, referred to as the "five-factor alpha".

Having emphasized the significance of multi-factor investment models, the next question is whether the incorporation of ESG criteria can serve as a valid criterion for assessing risk and return. With the existence of various multi-factor models and their evolution over time, the subsequent chapter will focus on establishing the ESG factor and integrating it into the Fama-French 3-factor model, aiming to address the aforementioned question.

Chapter 3 - Implementation of the ESG factor in the Fama-French 3-Factor model

In this chapter, we will proceed with the development of the Fama and French three-factor model, utilizing a dataset comprising companies listed in the S&P 500 index (updated as of June 2023) and focusing on the time period spanning from 2018 to 2022. During this phase, we will construct the two fundamental factors, SMB (Small Minus Big) and HML (High Minus Low), with reference to the S&P 500. Concurrently, an ESG (Environmental, Social, and Governance) factor will be introduced, designed analogously to the HML factor, and integrated into our Fama and French three-factor model.

Upon completion of the model construction, an in-depth regression analysis will be conducted. This analysis will encompass both specific portfolios and individual assets comprising the entire index. The objective of this evaluation is to determine whether the inclusion of the ESG factor results in a significant enhancement in the model's ability to explain observed variations in returns.

Through this detailed approach, our aim is to provide a comprehensive overview of the impact of ESG within the framework of the Fama and French model and to identify any positive effects or improvements in its predictive capacity.

3.1 Data sample, data sources and selection, data treatment and screening

The selected index for constructing the model is the S&P 500, which comprises 503 stocks representing companies listed on the New York Stock Exchange (NYSE) and Nasdaq. These companies collectively account for approximately 80 percent of the total market capitalization and are chosen through a specialized committee.
The selection of companies for inclusion in this index is based on the free float capitalization method[48] a departure from the Fortune 500 index, which focuses solely on the top 500 U.S. companies by revenue without distinction regarding their listing status. It also differs from the Dow Jones Index, which, as a "price-weighted index", assigns greater weight to stocks with higher prices.

[48] The free float is the part of the share capital that can be bought and sold on the market, i.e. securities not held by states, controlling blocks or shareholders bound by syndicate pacts. Free float capitalisation is simply the product of the number of floating securities multiplied by the prices of those securities.

All stocks featured in the S&P 500 are constituents of other comprehensive indices, including the S&P 1500, encompassing the S&P MidCap 400 and S&P SmallCap 600, as well as the S&P Global 1200 (S&P 500® (US), S&P Europe 350, S&P TOPIX 150 (Japan), S&P/TSX 60 (Canada), S&P/ASX All Australian 50, S&P Asia 50 and S&P Latin America 40).

NUMBER OF CONSTITUENTS	503
CONSTITUENT MARKET [USD MILLION]	
MEAN TOTAL MARKET CAP	80,195.51
LARGEST TOTAL MARKET CAP	3,089,903.51
SMALLEST TOTAL MARKET CAP	3,871.48
MEDIAN TOTAL MARKET CAP	32,156.59

Figure 8 – Index characteristics.

Source: S&global.com

CONSTITUENT	SYMBOL	SECTOR*
Apple Inc.	AAPL	Information Technology
Microsoft Corp	MSFT	Information Technology
Amazon.com Inc	AMZN	Consumer Discretionary
Nvidia Corp	NVDA	Information Technology
Alphabet Inc A	GOOGL	Communication Services
Tesla, Inc	TSLA	Consumer Discretionary
Meta Platforms, Inc. Class A	META	Communication Services
Alphabet Inc C	GOOG	Communication Services
Berkshire Hathaway B	BRK.B	Financials
Unitedhealth Group Inc	UNH	Health Care

Figure 9 – Top 10 constituents by index weight.

Source: S&global.com

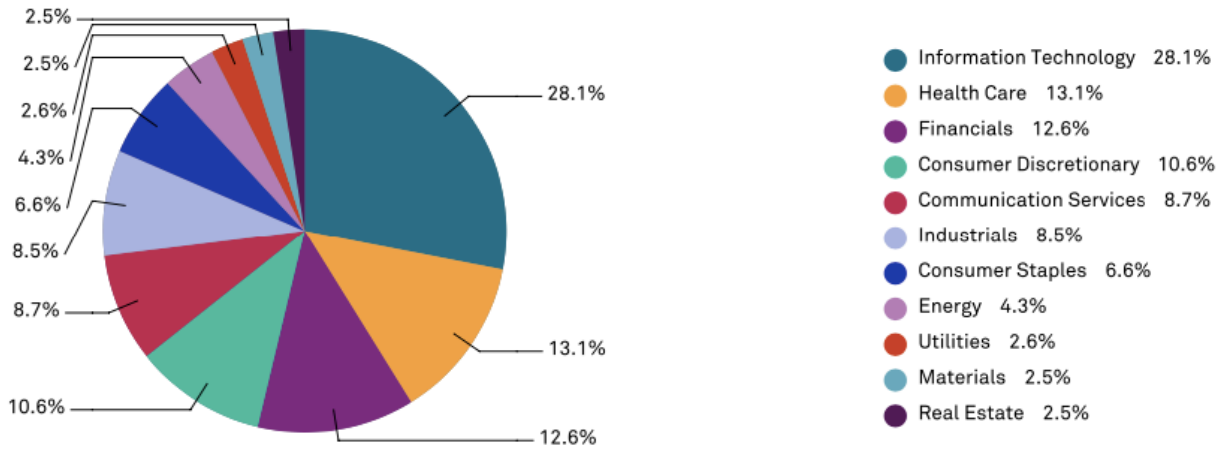
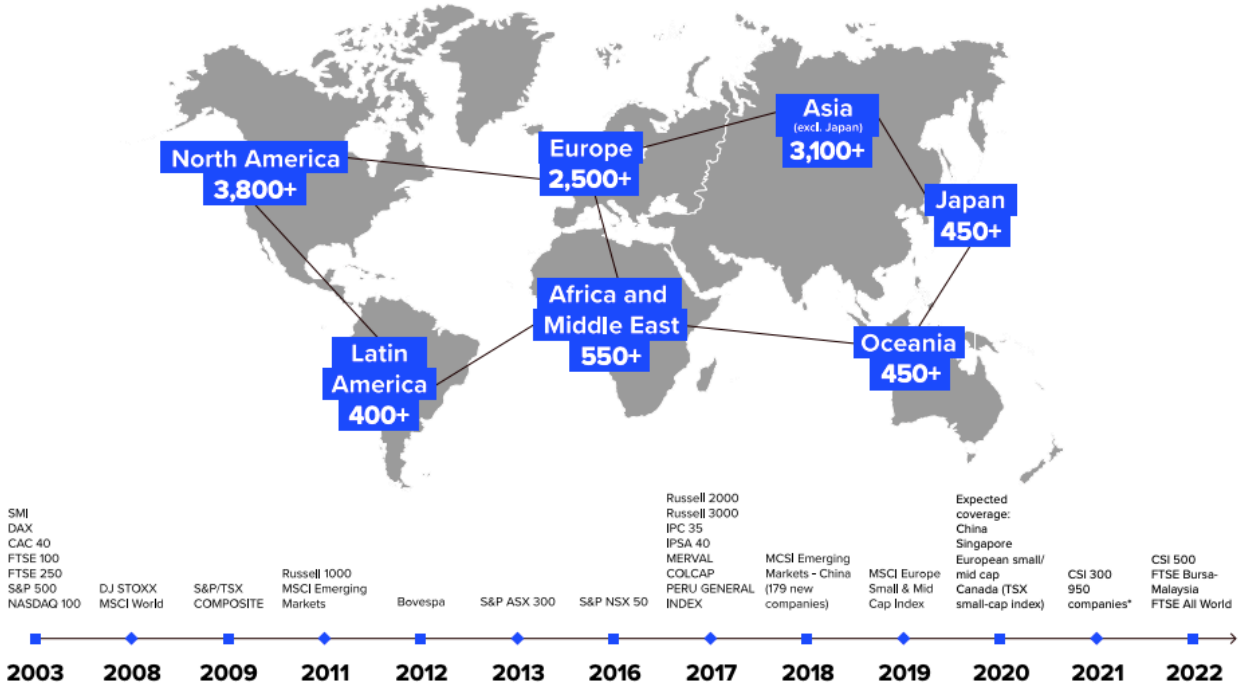


Figure 10 – S&P500 Sector breakdown.

Source: S&global.com

The primary data source utilized for this research was Refinitiv Eikon Datastream, a highly reputable tool known for its comprehensive stock market data coverage. Moreover, Refinitiv Eikon produces its proprietary ESG scores, which serve as the basis for the independent variables created for the factor analysis. A detailed explanation of the methodology for variable creation and Refinitiv Eikon's ESG score methodology has been provided in the preceding section, both concerning variable creation and Refinitiv Eikon's ESG score methodology.[49]. Subsequent sections will address data sources, the process involved in assembling the data sample, data cleaning and preparation procedures, as well as an evaluation of data quality. These aspects are vital to ensuring the integrity and reliability of the data sample, ultimately impacting the robustness of the results.

The selection of Refinitiv's Eikon database[50] was made due to its extensive coverage of ESG data for a wide range of companies. In the United States alone, as of 2023, Refinitiv's database includes ESG ratings for more than 3,800 companies, highlighting the availability of a substantial and diverse sample.



[49] Environmental, social and governance scores from Refinitiv

[50] Refinitiv Eikon: Refinitiv is a global provider of financial market data and infrastructure. The company was founded in 2018. It is jointly owned by Blackstone Group LP with a 55% stake and Thomson Reuters which owns 45%.

Figure 11 - Regional breakdown.
Source: refinitiv.com

The dataset used in this thesis consists of accounting information from a total of 472 companies, spanning the years 2018 to 2022. This dataset encompasses various components, including the daily closing prices for each of the 472 companies, recorded from 01/07/2018 to 30/06/2022. Additionally, it includes annual market capitalization data from 2018 to 2022 for all 472 companies considered, along with annual book equity figures for the same period. Book equity is defined as the book value of assets minus total liabilities.

It is important to note that the dataset comprises 472 companies, as detailed in Appendix Table 1, and does not encompass the full complement of 503 companies found in the S&P 500 index. This discrepancy arises from the absence of data related to daily share prices, market capitalization, book equity, and ESG score grades for certain companies.

473	MRNA.OQ	Moderna Inc
474	FOXA.OQ	Fox Corp
475	FOX.OQ	Fox Corp
476	DOW.N	Dow Inc
477	CTVA.N	Corteva Inc
478	AMCR.N	Amcor PLC
479	CARR.N	Carrier Global Corp
480	OTIS.N	Otis Worldwide Corp
481	OGN.N	Organon & Co
482	CEG.OQ	Constellation Energy Corp
483	GEHC.OQ	GE Healthcare Technologies Inc
484	AXP.N	American Express Co
485	ABC.N	Amerisourcebergen Corp
486	FICO.N	Fair Isaac Corp
487	AJG.N	Arthur J. Gallagher & Co.
488	LHX.N	L3Harris Technologies Inc
489	BBWI.N	Bath & Body Works Inc
490	L.N	Loews Corp
491	NKE.N	Nike Inc
492	BRO.N	Brown & Brown Inc
493	POOL.OQ	Pool Corp
494	BLK.N	BlackRock Inc
495	CME.OQ	CME Group Inc
496	MSCI.N	MSCI Inc
497	CFG.N	Citizens Financial Group Inc
498	CVS.N	CVS Health Corp
499	PNW.N	Pinnacle West Capital Corp
500	PEG.N	Public Service Enterprise Group Inc
501	EVRG.OQ	Evergy Inc
502	CDW.OQ	CDW Corp
503	IRM.N	Iron Mountain Inc

Figure 12 - Companies for which data are missing.

Source: Personal elaboration on Excel.

At the outset, the original dataset included 503 companies. Unfortunately, data crucial for creating the size factor (market capitalization) and the value factor (book equity) was unavailable for 31 of these companies. Specifically, data was missing for:

- market capitalitazion, essential for the construction of the size factor:

CVS.N	CVS Health Corp
LHX.N	L3Harris Technologies Inc
PNW.N	Pinnacle West Capital Corp
PEG.N	Public Service Enterprise Group Inc
EVRG.OQ	Evergy Inc
IRM.N	Iron Mountain Inc
CDW.OQ	CDW Corp
MRNA.OQ	Moderna Inc
FOXA.OQ	Fox Corp
FOX.OQ	Fox Corp
DOW.N	Dow Inc
CTVA.N	Corteva Inc
AMCR.N	Amcor PLC
CARR.N	Carrier Global Corp
OTIS.N	Otis Worldwide Corp
OGN.N	Organon & Co
CEG.OQ	Constellation Energy Corp
GEHC.OQ	GE Healthcare Technologies Inc

Figure 13 - Companies for which data on market capitalization are missing.

Source: Personal elaboration on Excel.

- book equity, essential for the construction of the value factor:

AXP.N	American Express Co
ABC.N	Amerisourcebergen Corp
FICO.N	Fair Isaac Corp
AJG.N	Arthur J. Gallagher & Co.
BBWI.N	Bath & Body Works Inc
L.N	Loews Corp
NKE.N	Nike Inc
BRO.N	Brown & Brown Inc
POOL.OQ	Pool Corp
BLK.N	BlackRock Inc
CME.OQ	CME Group Inc
MSCI.N	MSCI Inc
CFG.N	Citizens Financial Group Inc

Figure 14 - Companies for which data on book equity are missing.

Source: Personal elaboration on Excel.

After meticulously obtaining and cleaning the dataset, as previously described, we retained a sample of 472 distinct companies. Each company's dataset includes ESG ratings, market capitalization, closing prices, and BE/ME (Book Equity to Market Equity) ratios. The dataset comprises a total of 734,061 daily closing price observations over a four-year period.

Price	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32
	AFL.N	AES.N	ABT.N	ATVI.OQ	ADBE.OQ	AMD.OQ	APD.N	ALK.N	ALB.N	HON.OQ	ALL.N	HWM.N	HES.N	AEE.N	AEP.OQ	AXP.N	AIG.N	ABC.N	AME.N	AMGN.OQ	APH.N	ADI.OQ	AON.N	APA.OQ	AAPL.OQ	AMAT.OQ	ADM.N	ATO.N	ADSK.OQ	ADP.OQ	AZO.N	AVB.N
	Aflac Inc	AES Corp	Abbott Labor	Activision Bliz	Adobe Inc	Advanced Mic	Air Products a	Alaska Air Gro	Albemarle Cor	Honeywell Int	Allstate Corp	Howmet Aero	Hess Corp	Ameren Corp	American Elec	American Exp	American Inte	Amerisourceb	AMETEK Inc	Amgen Inc	Amphenol Co	Analog Device	Aon PLC	APA Corp (US)	Apple Inc	Applied Mate	Archer-Daniel	Atmos Energy	Autodesk Inc	Automatic Da	Autozone Inc	Avalonbay Co
01/07/18	43,02	13,41	60,99	76,32	243,81	14,99	155,73	60,39	94,33	137,92	91,27	13,04	66,89	60,85	69,25	98,00	53,02	85,27	72,16	184,59	43,58	95,92	137,17	46,75	46,28	46,19	45,83	90,14	131,09	134,14	670,93	171,89
02/07/18	42,89	13,14	61,00	77,28	243,26	15,16	155,49	61,18	93,48	138,65	91,67	12,92	64,89	61,22	70,05	99,00	53,36	85,72	71,91	185,29	43,56	96,31	137,25	44,68	46,80	45,68	45,23	90,34	131,90	134,86	667,81	170,60
03/07/18	42,90	13,01	60,81	75,88	242,01	15,00	155,00	61,67	96,62	138,77	91,90	12,95	65,96	61,23	70,50	97,84	53,67	86,68	71,57	185,71	43,36	94,51	137,08	45,78	45,98	44,80	45,66	91,27	131,60	133,66	673,51	170,98
04/07/18	42,90	13,01	60,81	75,88	242,01	15,00	155,00	61,67	96,62	138,77	91,90	12,95	65,96	61,23	70,50	97,84	53,67	86,68	71,57	185,71	43,36	94,51	137,08	45,78	45,98	44,80	45,66	91,27	131,60	133,66	673,51	170,98
05/07/18	43,04	12,97	61,33	76,19	244,18	15,50	155,79	62,14	94,78	138,75	91,94	13,08	66,38	61,55	71,13	98,53	53,92	87,20	71,98	187,36	43,91	96,40	138,22	46,33	46,35	45,44	46,34	92,05	132,80	133,71	675,94	172,39
06/07/18	42,91	13,00	62,16	77,19	248,19	16,36	156,64	62,34	95,54	139,52	92,16	13,21	67,55	62,03	71,56	98,52	54,37	87,97	71,89	191,01	44,10	97,20	139,62	46,91	46,99	46,13	46,71	92,57	135,11	134,22	681,86	172,89
07/07/18	42,91	13,00	62,16	77,19	248,19	16,36	156,64	62,34	95,54	139,52	92,16	13,21	67,55	62,03	71,56	98,52	54,37	87,97	71,89	191,01	44,10	97,20	139,62	46,91	46,99	46,13	46,71	92,57	135,11	134,22	681,86	172,89
08/07/18	42,91	13,00	62,16	77,19	248,19	16,36	156,64	62,34	95,54	139,52	92,16	13,21	67,55	62,03	71,56	98,52	54,37	87,97	71,89	191,01	44,10	97,20	139,62	46,91	46,99	46,13	46,71	92,57	135,11	134,22	681,86	172,89
09/07/18	43,36	12,63	62,44	76,84	249,77	16,61	157,89	63,49	95,98	141,15	93,60	13,64	69,21	59,97	68,87	99,91	55,56	88,25	73,03	194,17	44,69	97,18	142,53	48,40	47,65	46,52	47,27	89,81	134,97	134,52	690,62	171,90
10/07/18	43,22	12,84	62,81	76,19	248,63	16,55	159,66	62,89	95,81	141,74	93,36	13,60	69,60	60,50	69,78	99,91	55,46	88,14	73,37	195,69	44,64	98,54	142,82	48,61	47,59	46,74	47,94	90,67	134,37	135,97	692,68	173,52
11/07/18	42,49	13,03	62,57	78,61	248,12	16,27	157,41	60,19	94,68	138,37	92,83	13,10	66,82	61,38	70,75	100,30	54,56	87,14	72,06	193,15	43,83	96,22	142,49	47,68	46,97	45,20	47,85	91,06	132,22	135,37	681,46	173,93
12/07/18	42,48	13,10	62,74	81,37	254,87	16,56	157,92	60,86	95,35	141,60	92,90	13,26	66,74	61,37	70,38	101,15	54,30	86,80	73,21	194,08	44,53	98,40	143,88	47,07	47,76	45,68	47,90	91,13	137,46	137,50	686,98	174,26
13/07/18	42,60	13,18	63,06	81,50	258,59	16,27	157,33	61,43	95,57	141,22	92,83	13,32	66,54	61,39	70,35	100,50	54,24	87,91	73,70	195,91	44,36	98,12	144,20	47,45	47,83	46,13	47,57	91,13	137,21	137,34	686,97	173,35
14/07/18	42,60	13,18	63,06	81,50	258,59	16,27	157,33	61,43	95,57	141,22	92,83	13,32	66,54	61,39	70,35	100,50	54,24	87,91	73,70	195,91	44,36	98,12	144,20	47,45	47,83	46,13	47,57	91,13	137,21	137,34	686,97	173,35
15/07/18	42,60	13,18	63,06	81,50	258,59	16,27	157,33	61,43	95,57	141,22	92,83	13,32	66,54	61,39	70,35	100,50	54,24	87,91	73,70	195,91	44,36	98,12	144,20	47,45	47,83	46,13	47,57	91,13	137,21	137,34	686,97	173,35
16/07/18	42,78	13,13	61,78	80,23	254,68	16,58	155,55	61,41	94,96	140,17	93,46	14,72	63,88	61,34	70,42	100,69	54,77	86,90	72,97	194,88	44,27	97,64	145,21	46,00	47,73	46,31	47,17	91,11	136,24	137,12	692,78	172,65
17/07/18	42,94	12,85	62,80	80,95	258,31	16,87	156,20	61,80	96,97	142,17	94,26	14,75	63,46	61,27	70,44	101,15	54,71	86,82	73,18	193,92	44,51	98,26	145,62	45,26	47,86	47,30	47,72	90,80	136,56	137,36	699,94	171,37
18/07/18	43,26	12,73	64,75	81,27	259,78	16,85	155,94	63,19	96,74	142,80	95,76	15,08	64,14	61,07	70,24	102,98	55,13	86,33	73,76	192,80	44,57	99,09	147,34	44,46	47,60	48,28	47,31	90,54	137,43	137,50	694,00	171,28
19/07/18	42,89	13,03	63,78	80,61	257,68	16,71	154,40	63,79	96,21	141,26	93,42	14,69	64,50	61,71	70,64	100,17	53,85	85,56	73,64	191,76	44,30	98,26	146,15	44,55	47,97	46,67	47,25	91,73	134,50	137,06	716,17	172,40
20/07/18	43,06	13,03	63,32	79,65	257,54	16,50	154,35	60,63	93,90	146,61	93,42	14,59	64,04	61,34	70,41	100,15	53,32	84,70	73,57	190,49	44,20	97,81	146,16	44,38	47,86	46,76	47,12	91,44	134,32	137,33	714,35	170,54
21/07/18	43,06	13,03	63,32	79,65	257,54	16,50	154,35	60,63	93,90	146,61	93,42	14,59	64,04	61,34	70,41	100,15	53,32	84,70	73,57	190,49	44,20	97,81	146,16	44,38	47,86	46,76	47,12	91,44	134,32	137,33	714,35	170,54
22/07/18	43,06	13,03	63,32	79,65	257,54	16,50	154,35	60,63	93,90	146,61	93,42	14,59	64,04	61,34	70,41	100,15	53,32	84,70	73,57	190,49	44,20	97,81	146,16	44,38	47,86	46,76	47,12	91,44	134,32	137,33	714,35	170,54
23/07/18	43,48	13,07	63,20	79,75	259,47	16,66	153,87	61,54	90,92	147,16	93,19	14,56	64,24	60,93	69,44	101,22	53,40	84,75	72,71	189,97	44,00	97,79	147,19	44,35	47,90	46,43	47,23	90,82	134,50	137,70	714,78	170,35
24/07/18	43,68	13,11	64,40	78,41	257,49	16,19	155,29	59,01	90,90	148,56	93,23	14,89	65,06	61,00	69,06	101,71	53,70	83,93	73,44	191,40	44,44	97,45	147,20	45,05	48,25	45,91	47,30	90,62	132,31	137,11	705,29	170,58
25/07/18	43,78	13,40	65,23	79,45	263,17	16,05	157,30	59,11	91,79	151,30	93,75	14,76	64,88	61,36	69,38	102,63	53,57	84,77	75,32	193,04	46,52	96,55	147,71	45,70	48,71	45,96	47,24	90,40	135,85	139,15	705,72	172,50
26/07/18	44,41	13,40	65,66	77,65	261,93	18,35	161,55	64,76	93,06	152,35	94,76	16,39	64,33	62,15	71,04	102,50	54,25	83,24	77,10	194,05	47,77	97,70	148,19	45,72	48,55	47,17	47,71	91,31	136,14	139,24	711,14	172,88
27/07/18	46,31	13,37	65,26	75,36	254,81	18,94	161,24	63,65	93,26	152,56	94,64	16,42	63,61	61,94	71,14	103,85	54,36	82,92	76,85	192,44	46,98	96,98	144,50	45,01	47,75	48,30	47,61	90,88	131,16	137,41	699,78	172,23
28/07/18	46,31	13,37	65,26	75,36	254,81	18,94	161,24	63,65	93,26	152,56	94,64	16,42	63,61	61,94	71,14	103,85	54,36	82,92	76,85	192,44	46,98	96,98	144,50	45,01	47,75	48,30	47,61	90,88	131,16	137,41	699,78	172,23
29/07/18	46,31	13,37	65,26	75,36	254,81	18,94	161,24	63,65	93,26	152,56	94,64	16,42	63,61	61,94	71,14	103,85	54,36	82,92	76,85	192,44	46,98	96,98	144,50	45,01	47,75	48,30	47,61	90,88	131,16	137,41	699,78	172,23
30/07/18	46,33	13,30	65,17	72,75	242,32	19,42	161,23	62,38	92,42	150,24	94,59	15,99	64,68	61,42	70,40	100,85	54,94	82,91	76,07	190,63	46,13	95,31	143,39	46,06	47,48	47,91	47,35	90,51	127,00	134,29	698,46	172,17
31/07/18	46,54	13,36	65,54	73,42	244,68	18,33	164,17	62,83	94,20	152,86	95,12	16,63	65,63	62,06	71,14	99,52	55,21	81,83	77,80	196,55	46,76	96,14	143,55	46,00	47,57	48,63	48,26	91,87	128,44	134,99	705,53	176,85
01/08/18	46,73	13,47	64,78	73,08	248,01	18,48	162,04	61,08	91,01	150,21	94,65	16,41	64,80	61,36	70,30	99,45	54,99	79,49	76,82	195,84	46,69	96,04	142,32	44,94	50,38	47,97	48,11	90,99	127,18	132,61	701,30	178,21
02/08/18	46,36	13,55	64,58	74,06	252,22	18,79	159,99	61,60	92,02	149,27	97,54	16,15	65,82	61,77	70,49	99,73	55,16	78,98	76,76	196,38	46,92	96,19	141,40	44,41	51,85	48,11	49,34	91,59	131,16	133,15	719,08	178,50
03/08/18	46,59	13,69	65,23	71,32	253,28	18,49	159,96	62,80	92,61	148,44	98,05	16,27	66,30	62,45	71,18	100,79	53,65	80,97	76,57	197,99	46,93	96,56	143,12	45,15	52,00	48,84	49,95	91,83	132,05	134,25	721,38	180,08
04/08/18	46,59	13,69	65,23	71,32	253,28	18,49	159,96	62,80	92,61	148,44	98,05	16,27	66,30	62,45	71,18	100,79	53,65	80,97	76,57	197,99	46,93	96,56	143,12	45,15	52,00	48,84	49,95	91,83	132,05	134,25	721,38	180,08
05/08/18	46,59	13,69	65,23	71,32	253,28	18,49	159,96	62,80	92,61	148,44	98,05	16,27	66,30	62,45	71,18	100,79	53,65	80,97	76,57	197,99	46,93	96,56	143,12	45,15	52,00	48,84	49,95	91,83	132,05	134,25	721,38	180,08
06/08/18	46,64	13,82	65,24	70,57	254,11	19,43	160,96	63,12	92,66	148,38	98,40	16,23	66,96	62,57	71,27	100,92	53,42	82,14	76,32	197,61	46,99	97,38	143,78	45,64	52,27	49,48	50,06	91,96	134,35	135,56	725,38	180,21
07/08/18	46,70	13,63	64,74	70,23	253,39	19,56	160,92	63,86	92,81	149,71	98,77	16,06	67,25	62,59	71,24	101,97	52,99	83,44	77,49	200,40	47,29	98,59	143,42	46,38	51,78	49,63	50,25	91,96	135,19	137,91	729,91	179,09
08/08/18	46,87	13,95	64,84	70,01	253,83	19,58	160,65	64,15	98,77	148,60	99,21	16,03	65,93	62,60	70,93	102,78	52,44	82,66	77,17	196,20	47,23	98,49	143,38	46,13	51,81	50,18	49,97	91,87	134,14	137,82	732,79	178,26
09/08/18	46,76	13,74	64,64	70,50	253,80	19,10	160,48	63,75	100,76	147,41	99,48	15,92	64,00	62,83	70,98	102,99	52,00	83,24	76,66	193,97	47,16	97,74	142,98	43,29	52,22	49,16	50,24	91,24	135,11	138,37	736,29	178,89
10/08/18	46,48	13,56	64,03	70,61	253,70	19,06	157,87	63,23	98,50	146,58	98,63	15,95	64,27	62,78	70,85	101,58	52,22	81,98	75,88	194,42	46,88	94,94	141,76	44,17	51,88	48,13	49,87	91,27	134,85	139,29	738,96	177,20
11/08/18	46,48	13,56	64,03	70,61	253,70	19,06	157,87	63,23	98,50	146,58	98,63	15,95	64,27	62,78	70,85	101,58	52,22	81,98	75,88	194,42	46,88	94,94	141,76	44,17	51,88	48,13	49,87	91,27	134,85	139,29	738,96	177,20
12/08/18	46,48	13,56	64,03	70,61	253,70	19,06	157,87	63,23	98,50	146,58	98,63	15,95	64,27	62,78	70,85	101,58	52,22	81,98	75,88	194,42	46,88	94,94	141,76	44,17	51,88	48,13	49,87	91,27	134,85	139,29	738,96	177,20
13/08/18	46,30	13,38	63,43	70,52	253,54	19,73	162,44	61,89	95,63	145,87	98,16	15,64	63,33	62,99	70,94	101,81	52,10	83,06	75,66	195,61	46,93	95,13	140,48	43,69	52,22	48,25	49,32	91,82	133,39	139,67	729,41	177,67
14/08/18	46,51	13,50	63,63	71,29	256,05	20,02	164,33	62,75	97,33	147,57	98,38	15,86	63,92	63,10	71,02	102,18	52,33	84,43	75,82	195,76	47,04	94,85	140,85	43,90	52,44	48,38	49,94	92,60	134,00	141,15	754,87	178,63
15/08/18	46,29	13,49	63,47	69,31	250,52	19,70	164,21	63,74	95,54	146,66	98,84	15,59	61,50	63,61	71,77	101,51	52,10	85,12	75,10	195,26	46,97	93,76	141,12	41,98	52,56	47,51	49,44	93,04	131,05	141,24	752,01	180,30
16/08/18	46,50	13,87	64,16	69,69	248,89	19,33	164,72	64,31	97,06	147,54	99,89	15,87	62,74	64,45	72,34	102,65	52,46	86,82	75,73	196,44	47,03	94,26	142,82	42,17	53,33	47,43	50,15	94,18	133,73	141,24	762,74	181,32
17/08/18	46,76	13,94	64,72	69,15	245,70	19,77	166,61	65,00	95,44	148,57	100,02	16,00	62,35	64,76	72,50	103,03	52,58	87,72	76,31	197,42	47,03	94,58	143,45	42,00	54,40	43,77	50,55	94,34	132,35	142,55	765,34	183,20
18/08/18	46,76	13,94	64,72	69,15	245,70	19,77	166,61	65,00	95,44	148,57	100,02	16,00	62,35	64,76	72,50	103,03	52,58	87,72	76,31	197,42	47,03	94,58	143,45	42,00	54,40	43,77	50,55	94,34	132,35	142,55	765,34	183,20
19/08/18	46,76	13,94	64,72	69,15	245,70	19,77	166,61	65,00	95,44	148,57	100,02	16,00	62,35	64,76	72,50	103,03	52,58	87,72	76,31	197,42	47,03	94,58	143,45	42,00	54,40	43,77	50,55	94,34	132,35	142,55	765,34	183,20
20/08/18	46,78	13,96	64,64	68,93	249,76	19,98	166,99	66,84	95,54	148,85	100,44	16,25	62,96	64,57	72,18	103,83	53,16	88,27	76,58	197,56	47,15	93,74	143,01	42,03	53,87	43,53	50,77	93,59	133,72	142,16	766,86	183,07
21/08/18	46,92	13,97	64,75	69,66	251,50	20,40	166,10	66,59	94,84	150,30	101,44	16,53	63,40	64,21	71,65	104,81	53,80	87,99	77,00	197,31	47,08	95,92	144,36	42,67	53,76	43,76	50,74	92,90	135,52	143,04	767,00	181,03
22/08/18	46,60	13,99	65,67	71,43	255,54	20,90	164,36	64,90	94,53	149,49	99,51	16,43	65,19	63,56	70,74	105,83	53,13	88,15	76,12	197,84	46,70	97,92	143,14	43,28	53,76	42,99	50,50	92,51	136,94	143,30	758,76	181,30
23/08/18	46,39	14,01	65,83	71,17	257,00	22,29	164,42	64,70	93,77	151,19	99,15	16,27	64,55	63,65	71,36	105,37	52,61	88,28	75,83	196,60	46,75	97,39	143,16	42,86	53,87	42,79	50,51	92,12	136,31	143,35	771,37	181,15
24/08/18	46,67	14,01	66,10	74,09	261,51	23,98	165,97	64,83	96,00	150,81	99,53	17,04	65,14	63,99	71,55	105,76	53,31	88,33	76,21	196,64	46,80	98,78	145,44	43,49	54,04	42,73	50,70	92,22	157,20	143,59	770,52	182,80
25/08/18	46,67	14,01	66,10	74,09	261,51	23,98	165,97	64,83	96,00	150,81	99,53	17,04	65,14	63,99	71,55	105,76	53,31	88,33	76,21	196,64	46,80	98,78	145,44	43,49	54,04	42,73	50,70	92,22	157,20	143,59	770,52	182,80
26/08/18	46,67	14,01	66,10	74,09	261,51	23,98	165,97	64,83	96,00	150,81	99,53	17,04	65,14	63,99	71,55	105,76	53,31	88,33	76,21	196,64	46,80	98,78	145,44	43,49	54,04	42,73	50,70	92,22	157,20	143,59	770,52	182,80
27/08/18	46,97	13,96	66,84	74,09	262,40	25,26	167,29	65,68	96,89	152,57	100,42	16,91	66,15	63,37	71,16	107,05	54,22	88,46	77,06	198,60	47,23	100,07	145,33	43,77	54,49	43,75	50,78	91,78	154,63	143,60	767,94	182,47
28/08/18	46,78	13,91	66,79	74,00	263,04	25,05	167,01	66,91	96,94	153,29	100,38	16,79	65,78	63,22	71,11	107,28	54,04	88,87	77,33	198,62	47,31	100,42	145,05	42,76	54,93	43,40	50,45	91,80	156,81	143,83	766,12	184,49
29/08/18	46,94	14,01	67,13	74,91	268,36	25,20	168,29	67,37	96,72	153,48	100,58	16,99	67,21	63,46	71,70	106,71	53,90	89,26	77,32	199,75	47,52	100,17	146,14	43,73	55,75	43,10	50,40	92,33	155,67	146,35	769,64	184,26
30/08/18	46,51	13,90	67,02	74,10	266,43	24,89	166,73	67,19	95,05	152,66	100,03	16,92	68,17	63,55	71,81	106,23	53,64	90,06	76,45	200,35	47,19	98,57	144,38	44,38	56,26	43,14	50,38	92,55	153,86	145,49	760,89	182,83
31/08/18	46,24	13,46	66,84	72,10	263,51	25,17	166,29	67,49	95,52	152,29	100,57	17,15	67,34	63,23	71,73	105,98	53,17	89,97	76,96	199,81	47,29	98,85	145,56	43,83	56,91	43,02	50,40	92,23	154,35	146,75	766,88	183,29

Figure 15 - Tabular example of daily closing prices in Excel for the first 32 companies over 472 in the sample for the period from 1 July 2018 to 31 August 2018. Source: Personal elaboration on Excel.

The inclusion of daily closing prices is pivotal, as they are instrumental in calculating daily stock returns for the 472 companies within our sample over the 2018-2022 timeframe. This calculation is executed utilizing the following formula:

$$\frac{stock\ price_t}{stock\ price_{t-1}} - 1 \tag{7}$$

obtaining the result shown in the image below taken from Excel:

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32
	AFL.N	AES.N	ABT.N	ATVI.OQ	ADBE.OQ	AMD.OQ	APD.N	ALK.N	ALB.N	HON.OQ	ALL.N	HWM.N	HES.N	AEE.N	AEP.OQ	AXP.N	AIG.N	ABC.N	AME.N	AMGN.OQ	APH.N	ADI.OQ	AON.N	APA.OQ	AAPL.OQ	AMAT.OQ	ADM.N	ATO.N	ADSK.OQ	ADP.OQ	AZO.N	AVB.N
	Aflac Inc	AES Corp	Abbott Labor	Activision Bliz	Adobe Inc	Advanced Mic	Air Products a	Alaska Air Gro	Albemarle Cor	Honeywell Int	Allstate Corp	Howmet Aero	Hess Corp	Ameren Corp	American Elec	American Exp	American Inte	Amerisourceb	AMETEK Inc	Amgen Inc	Amphenol Co	Analog Device	Aon PLC	APA Corp (US)	Apple Inc	Applied Mate	Archer-Daniel	Atmos Energy	Autodesk Inc	Automatic Da	Autozone Inc	Avalonbay Co
01/07/18																																
02/07/18	-0,0030219	-0,0201342	0,00016396	0,01257862	-0,0022559	0,01134089	-0,0015411	0,01308164	-0,0090109	0,00527595	0,0043826	-0,0088183	-0,0298998	0,00608053	0,01155235	0,01020408	0,00641267	0,00527735	-0,0034645	0,00379219	-0,000459	0,00406589	0,00058322	-0,0442781	0,01118254	-0,0110414	-0,0130919	0,00221877	0,00617896	0,00536753	-0,0046503	-0,0075048
03/07/18	0,00023315	-0,0098935	-0,0031148	-0,0181159	-0,0051385	-0,0105541	-0,0031513	0,00800915	0,03359007	0,00089773	0,002509	0,00237248	0,01648944	0,00016335	0,00642398	-0,0117172	0,0058096	0,01119925	-0,0047281	0,00226672	-0,0045919	-0,0186896	-0,0012386	0,02461952	-0,0174164	-0,0192644	0,00950696	0,01029444	-0,0022745	-0,0088981	0,00853536	0,00222743
04/07/18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
05/07/18	0,0032634	-0,0030746	0,00855123	0,0040854	0,00896657	0,03333333	0,00509677	0,00762121	-0,0190437	-0,000138	0,00043526	0,01005917	0,0063675	0,0052262	0,00893617	0,00705233	0,0046581	0,00599908	0,00572866	0,00888482	0,01268596	0,01999788	0,00831631	0,01201398	0,00804698	0,01428571	0,01489269	0,00854607	0,00911854	0,00037408	0,00360796	0,00824658
06/07/18	-0,0030204	0,00231303	0,01353334	0,01312508	0,01642231	0,05548387	0,00545606	0,00321854	0,00801857	0,00552029	0,00239286	0,00937317	0,01762579	0,00779854	0,00604527	-0,0001015	0,0083457	0,00883028	-0,0012503	0,01948121	0,00432753	0,00829876	0,01012878	0,01251889	0,01386192	0,01518486	0,00798446	0,0056491	0,01739458	0,00381422	0,00875817	0,0029004
07/07/18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
08/07/18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
09/07/18	0,01048707	-0,0284615	0,0045045	-0,0045343	0,00636609	0,01528117	0,00798008	0,01844722	0,0046054	0,01166621	0,015625	0,03250145	0,02457439	-0,0332097	-0,0375908	0,01410881	0,02188707	0,0031829	0,01585756	0,01654364	0,0133802	-0,0002058	0,02084229	0,03176295	0,01388519	0,00845437	0,01198887	-0,0298153	-0,0010362	0,00223514	0,01284721	-0,0057262
10/07/18	-0,0032288	0,01662708	0,00592569	-0,0084591	-0,0045642	-0,0036123	0,01121034	-0,0094503	-0,0017712	0,00420567	-0,0025641	-0,0028106	0,00563502	0,00883775	0,0132133	0	-0,0017999	-0,0012465	0,00465562	0,00782819	-0,0011189	0,01399465	0,00203466	0,00433884	-0,0012068	0,00472915	0,01417389	0,00957577	-0,0044454	0,01077907	0,00298283	0,00942408
11/07/18	-0,0168903	0,01479751	-0,003821	0,0317627	-0,0020512	-0,0169184	-0,0140924	-0,0429321	-0,0117942	-0,0237774	-0,0056769	-0,0366404	-0,0399425	0,01454545	0,01390083	0,00390351	-0,0162279	-0,0113456	-0,0178547	-0,0129797	-0,0181472	-0,0235437	-0,0023106	-0,0191319	-0,0129761	-0,0329482	-0,0018773	0,00430131	-0,0160006	-0,0044127	-0,016198	0,00236284
12/07/18	-0,0002353	0,00537222	0,00271696	0,03511004	0,02720458	0,01782422	0,00323995	0,01113142	0,00707647	0,02331857	0,00075407	0,01228789	-0,0011972	-0,0001629	-0,0052297	0,00847458	-0,0047654	-0,0039018	0,01595892	0,00481491	0,01597262	0,02265641	0,00975507	-0,0127936	0,01676602	0,01061947	0,00104493	0,00076872	0,03963092	0,01573465	0,00810026	0,00189732
13/07/18	0,00282486	0,00610687	0,00510041	0,00159764	0,01459568	-0,0175121	-0,0037361	0,00936576	0,00230729	-0,0026371	-0,0007535	0,00462428	-0,0029967	0,00032589	-0,0004263	-0,0064261	-0,001105	0,01278802	0,00669307	0,0094291	-0,0038181	-0,0028455	0,00222408	0,00807308	0,00157043	0,00985114	-0,0068894	0	-0,0018187	-0,0011636	-1,456E-05	-0,0052221
14/07/18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
15/07/18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
16/07/18	0,00422535	-0,0037936	-0,0202981	-0,0155828	-0,0151205	0,01905347	-0,0113138	-0,0003256	-0,0063828	-0,0074576	0,0067866	0,10471807	-0,039976	-0,0008145	0,00099502	0,00189055	0,00977139	-0,011489	-0,009905	-0,0052575	-0,0020291	-0,004892	0,00700416	-0,0305585	-0,0021952	0,00390202	-0,0084087	-0,0002195	-0,0070695	-0,0016019	0,00845743	-0,0040381
17/07/18	0,00374007	-0,0213252	0,0165102	0,0089742	0,01425318	0,01749095	0,00417872	0,00635076	0,02116681	0,01427596	0,00855981	0,00208333	-0,0065748	-0,0011412	0,00028401	0,00456848	-0,0010955	-0,0009206	0,0028779	-0,0049261	0,00542189	0,00634986	0,0028235	-0,016087	0,00282856	0,02137767	0,01165995	-0,0034025	0,0023488	0,00175029	0,01033517	-0,0074138
18/07/18	0,00745226	-0,0093385	0,03105096	0,00395306	0,00569084	-0,0011855	-0,0016645	0,02249191	-0,0023719	0,00444474	0,01591343	0,02286902	0,01071541	-0,0032642	-0,0028393	0,01809194	0,00767684	-0,0056439	0,00792566	-0,0057756	0,00134816	0,00844698	0,01181156	-0,0176757	-0,0054845	0,02071882	-0,0085918	-0,0028634	0,00637083	0,00101922	-0,0084864	-0,0005252
19/07/18	-0,0085529	0,02356638	-0,0149807	-0,0081211	-0,0080838	-0,0083086	-0,0098756	0,00949517	-0,0054786	-0,0107945	-0,0244361	-0,0259146	0,00561272	0,01047978	0,00569476	-0,0272869	-0,0232178	-0,0089193	-0,0016269	-0,0053942	-0,0060586	-0,0083762	-0,0080766	0,00202429	0,00777311	-0,0333471	-0,0012682	0,01314336	-0,0213199	-0,0032	0,03194524	0,006539
20/07/18	0,00396363	0	-0,0072123	-0,0119092	-0,0005433	-0,0125673	-0,0003238	-0,0495375	-0,02401	0,03788803	0	-0,0073031	-0,0071318	-0,0059958	-0,0032559	-0,0001997	-0,0098422	-0,0100514	-0,0009506	-0,0066229	-0,0021447	-0,0045797	6,8423E-05	-0,0038159	-0,0022931	0,00192843	-0,0027513	-0,0031615	-0,0013383	0,00196994	-0,0025413	-0,0107889
21/07/18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
22/07/18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
23/07/18	0,00975383	0,00306984	-0,0018951	0,00125549	0,00749398	0,00969697	-0,0031098	0,01500907	-0,0317359	0,00372233	-0,002462	-0,0021019	0,00312305	-0,0066841	-0,0137765	0,01068397	0,00150038	0,00059032	-0,0116895	-0,0027298	-0,0045249	-0,0002045	0,00704707	-0,000676	0,00088801	-0,0070573	0,00233447	-0,0067804	0,00134008	0,00269424	0,00060195	-0,0011141
24/07/18	0,00459982	0,00306044	0,01898734	-0,0168025	-0,0076309	-0,0282113	0,00922857	-0,0411115	-0,00022	0,00949902	0,00042923	0,02317009	0,01276463	0,00114886	-0,0054724	0,00484094	0,00561798	-0,0096755	0,01003988	0,0075275	0,01	-0,0034768	6,7939E-05	0,01578354	0,00725432	-0,0111997	0,00148211	-0,0022022	-0,0162825	-0,0042847	-0,0132768	0,00135016
25/07/18	0,00228938	0,02212052	0,0128882	0,01326361	0,02205911	-0,0086473	0,01294353	0,00169463	0,00979098	0,01843259	0,0055776	-0,0087494	-0,0027667	0,00590164	0,00463365	0,00904532	-0,0024209	0,01000834	0,02559913	0,00856844	0,04680468	-0,0092355	0,00346467	0,01442841	0,00943005	0,00108909	-0,0012685	-0,0024277	0,02675535	0,01487856	0,00060968	0,01125572
26/07/18	0,01439013	0	0,00659206	-0,0226558	-0,0047118	0,14330218	0,02701844	0,0955845	0,01383593	0,00696114	0,01077333	0,11007269	-0,0084772	0,01287484	0,0239262	-0,0012667	0,01269367	-0,0180488	0,0236325	0,00523208	0,02676268	0,01191093	0,00324961	0,00043764	-0,0031311	0,02632724	0,0099492	0,01006637	0,00213471	0,00064678	0,0076801	0,0022029
27/07/18	0,04278316	-0,0022388	-0,006092	-0,0294913	-0,0271828	0,03215259	-0,0019189	-0,0171402	0,00214915	0,0013826	-0,0012664	0,00187091	-0,0111923	-0,0033789	0,00140766	0,01317073	0,00202765	-0,0038443	-0,0032425	-0,0082968	-0,0164346	-0,0073695	-0,0249005	-0,0155293	-0,0166315	0,0239559	-0,002096	-0,0047092	-0,03658	-0,0131428	-0,0159744	-0,0037598
28/07/18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
29/07/18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
30/07/18	0,00043187	-0,0052356	-0,0013791	-0,0346338	-0,0490169	0,02534319	-6,202E-05	-0,0199529	-0,0090071	-0,0151876	-0,0005283	-0,0261438	0,01682125	-0,0083952	-0,010402	-0,0288878	0,01066961	-0,0001206	-0,0101496	-0,0094055	-0,0181992	-0,01722	-0,0076817	0,02332815	-0,0056027	-0,0080745	-0,005461	-0,0040713	-0,031717	-0,0227058	-0,0018863	-0,0003484
31/07/18	0,0045327	0,00451128	0,00567746	0,00920962	0,00973919	-0,0561277	0,01823482	0,00721385	0,0192599	0,0173974	0,00560313	0,03978907	0,01468769	0,01042006	0,01051136	-0,0131879	0,00491445	-0,0130262	0,02274221	0,03105492	0,01365854	0,00870843	0,00111584	-0,0013026	0,00200095	0,01502818	0,01921859	0,01502596	0,01133858	0,0052126	0,01012227	0,02718244
01/08/18	0,00408251	0,00823353	-0,011596	-0,0046309	0,01360961	0,00818331	-0,0129744	-0,0278529	-0,0338641	-0,0172878	-0,0049411	-0,0129092	-0,0126467	-0,0112794	-0,0118077	-0,0007034	-0,0039848	-0,0285959	-0,0125964	-0,0036123	-0,0013902	-0,0010401	-0,0085684	-0,0230435	0,05891008	-0,0135719	-0,0031082	-0,0095788	-0,00981	-0,0176309	-0,0059955	0,00769013
02/08/18	-0,0079178	0,00593912	-0,0030874	0,01340996	0,01697512	0,01677489	-0,0126512	0,00851343	0,01109768	-0,0063102	0,03053354	-0,0158804	0,01574074	0,00668188	0,0027027	0,00281549	0,00309147	-0,0064159	-0,000781	0,00275735	0,00492611	0,00156185	-0,0064643	-0,0117935	0,02923077	0,00291849	0,02556641	0,00659413	0,03129423	0,00407209	0,02535292	0,00162729
03/08/18	0,00496117	0,0103321	0,01006504	-0,036997	0,00420268	-0,0159659	-0,0001875	0,01948052	0,00641165	-0,0055164	0,00522862	0,00759374	0,00729262	0,01100858	0,00978862	0,0106287	-0,0273749	0,02519625	-0,0024752	0,00819839	0,00021313	0,00384655	0,01216407	0,01666291	0,0028931	0,01517356	0,01236319	0,00262037	0,00678561	0,00826136	0,00319853	0,00885154
04/08/18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
05/08/18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
06/08/18	0,00107319	0,00949598	0,0001533	-0,010516	0,00327701	0,05083829	0,00625156	0,00509554	0,0005399	-0,0004515	0,00356961	-0,0023552	0,00995475	0,00192154	0,0012644	0,00128981	-0,004287	0,0144498	-0,003265	-0,0019193	0,00117196	0,00849213	0,00461151	0,01085271	0,00519256	0,01310401	0,0022022	0,00141566	0,01741764	0,00975791	0,00554493	0,0007219
07/08/18	0,00128645	-0,0137482	-0,007664	-0,0048179	-0,0028334	0,00669068	-0,0002485	0,0117237	0,00161882	0,00896948	0,00376016	-0,0108593	0,00433094	0,00031964	-0,0004209	0,01040428	-0,0080494	0,01582664	0,01533019	0,01411872	0,00649143	0,01242555	-0,0025038	0,01621385	-0,0093749	0,00303153	0,00379545	0	0,00625233	0,0173355	0,006245	-0,006215
08/08/18	0,00364026	0,02347762	0,00154464	-0,0031326	0,00173645	0,00102249	-0,0016779	0,00454118	0,06421722	-0,0074188	0,00445479	-0,0019093	-0,0196283	0,00015977	-0,0043515	0,00794351	-0,0103793	-0,009348	-0,0041296	-0,0209581	-0,0012688	-0,0010143	-0,0002789	-0,0053903	0,00067597	0,01108201	-0,0055721	-0,0009787	-0,0077668	-0,0006526	0,00394569	-0,0046345
09/08/18	-0,0023469	-0,0150538	-0,0030845	0,006999	-0,0001182	-0,0245148	-0,0010582	-0,0062354	0,02014782	-0,0079897	0,0027215	-0,0066954	-0,0292735	0,00367412	0,00070492	0,0020432	-0,0083905	0,00701669	-0,0066088	-0,011366	-0,0014821	-0,007615	-0,0027898	-0,0615651	0,0078649	-0,0203268	0,00540324	-0,0068575	0,00723125	0,00399071	0,00477627	0,00353416
10/08/18	-0,005988	-0,0131004	-0,0094369	0,00156028	-0,000394	-0,0020942	-0,0162637	-0,0081569	-0,0224295	-0,0056508	-0,0085444	0,00192585	0,00421875	-0,0007958	-0,0018315	-0,0136906	0,00423077	-0,015137	-0,0101748	0,00231995	-0,0060433	-0,0286474	-0,0085327	0,02032802	-0,006463	-0,020952	-0,0073646	0,0003288	-0,0019244	0,00664884	0,00362629	-0,0094471
11/08/18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12/08/18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
13/08/18	-0,0038726	-0,0132743	-0,0093706	-0,0012746	-0,0006307	0,03515215	0,02894787	-0,0211925	-0,0291371	-0,0048338	-0,0047653	-0,0192215	-0,0146258	0,00334501	0,00127029	0,00226423	-0,002298	0,01317394	-0,0028993	0,00612077	0,00106667	0,00200126	-0,0090293	-0,0108671	0,0064569	0,00249325	-0,0110287	0,00602608	-0,0108268	0,00272812	-0,0129236	0,00265237
14/08/18	0,00453564	0,00896861	0,00315308	0,01091889	0,00989982	0,01469843	0,01163507	0,01389562	0,01777685	0,01168362	0,00224124	0,01371877	0,00931628	0,00174631	0,00112771	0,00363422	0,00441459	0,0164941	0,00211472	0,00076683	0,00234417	-0,0029433	0,00263383	0,00480659	0,00421315	0,0026943	0,01257097	0,00849488	0,00457306	0,01059641	0,03490492	0,00540328
15/08/18	-0,0047302	-0,0007407	-0,0025145	-0,0277739	-0,0215973	-0,015984	-0,0007302	0,01577689	-0,018391	-0,0061636	0,00467575	-0,0169164	-0,0378598	0,00808241	0,01056041	-0,0065571	-0,0043952	0,00817245	-0,0094962	-0,0025541	-0,0014883	-0,0114918	0,00191693	-0,0437358	0,00233611	-0,0179826	-0,010012	0,00475162	-0,0220149	0,00063762	-0,0037887	0,00934893
16/08/18	0,00453662	0,02816901	0,01087128	0,00548261	-0,0065065	-0,0187817	0,00310578	0,00894258	0,01590957	0,00600601	0,01062323	0,01769912	0,0201626	0,01320547	0,00794204	0,01123042	0,00690979	0,0199718	0,00838881	0,00604322	0,00138401	0,00533276	0,01204649	0,00452596	0,01464992	-0,0016839	0,01436084	0,01225279	0,02045021	0	0,01426843	0,00565724
17/08/18	0,0055914	0,00504686	0,00872818	-0,0077486	-0,0128169	0,02276255	0,01147402	0,01072928	-0,0166907	0,00694354	0,00130143	0,00869565	-0,0062161	0,00480993	0,00221178	0,0037019	0,00228746	0,01036628	0,00765879	0,0049888	-0,0001063	0,00339487	0,00441115	-0,0040313	0,01997	-0,0771664	0,00797607	0,00169887	-0,0103193	0,00927499	0,00340876	0,01036841
18/08/18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
19/08/18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
20/08/18	0,00042772	0,00143472	-0,0012361	-0,0031815	0,01652422	0,01062215	0,00228078	0,02830769	0,00104778	0,00193336	0,00419916	0,01532567	0,00978348	-0,0029339	-0,0044138	0,00776473	0,01103081	0,00626995	0,0035382	0,00070915	0,00265816	-0,0088814	-0,0030673	0,00071429	-0,0097435	-0,0054832	0,00435213	-0,00795	0,01035134	-0,0027359	0,00198605	-0,0007096
21/08/18	0,00299273	0,00071633	0,00170173	0,01059045	0,00696669	0,02102102	-0,0053297	-0,0037403	-0,0073268	0,00971248	0,00995619	0,01698113	0,00698856	-0,0055753	-0,0073428	0,00943851	0,01203913	-0,0031721	0,00548446	-0,0012654	-0,0015907	0,02325581	0,0094399	0,01522722	-0,0019493	0,00528371	-0,0005909	-0,0073726	0,01346096	0,00619021	0,00018256	-0,0111433
22/08/18	-0,0068201	0,00143164	0,01420849	0,02540913	0,01606362	0,0245098	-0,0104756	-0,0253792	-0,0032687	-0,0054147	-0,019026	-0,0060297	0,02823344	-0,010123	-0,0127006	0,0097319	-0,0124535	0,00181839	-0,0114286	0,00268613	-0,0080722	0,02085071	-0,0084511	0,01429576	4,6503E-05	-0,017596	-0,00473	-0,0041981	0,01047816	0,00181767	-0,0107432	0,00149147
23/08/18	-0,0045064	0,00142959	0,00243642	-0,0036399	0,00571339	0,06650718	0,00036505	-0,0030817	-0,0080398	0,01140076	-0,0036177	-0,0093327	-0,0098175	0,00141598	0,00876449	-0,0043466	-0,0097873	0,00147476	-0,0038098	-0,0062677	0,00117786	-0,0054126	0,00013972	-0,0097043	0,00204604	-0,0046522	0,00019802	-0,0042158	-0,0046006	0,00034892	0,01661922	-0,0008274
24/08/18	0,00603578	0	0,00410147	0,04102852	0,01754864	0,07581875	0,00942708	0,00200927	0,02378159	-0,0025331	0,00383258	0,04710316	0,0091402	0,00534171	0,00266256	0,00370124	0,01330546	0,00056638	0,00501121	0,00020346	0,00106952	0,01427251	0,01592624	0,01469902	0,00310919	-0,0014022	0,00376163	0,00108554	0,15325361	0,00167422	-0,0011019	0,00910847
25/08/18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
26/08/18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
27/08/18	0,00642811	-0,0035689	0,01119516	0	0,00340331	0,05337781	0,00795324	0,01311121	0,00927083	0,0116818	0,00894203	-0,0076473	0,01550507	-0,009689	-0,0054507	0,01219743	0,01706997	0,00147175	0,01115339	0,00996745	0,0090812	0,01305932	-0,0007563	0,00643826	0,00823464	0,02387082	0,00157791	-0,0047712	-0,0163486	9,6943E-05	-0,0033484	-0,0018053
28/08/18	-0,0040451	-0,0035817	-0,0007481	-0,0012147	0,00243902	-0,0083135	-0,0016737	0,01872716	0,00051605	0,00470662	-0,0003983	-0,0072529	-0,0055933	-0,0023671	-0,0007026	0,00214853	-0,0033198	0,00463486	0,00350376	0,0001007	0,00179989	0,00349755	-0,0019266	-0,0230752	0,00807562	-0,008	-0,0064986	0,00021791	0,01409817	0,00160167	-0,00237	0,01107031
29/08/18	0,00342027	0,00718907	0,00509058	0,0122973	0,02022506	0,00598802	0,00766421	0,00687491	-0,0022694	0,00124922	0,00199243	0,01232877	0,02173913	0,00379627	0,008297	-0,0053132	-0,0025907	0,00438843	-0,0001293	0,00568926	0,00433312	-0,0024895	0,00751465	0,02268475	0,01492945	-0,0069124	-0,0009911	0,00577342	-0,0072699	0,01752068	0,00459458	-0,0012467
30/08/18	-0,0091606	-0,0078515	-0,0016386	-0,010813	-0,0071918	-0,0123016	-0,0092697	-0,0026718	-0,0172663	-0,0053026	-0,0054683	-0,0045106	0,01428359	0,00141822	0,00153417	-0,0044982	-0,0048237	0,00896258	-0,0112519	0,00300375	-0,0068399	-0,0159728	-0,0120432	0,01486394	0,00919365	0,00092807	-0,0003968	0,00238276	-0,0116272	-0,0058763	-0,011369	-0,0077608
31/08/18	-0,0058052	-0,0316547	-0,0026858	-0,0269906	-0,0109597	0,0112495	-0,002639	0,00446495	0,00494477	-0,0024459	0,00539838	0,01404622	-0,0121754	-0,0050354	-0,0011141	-0,0023534	-0,0087621	-0,0009993	0,00667103	-0,0026953	0,00211909	0,00284062	0,00817288	-0,012393	0,01155402	-0,0027816	0,00039698	-0,0034576	0,00318471	0,00866039	0,00787236	0,002516

Figure 16 - Tabular example of daily returns for the shares in Excel for the first 32 companies over 472 in the sample for the period from 1 July 2018 to 31 August 2018[51]. Source: Personal elaboration on Excel.

[51] The value zero corresponds to public and national holidays in the USA.

3.2 Construction of the SMB - HML factors

Fama and French's model extends the Capital Asset Pricing Model (CAPM) by introducing two additional factors: the size factor, represented by the SMB variable and measured in terms of market capitalization, and the value factor, quantified through the HML variable, which is derived from the Book Equity to Market Equity (BE/ME) ratio.

To begin, the process involves the identification of a relevant sample, which is subsequently segmented into subgroups based on specific criteria:

- Two distinct groups, namely Small and Big, are categorized based on the median values of market capitalizations within the sample.
- Three distinct groups, categorized as Low, Neutral, and High, are determined based on the values of BE/ME within the sample.[52]

The intersection of these criteria results to the identification of six portfolios of securities, denoted as $p \in \{S/L; S/N; S/H; B/L; B/N; B/H\}$.

In this case, the procedure for constructing the SMB and HML factors starts with the sorting of companies within the S&P 500 index. These companies are ranked from the first to the 472nd position, excluding those with missing data, as previously described. For these 472 companies, it is necessary to acquire the annual Market Equity (ME)[53] data for the period spanning 2018 to 2022, given that ME represents the size factor (Figure 17).

Subsequently, the annual book equity (BE)[54] data for all 472 companies must be acquired. In instances, where BE data from 2018 to 2022 was unavailable, it was calculated as the difference between book value of assets and total liabilities for each of the 472 companies within the sample (Figure 18).

[52] Kenneth R. French Data Library: "the portfolios, which are constructed at the end of each June, are the intersections of 2 portfolios formed on size (market equity, ME) and 3 portfolios formed on the ratio of book equity to market equity (BE/ME). The size breakpoint for year t is the median NYSE market equity at the end of June of year t. BE/ME for June of year t is the book equity for the last fiscal year end in t-1 divided by ME for December of t-1. The BE/ME breakpoints are the 30th and 70th NYSE percentiles".

[53] Kenneth R. French Data Library: Market equity (size) is price times shares.

[54] Book equity is constructed from Compustat data or collected from the Moody's Industrial, Financial, and Utilities manuals. BE is the book value of stockholders' equity, plus balance sheet deferred taxes and investment tax credit (if available), minus the book value of preferred stock. Depending on availability, we use the redemption, liquidation, or par value (in that order) to estimate the book value of preferred stock. Stockholders' equity is the value reported by Moody's or Compustat, if it is available. If not, we measure stockholders' equity as the book value of common equity plus the par value of preferred stock, or the book value of assets minus total liabilities (in that order). See Davis, Fama, and French, 2000, "Characteristics, Covariances, and Average Returns: 1929-1997," Journal of Finance, for more details.

ME			Market Capitalization				
	Identifier (RIC)	Company Name	FY0	FY-1	FY-2	FY-3	FY-4
ID	Identifier (RIC)	Company Name	2022	2021	2020	2019	2018
1	AFL.N	Aflac Inc	44.731.469.006,40	38.626.632.707,41	31.237.740.045,15	38.829.552.729,00	34.683.886.958,20
2	AES.N	AES Corp	19.210.235.615,28	16.203.085.087,50	15.630.581.978,00	13.212.657.854,40	9.576.821.546,34
3	ABT.N	Abbott Laboratories	191.426.964.976,83	248.868.708.017,06	194.055.869.503,69	153.608.062.536,30	127.035.568.204,56
4	ATVI.OQ	Activision Blizzard Inc	59.909.968.169,45	51.819.457.493,52	71.759.789.627,25	45.650.013.359,40	35.535.271.937,26
5	ADBE.OQ	Adobe Inc	158.777.297.000,00	293.344.974.000,00	228.840.346.460,49	149.836.851.843,77	122.467.820.589,03
6	AMD.OQ	Advanced Micro Devices Inc	104.432.308.612,74	176.480.191.893,70	110.420.955.484,78	51.427.319.243,04	17.809.436.589,12
7	APD.N	Air Products and Chemicals Inc	51.619.277.080,86	56.693.703.072,60	65.795.598.835,36	48.887.991.138,54	36.629.470.456,80
8	ALK.N	Alaska Air Group Inc	5.446.416.463,14	6.528.685.802,80	6.430.516.456,00	8.344.999.611,50	7.502.798.610,75
9	ALB.N	Albemarle Corp	25.405.754.906,84	27.345.553.858,86	15.704.565.111,36	7.744.652.730,32	8.185.287.556,95
10	HON.OQ	Honeywell International Inc	144.078.654.317,60	143.543.074.517,25	149.248.562.853,60	126.472.429.323,00	97.806.890.592,36
11	ALL.N	Allstate Corp	35.962.418.234,40	33.727.436.223,65	33.426.198.098,18	36.428.865.244,20	28.461.264.770,10
12	HWM.N	Howmet Aerospace Inc	16.304.391.378,17	13.422.453.558,96	12.375.055.848,26	13.321.596.508,51	8.147.944.288,62
13	HES.N	Hess Corp	43.724.306.648,12	22.929.081.962,82	16.210.617.212,96	20.357.423.560,35	11.998.252.008,00
14	AEE.N	Ameren Corp	22.987.791.267,48	22.929.527.060,91	19.296.976.702,68	18.895.088.025,60	15.935.414.512,16
15	AEP.OQ	American Electric Power Company Inc	48.791.356.226,10	44.859.742.974,55	41.352.231.234,38	46.703.956.704,21	36.865.196.772,24
16	AIG.N	American International Group Inc	46.986.055.832,40	47.210.721.990,88	32.617.364.289,24	44.654.615.935,98	34.863.996.202,70
17	AME.N	AMETEK Inc	32.087.312.348,84	34.014.052.408,64	27.824.043.684,64	22.799.853.053,28	15.714.251.304,40
18	AMGN.OQ	Amgen Inc	140.139.242.663,84	126.717.929.972,94	133.852.207.271,04	143.239.826.228,87	124.047.470.229,48
19	APH.N	Amphenol Corp	45.310.498.275,60	52.303.509.813,72	39.120.466.788,27	32.089.297.448,61	24.413.524.720,76
20	ADI.OQ	Analog Devices Inc	74.517.801.011,28	93.061.699.422,12	43.803.919.182,51	40.401.949.094,32	32.402.187.635,88
21	AON.N	Aon PLC	62.084.840.211,04	66.223.107.947,36	48.128.108.826,00	48.334.007.768,16	35.009.100.411,04
22	APA.OQ	APA Corp (US)	15.008.170.870,68	9.768.444.824,51	5.356.415.402,58	9.622.768.584,33	9.963.020.602,50
23	AAPL.OQ	Apple Inc	2.417.523.223.360,00	2.428.611.988.720,00	1.920.272.742.080,00	988.886.967.600,00	1.090.307.495.240,00
24	AMAT.OQ	Applied Materials Inc	77.186.957.304,44	123.385.179.525,00	55.664.584.465,80	51.471.559.284,32	31.809.573.259,56
25	ADM.N	Archer-Daniels-Midland Co	51.005.682.976,95	37.812.634.763,40	28.047.571.960,09	25.802.410.700,25	22.969.600.043,75
26	ATO.N	Atmos Energy Corp	14.247.991.848,30	11.679.422.302,80	11.791.502.729,38	13.461.876.470,21	10.442.851.351,12
27	ADSK.OQ	Autodesk Inc	46.424.534.009,04	54.947.159.832,43	61.003.917.074,29	43.313.496.443,70	32.238.100.659,20
28	ADP.OQ	Automatic Data Processing Inc	87.397.644.000,00	84.516.448.718,40	63.989.106.842,64	71.956.284.423,21	59.091.664.541,36
29	AZO.N	Autozone Inc	42.152.066.388,98	33.361.833.024,48	27.777.101.189,12	27.023.029.011,45	20.369.543.772,00
30	AVB.N	Avalonbay Communities Inc	22.596.220.133,52	35.297.159.487,98	22.397.469.142,69	29.287.078.411,50	24.108.696.572,20
31	AVY.N	Avery Dennison Corp	14.655.391.534,00	17.931.039.410,31	12.938.922.859,42	10.989.815.879,34	7.702.471.329,84
32	TFC.N	Truist Financial Corp	57.090.740.980,00	78.157.898.847,30	64.615.310.885,88	75.543.998.520,32	33.383.247.483,36
33	BKR.OQ	Baker Hughes Co	29.780.046.721,97	24.940.932.094,14	21.585.102.486,90	26.329.613.447,06	23.648.529.507,50
34	BALL.N	Ball Corp	16.053.876.471,00	31.181.292.901,14	30.480.265.224,24	21.155.466.446,42	15.596.011.697,86
35	BAX.N	Baxter International Inc	25.695.035.086,23	42.979.524.975,44	40.988.068.255,52	42.692.681.765,78	35.025.520.488,36
36	BDX.N	Becton Dickinson and Co	63.550.026.806,96	70.597.090.047,60	67.446.614.446,68	68.287.599.507,36	69.834.092.814,00
37	VZ.N	Verizon Communications Inc	165.472.807.411,80	215.122.916.036,16	243.113.044.061,25	253.937.150.432,60	232.301.888.978,22
38	WRB.N	W R Berkley Corp	19.265.602.100,97	14.553.405.769,21	11.837.432.377,26	12.691.922.322,80	9.026.202.800,13
39	BRKb.N	Berkshire Hathaway Inc	681.920.932.605,96	669.122.034.349,00	543.678.513.841,28	553.690.015.005,50	502.599.567.547,08
40	BBY.N	Best Buy Co Inc	18.847.306.191,72	23.488.366.080,72	28.178.378.794,64	21.915.861.986,43	15.734.368.739,43

Figure 17 - Tabular example of annual market capitalization in Excel for the first 40 companies over 472 in the sample for the period from 2018 to 2022. Source: Personal elaboration on Excel.

BE			Annual book equity				
ID	Identifier (RIC)	Company Name	FY0	FY-1	FY-2	FY-3	FY-4
			2022	2021	2020	2019	2018
1	AFL.N	Aflac Inc	22.365.000.000,00	33.253.000.000,00	33.559.000.000,00	28.959.000.000,00	23.462.000.000,00
2	AES.N	AES Corp	2.437.000.000,00	2.798.000.000,00	2.634.000.000,00	2.996.000.000,00	3.208.000.000,00
3	ABT.N	Abbott Laboratories	36.686.000.000,00	35.802.000.000,00	32.784.000.000,00	31.088.000.000,00	30.524.000.000,00
4	ATVI.OQ	Activision Blizzard Inc	19.243.000.000,00	17.599.000.000,00	15.037.000.000,00	12.805.000.000,00	11.357.000.000,00
5	ADBE.OQ	Adobe Inc	14.051.000.000,00	14.797.000.000,00	13.264.000.000,00	10.530.155.000,00	9.362.114.000,00
6	AMD.OQ	Advanced Micro Devices Inc	54.750.000.000,00	7.497.000.000,00	5.837.000.000,00	2.827.000.000,00	1.266.000.000,00
7	APD.N	Air Products and Chemicals Inc	13.702.400.000,00	13.539.700.000,00	12.079.800.000,00	11.053.600.000,00	10.857.500.000,00
8	ALK.N	Alaska Air Group Inc	3.816.000.000,00	3.801.000.000,00	2.988.000.000,00	4.331.000.000,00	3.751.000.000,00
9	ALB.N	Albemarle Corp	7.982.627.000,00	5.625.266.000,00	4.268.227.000,00	3.932.250.000,00	3.585.321.000,00
10	HON.OQ	Honeywell International Inc	17.319.000.000,00	19.242.000.000,00	17.790.000.000,00	18.494.000.000,00	18.180.000.000,00
11	ALL.N	Allstate Corp	17.475.000.000,00	25.179.000.000,00	30.217.000.000,00	25.998.000.000,00	21.312.000.000,00
12	HWM.N	Howmet Aerospace Inc	3.601.000.000,00	3.508.000.000,00	3.580.000.000,00	4.607.000.000,00	5.518.000.000,00
13	HES.N	Hess Corp	7.982.000.000,00	6.300.000.000,00	5.366.000.000,00	8.732.000.000,00	9.628.000.000,00
14	AEE.N	Ameren Corp	10.508.000.000,00	9.700.000.000,00	8.938.000.000,00	8.059.000.000,00	7.773.000.000,00
15	AEP.OQ	American Electric Power Company Inc	23.939.300.000,00	22.476.500.000,00	20.596.100.000,00	19.675.100.000,00	19.028.400.000,00
16	AIG.N	American International Group Inc	22.577.000.000,00	13.511.000.000,00	13.511.000.000,00	65.675.000.000,00	56.361.000.000,00
17	AME.N	AMETEK Inc	7.476.512.000,00	6.871.884.000,00	5.949.346.000,00	5.115.492.000,00	4.241.922.000,00
18	AMGN.OQ	Amgen Inc	3.661.000.000,00	6.700.000.000,00	9.409.000.000,00	9.673.000.000,00	12.500.000.000,00
19	APH.N	Amphenol Corp	7.015.600.000,00	6.302.000.000,00	5.384.900.000,00	4.530.300.000,00	4.017.000.000,00
20	ADI.OQ	Analog Devices Inc	36.465.323.000,00	37.992.542.000,00	11.997.945.000,00	11.709.188.000,00	10.988.540.000,00
21	AON.N	Aon PLC	-529.000.000,00	1.061.000.000,00	3.495.000.000,00	3.375.000.000,00	4.219.000.000,00
22	APA.OQ	APA Corp (US)	423.000.000,00	-1.595.000.000,00	-1.639.000.000,00	3.255.000.000,00	7.130.000.000,00
23	AAPL.OQ	Apple Inc	50.672.000.000,00	63.090.000.000,00	65.339.000.000,00	90.488.000.000,00	107.147.000.000,00
24	AMAT.OQ	Applied Materials Inc	12.194.000.000,00	12.247.000.000,00	10.578.000.000,00	8.214.000.000,00	6.839.000.000,00
25	ADM.N	Archer-Daniels-Midland Co	24.317.000.000,00	22.528.000.000,00	20.022.000.000,00	19.208.000.000,00	18.996.000.000,00
26	ATO.N	Atmos Energy Corp	9.419.091.000,00	7.906.889.000,00	6.791.203.000,00	5.750.223.000,00	4.769.951.000,00
27	ADSK.OQ	Autodesk Inc	1.145.000.000,00	849.100.000,00	965.500.000,00	-139.100.000,00	-210.900.000,00
28	ADP.OQ	Automatic Data Processing Inc	3.225.300.000,00	5.670.100.000,00	5.752.200.000,00	5.399.900.000,00	3.459.600.000,00
29	AZO.N	Autozone Inc	-3.538.913.000,00	-1.797.536.000,00	-877.977.000,00	-1.713.851.000,00	-1.520.355.000,00
30	AVB.N	Avalonbay Communities Inc	11.253.553.000,00	10.933.093.000,00	10.752.174.000,00	10.989.549.000,00	10.632.606.000,00
31	AVY.N	Avery Dennison Corp	2.032.200.000,00	1.924.400.000,00	1.499.900.000,00	1.204.000.000,00	955.100.000,00
32	TFC.N	Truist Financial Corp	60.514.000.000,00	62.598.000.000,00	70.807.000.000,00	66.384.000.000,00	30.122.000.000,00
33	BKR.OQ	Baker Hughes Co	14.394.000.000,00	16.746.000.000,00	18.242.000.000,00	21.929.000.000,00	35.013.000.000,00
34	BALL.N	Ball Corp	3.527.000.000,00	3.685.000.000,00	3.337.000.000,00	3.019.000.000,00	3.562.000.000,00
35	BAX.N	Baxter International Inc	5.833.000.000,00	9.077.000.000,00	8.689.000.000,00	7.882.000.000,00	7.794.000.000,00
36	BDX.N	Becton Dickinson and Co	25.301.000.000,00	23.677.000.000,00	23.775.000.000,00	21.081.000.000,00	20.994.000.000,00
37	VZ.N	Verizon Communications Inc	91.144.000.000,00	81.790.000.000,00	67.842.000.000,00	61.395.000.000,00	53.145.000.000,00
38	WRB.N	W R Berkley Corp	6.748.332.000,00	6.653.011.000,00	6.310.802.000,00	6.074.939.000,00	5.437.851.000,00
39	BRKb.N	Berkshire Hathaway Inc	472.360.000.000,00	506.199.000.000,00	443.164.000.000,00	424.791.000.000,00	348.703.000.000,00
40	BBY.N	Best Buy Co Inc	2.795.000.000,00	3.020.000.000,00	4.587.000.000,00	3.479.000.000,00	3.306.000.000,00

Figure 18 - Tabular example of annual book equity in Excel for the first 40 companies over 472 in the sample for the period from 2018 to 2022.

Source: Personal elaboration on Excel.

As per the procedure outlined by Fama and French, the Book Equity (BE) data must be divided by the Market Equity (ME), obtaining the ratio BE/ME (Figure 19).

BE/ME			BE/ME				
	Identifier (RIC)	Company Name	FY0	FY-1	FY-2	FY-3	FY-4
ID	Identifier (RIC)	Company Name	2022	2021	2020	2019	2018
1	AFL.N	Aflac Inc	0,49998358	0,860882704	1,074309472	0,745797929	0,676452441
2	AES.N	AES Corp	0,126859454	0,172683164	0,168515798	0,226752258	0,334975439
3	ABT.N	Abbott Laboratories	0,191644892	0,143858986	0,168941038	0,20238521	0,240279163
4	ATVI.OQ	Activision Blizzard Inc	0,321198635	0,339621464	0,209546322	0,280503751	0,319597948
5	ADBE.OQ	Adobe Inc	0,08849502	0,050442316	0,057961807	0,070277471	0,076445502
6	AMD.OQ	Advanced Micro Devices Inc	0,524263044	0,042480688	0,052861343	0,054970783	0,07108591
7	APD.N	Air Products and Chemicals Inc	0,265451219	0,238821937	0,183595867	0,226100516	0,296414332
8	ALK.N	Alaska Air Group Inc	0,700644181	0,582199866	0,464659413	0,518993433	0,499946779
9	ALB.N	Albemarle Corp	0,314205464	0,205710443	0,271782566	0,507737421	0,438020164
10	HON.OQ	Honeywell International Inc	0,120205176	0,134050354	0,119197128	0,146229499	0,185876474
11	ALL.N	Allstate Corp	0,485923941	0,746543551	0,903991531	0,713664832	0,748807201
12	HWM.N	Howmet Aerospace Inc	0,220860743	0,261353111	0,289291624	0,34582942	0,677226035
13	HES.N	Hess Corp	0,182552923	0,274760237	0,331017624	0,428934436	0,802450223
14	AEE.N	Ameren Corp	0,457112207	0,423035328	0,463181365	0,426512964	0,487781475
15	AEP.OQ	American Electric Power Company Inc	0,490646333	0,501039429	0,498065023	0,421272658	0,516161628
16	AIG.N	American International Group Inc	0,48050426	0,28618499	0,414227216	1,470732613	1,616596092
17	AME.N	AMETEK Inc	0,233005243	0,202030735	0,213820323	0,22436513	0,269941082
18	AMGN.OQ	Amgen Inc	0,026124017	0,052873338	0,070293947	0,067530101	0,100767875
19	APH.N	Amphenol Corp	0,154833874	0,120489046	0,137649176	0,141177912	0,164539944
20	ADI.OQ	Analog Devices Inc	0,489350498	0,408251109	0,273901177	0,289817404	0,339129571
21	AON.N	Aon PLC	-0,008520599	0,016021598	0,072618686	0,069826612	0,120511523
22	APA.OQ	APA Corp (US)	0,028184647	-0,163280853	-0,305988217	0,338260239	0,715646417
23	AAPL.OQ	Apple Inc	0,020960295	0,025977801	0,034025896	0,091504897	0,098272277
24	AMAT.OQ	Applied Materials Inc	0,157980058	0,099258274	0,19003106	0,159583275	0,214998169
25	ADM.N	Archer-Daniels-Midland Co	0,476750797	0,595779695	0,713858584	0,744426566	0,827006128
26	ATO.N	Atmos Energy Corp	0,661082004	0,676993159	0,575940417	0,427148697	0,456767107
27	ADSK.OQ	Autodesk Inc	0,024663683	0,015453028	0,015826853	-0,00321147	-0,006541949
28	ADP.OQ	Automatic Data Processing Inc	0,036903741	0,067088716	0,089893425	0,075044175	0,058546328
29	AZO.N	Autozone Inc	-0,08395586	-0,053880013	-0,031607942	-0,063421869	-0,074638638
30	AVB.N	Avalonbay Communities Inc	0,498028119	0,309744273	0,480062008	0,375235414	0,441027824
31	AVY.N	Avery Dennison Corp	0,138665691	0,107322278	0,115921551	0,109555976	0,123999163
32	TFC.N	Truist Financial Corp	1,05996172	0,80091713	1,095823869	0,878746178	0,902308861
33	BKR.OQ	Baker Hughes Co	0,483343768	0,67142639	0,845119916	0,832864487	1,480557173
34	BALL.N	Ball Corp	0,219697716	0,118179833	0,109480675	0,142705433	0,228391724
35	BAX.N	Baxter International Inc	0,227008836	0,211193586	0,211988522	0,184621806	0,22252346
36	BDX.N	Becton Dickinson and Co	0,398127291	0,335382096	0,352501014	0,30870905	0,300626802
37	VZ.N	Verizon Communications Inc	0,550809534	0,380201243	0,279055368	0,241772422	0,228775583
38	WRB.N	W R Berkley Corp	0,350278801	0,45714461	0,533122539	0,47864609	0,602451675
39	BRKb.N	Berkshire Hathaway Inc	0,692690277	0,756512226	0,815121416	0,767200037	0,693798846
40	BBY.N	Best Buy Co Inc	0,148297055	0,12857429	0,162784383	0,158743471	0,210113291

Figure 19 - Tabular example of annual BE/ME in Excel for the first 40 companies over 472 in the sample for the period from 2018 to 2022.

Source: Personal elaboration on Excel.

The ME data necessitates reordering from the smallest to the largest values, based on the market equity of each company within the S&P 500 index. This process allows for the calculation of the median, corresponding to the 50th percentile; it is calculated to segment the data into "SMALL" and "BIG" groups. An illustrative example for the year 2018 is provided in Table 2 in the Appendix.

MEDIAN	236,5

The subsequent step involves the reordering of the BE/ME data, arranging them from the smallest to the largest values. This rearrangement facilitates the calculation of the 30th and 70th percentiles, which play a crucial role in establishing divisions based on the Book Equity to Market Equity (BE/ME) ratio. An example for the year 2018 is detailed in Table 3 in the Appendix:

30th percentile	141,6
70th percentile	330,4

The companies are divided based on their BE/ME ratios, resulting in three distinct divisions[55] (an example for 2018 is given in the Table 3 in Appendix):

- companies with a BE/ME below the 30th percentile are categorized in the "GROWTH=LOW" group;
- companies with a BE/ME between the 30th percentile and the 70th percentile are categorized in the "NEUTRAL" group;
- companies with a BE/ME above the 70th percentile are categorized in the "VALUE=HIGH" group.

3.2.1 Six portfolios formed on Size and Book-to-Market

Following these steps, it is possible to proceed with the creation of the six portfolios through the intersection of companies (Table 4 in Appendix):

- the first portfolio comprises companies present in both the SMALL group (small-ME) and the LOW group (low-BE/ME);
- the second portfolio is composed of companies present in both the SMALL group (small-ME) and the NEUTRAL group (medium-BE/ME);

[55] Kenneth R. French Data Library: To construct the SMB and HML factors, we sort stocks in a region into two market cap and three book-to-market equity (B/M) groups at the end of each June. Big stocks are those in the top 90% of June market cap for the region, and small stocks are those in the bottom 10%. The B/M breakpoints for a region are the 30th and 70th percentiles of B/M for the big stocks of the region.

- the third portfolio includes companies present in both the SMALL group (small-ME) and the HIGH group (high-BE/ME);
- the fourth portfolio comprises companies present in both the BIG group (big-ME) and the LOW group (low-BE/ME);
- the fifth portfolio is composed of companies present in both BIG group (big-ME) and the NEUTRAL group (medium-BE/ME);
- the sixth portfolio includes companies present in both BIG group (big-ME) and the HIGH group (high-BE/ME).

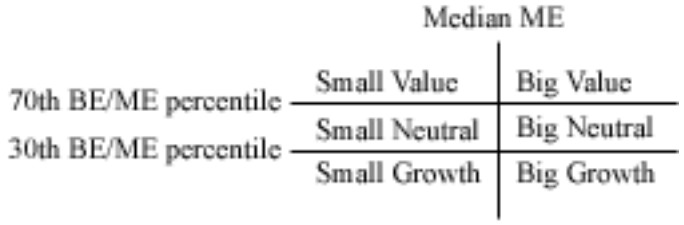


Figure 20: Intersections to create the 6 portfolios.

Source: Kenneth R. French Data Library

The tables below provide the number of companies within each of the six portfolios and the percentage of stocks observed in each of six portfolios for each year across the reviewed period:

	Number of Stocks In Portfolios						
Time Period	S/L	S/N	S/H	B/L	B/N	B/H	Total number
July 2018- June 2019	63	96	77	78	92	66	472
July 2019- June 2020	60	97	79	81	91	64	472
July 2020 - June 2021	52	90	94	89	98	49	472
July 2021 - June 2022	47	105	84	94	83	59	472

Figure 21: Number of stocks in each of the six portfolios.

Source: Personal elaboration on Excel.

	Percentage of Stocks					
Time Period	S/L	S/N	S/H	B/L	B/N	B/H
July 2018- June 2019	13%	20%	16%	17%	19%	14%
July 2019- June 2020	13%	21%	17%	17%	19%	14%
July 2020 - June 2021	11%	19%	20%	19%	21%	10%
July 2021 - June 2022	10%	22%	18%	20%	18%	13%

Figure 22: Percentage of Stocks In Six Size-B/M Portfolios[56].
Source: Personal elaboration on Excel.

The number of stocks within the S/L and B/H portfolios is smaller compared to the other four portfolios. This outcome aligns with expectations, given the negative correlation between the BE/ME ratio and company size. Typically, larger firms exhibit smaller BE/ME ratios, while smaller firms tend to have higher BE/ME ratios.
Following the determination of portfolio compositions for each year, the subsequent step involves utilizing the daily returns of each constituent company within the entire S&P 500 index for the period spanning from 2018 to 2022.

Leveraging Excel software, it becomes feasible to calculate the weights of each company present in the various portfolios, thereby generating a vector essential for the subsequent computation. The computation involves multiplying this vector by a sub-matrix of daily returns, aimed at calculating the portfolio return. A distinct sub-matrix is created for each year, spanning from July of year "t" to June of "t+1", derived from the initial daily returns matrix.[57].
For clarity, an illustrative example of this process, specifically for the 2018/2019 period, is presented in Figure 23 [58]:

[56] Notes: S=Small Size // B=Big Size //L=Low BE/ME // N=Neutral BE/ME // H=High BE/ME

[57] Eugene F. Fama and Kenneth R. French, Common risk factors in the returns on stocks and bonds
[58] In the event that the company is not contained within the portfolio, we obviously obtain a weight of zero.

SL weight vector	
-	0
-	0
-	0
-	0
-	0
Advanced Micro Devices Inc	0,02235851
-	0
-	0
-	0
-	0
-	0
-	0
-	0
-	0
-	0
-	0
-	0
-	0
-	0
-	0
-	0
-	0
-	0
-	0

SN weight vector	
-	0
AES Corp	0,00912658
-	0
-	0
-	0
-	0
-	0
-	0
Albemarle Corp	0,00780047
-	0
-	0
-	0
-	0
-	0
-	0
-	0
AMETEK Inc	0,01497546
-	0
-	0
-	0
-	0

SH weight vector	
-	0
-	0
-	0
-	0
-	0
-	0
-	0
Alaska Air Group Inc	0,00866474
-	0
-	0
-	0
Howmet Aerospace Inc	0,00940979
Hess Corp	0,01385639
Ameren Corp	0,01840329
-	0
-	0
-	0
-	0
-	0
-	0
-	0
-	0

BL weight vector	
-	0
-	0
-	0
-	0
Adobe Inc	0,01429578
-	0
-	0
-	0
-	0
-	0
-	0
-	0
-	0
-	0
-	0
-	0
-	0
-	0
Amgen Inc	0,01448017
Amphenol Corp	0,00284981
-	0
Aon PLC	0,00408664

BN weight vector	
-	0
-	0
Abbott Laboratories	0,01749828
Activision Blizzard Inc	0,00489474
-	0
-	0
Air Products and Chemicals Inc	0,00504546
-	0
-	0
Honeywell International Inc	0,01347223
-	0
-	0
-	0
-	0
-	0
-	0
-	0
-	0
-	0
Analog Devices Inc	0,00446318
-	0

BH weight vector	
Aflac Inc	0,0078972
-	0
-	0
-	0
-	0
-	0
-	0
-	0
-	0
Allstate Corp	0,00648037
-	0
-	0
-	0
American Electric Power Company Inc	0,00839386
-	0
American International Group Inc	0,00793821
-	0
-	0
-	0
-	0
-	0
-	0

[…]

Masco Corp	0,01121447
McCormick & Company Inc	0,02479336
-	0
-	0
-	0
-	0
-	0
-	0
-	0
-	0
-	0
-	0
-	0
-	0
Motorola Solutions Inc	0,02361747
-	0
-	0
NetApp Inc	0,02229329
-	0
-	0
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Microchip Technology Inc	0,0187347
-	0
-	0
-	0
-	0
-	0
-	0
-	0
-	0
NVR Inc	0,00830922
-	0
-	0
Nordson Corp	0,00679774
-	0
-	0
-	0
-	0
-	0
-	0
-	0
-	0
Old Dominion Freight Line Inc	0,0096207

-	0
-	0
-	0
-	0
-	0
-	0
-	0
Mid-America Apartment Communities Inc	0,01303654
-	0
Mohawk Industries Inc	0,01002229
-	0
-	0
Viatris Inc	0,01631631
-	0
-	0
Newmont Corporation	0,02131501
-	0
-	0
-	0
-	0
-	0
-	0
Northern Trust Corp	0,02137248
-	0
-	0
Nucor Corp	0,01828463
-	0
-	0

-	0
-	0
McDonald's Corp	0,01597935
S&P Global Inc	0,00497717
-	0
-	0
-	0
Microsoft Corp	0,08844
-	0
-	0
-	0
3M Co	0,01282413
-	0
-	0
-	0
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-	0
-	0
-	0
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-	0
Mckesson Corp	0,00309303
Medtronic PLC	0,01613109
-	0
-	0
-	0
-	0
-	0
-	0
-	0
-	0
-	0
-	0
-	0
-	0
Norfolk Southern Corp	0,00552232
-	0
-	0
-	0
Northrop Grumman Corp	0,00585676
-	0
-	0
Occidental Petroleum Corp	0,0063835
-	0

[…]

Allegion PLC	0,00951227	-	0	-	0	-	0	-	0	-	0
-	0	-	0	-	0	Hilton Worldwide Holdings Inc	0,00248564	-	0	-	0
American Airlines Group Inc	0,0185669	-	0	-	0	-	0	-	0	-	0
-	0	-	0	-	0	-	0	Alphabet Inc	0,09965237	-	0
Arista Networks Inc	0,01995197	-	0	-	0	-	0	-	0	-	0
Paycom Software Inc	0,00880505	-	0	-	0	-	0	-	0	-	0
-	0	Catalent Inc	0,00532418	-	0	-	0	-	0	-	0
-	0	-	0	Synchrony Financial	0,01947273	-	0	-	0	-	0
-	0	Solaredge Technologies Inc	0,00153038	-	0	-	0	-	0	-	0
-	0	-	0	-	0	-	0	-	0	-	0
-	0	Caesars Entertainment Inc	0,00267059	-	0	-	0	-	0	-	0
-	0	Keysight Technologies Inc	0,01019542	-	0	-	0	-	0	-	0
-	0	-	0	Qorvo Inc	0,01017164	-	0	-	0	-	0
ETSY Inc	0,00719397	-	0	-	0	-	0	-	0	-	0
-	0	-	0	Westrock Co	0,01574454	-	0	-	0	-	0
-	0	-	0	-	0	-	0	-	0	Kraft Heinz Co	0,01209739
-	0	-	0	-	0	PayPal Holdings Inc	0,01156666	-	0	-	0
-	0	-	0	-	0	-	0	-	0	Hewlett Packard Enterprise Co	0,00510998
Match Group Inc	0,01494755	-	0	-	0	-	0	-	0	-	0
-	0	STERIS plc	0,01032058	-	0	-	0	-	0	-	0
-	0	-	0	-	0	-	0	Fortive Corp	0,00311243	-	0
Lamb Weston Holdings Inc	0,01201178	-	0	-	0	-	0	-	0	-	0
-	0	-	0	Invitation Homes Inc	0,01207369	-	0	-	0	-	0
-	0	Ingersoll Rand Inc	0,0038736	-	0	-	0	-	0	-	0
-	0	-	0	-	0	-	0	-	0	Dupont De Nemours Inc	0,02762912
-	0	-	0	VICI Properties Inc	0,00868032	-	0	-	0	-	0
-	0	Ceridian HCM Holding Inc	0,00458363	-	0	-	0	-	0	-	0
-	0	-	0	-	0	-	0	-	0	Linde PLC	0,01957834

Figure 23 – Vectors of the weights of each company making up the entire S&P500 index for the year 2018/2019.

Source: Personal elaboration on Excel.

It is important to note that the sum of each vector associated with the SL, SN, SH, BL, BN, BH portfolios is normalized such that the sum of all its elements equals 1. This normalization allows for the representation of stock weights in each portfolio as fractions of the total portfolio, simplifying the analysis and comparison across different portfolios.

As previously described, the weight vectors for each year undergo multiplication using the MMULT formula within Excel. This operation is executed with the corresponding sub-matrix of daily returns, covering the period from July of year “t” to June of “t+1”. The resultant vectors for the 2018/2019 period are visually presented in the following figure.

	Weighted portfolio return SL	Weighted portfolio return SN	Weighted portfolio return SH	Weighted portfolio return BL	Weighted portfolio return BN	Weighted portfolio return BH
01/07/18						
02/07/18	0,00643	-0,00081	-0,00054	0,00482	0,00384	0,00157
03/07/18	-0,00464	-0,00096	-0,00048	-0,00593	-0,00750	-0,00412
04/07/18	0,00000	0,00000	0,00000	0,00000	0,00000	0,00000
05/07/18	0,01113	0,00946	0,00780	0,00950	0,01247	0,00418
06/07/18	0,01023	0,00624	0,00773	0,00893	0,01011	0,00501
07/07/18	0,00000	0,00000	0,00000	0,00000	0,00000	0,00000
08/07/18	0,00000	0,00000	0,00000	0,00000	0,00000	0,00000
09/07/18	0,00736	0,00582	0,01156	0,00799	0,00735	0,01181
10/07/18	0,00048	0,00349	0,00040	0,00512	0,00322	0,00383
11/07/18	-0,00103	-0,00764	-0,00987	-0,00456	-0,00580	-0,00904
12/07/18	0,01215	0,00787	-0,00022	0,01310	0,01061	0,00355
13/07/18	-0,00082	0,00149	-0,00059	0,00314	0,00195	-0,00174
14/07/18	0,00000	0,00000	0,00000	0,00000	0,00000	0,00000
15/07/18	0,00000	0,00000	0,00000	0,00000	0,00000	0,00000
16/07/18	-0,00456	-0,00482	-0,00099	-0,00280	-0,00416	0,00831
17/07/18	0,00509	0,00479	0,00346	0,00735	0,00555	-0,00109
18/07/18	0,00232	0,00055	0,00497	-0,00161	0,00284	0,00901
19/07/18	-0,00069	0,00543	-0,00354	-0,00353	-0,00295	-0,00826
20/07/18	-0,00023	-0,00417	-0,00533	0,00127	-0,00136	-0,00173
21/07/18	0,00000	0,00000	0,00000	0,00000	0,00000	0,00000
22/07/18	0,00000	0,00000	0,00000	0,00000	0,00000	0,00000
23/07/18	0,00051	-0,00165	0,00419	0,00007	0,00288	0,00438
24/07/18	-0,00806	-0,00590	0,00011	0,00464	0,01113	0,00626
25/07/18	0,01303	0,00858	0,00273	0,01409	0,00954	0,00142
26/07/18	0,00401	0,00424	0,00492	-0,00389	-0,00461	0,00476
27/07/18	-0,01367	-0,00521	-0,00703	-0,00993	-0,00956	0,00243
28/07/18	0,00000	0,00000	0,00000	0,00000	0,00000	0,00000
29/07/18	0,00000	0,00000	0,00000	0,00000	0,00000	0,00000
30/07/18	-0,01705	-0,00939	0,00227	-0,01183	-0,00634	0,00392
31/07/18	0,00906	0,01212	0,00472	0,00674	0,00580	-0,00107

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01/01/19	0,00000	0,00000	0,00000	0,00000	0,00000	0,00000
02/01/19	-0,00777	-0,00604	0,00559	-0,00046	-0,00006	0,01041
03/01/19	-0,02745	-0,02107	-0,00955	-0,03671	-0,02360	-0,01920
04/01/19	0,03533	0,03032	0,03442	0,03904	0,03472	0,03080
05/01/19	0,00000	0,00000	0,00000	0,00000	0,00000	0,00000
06/01/19	0,00000	0,00000	0,00000	0,00000	0,00000	0,00000
07/01/19	0,01616	0,01191	0,00513	0,00858	0,00297	0,00701
08/01/19	0,01259	0,01532	0,00951	0,01154	0,01058	0,00355
09/01/19	0,00706	0,00879	0,01040	0,00473	0,00328	0,00341
10/01/19	0,00640	0,00953	0,00829	0,00406	0,00395	0,00360
11/01/19	0,00167	0,00099	0,00263	-0,00188	-0,00207	0,00220
12/01/19	0,00000	0,00000	0,00000	0,00000	0,00000	0,00000
13/01/19	0,00000	0,00000	0,00000	0,00000	0,00000	0,00000
14/01/19	-0,00830	-0,00718	-0,01344	-0,00937	-0,00540	0,00117
15/01/19	0,01359	0,00642	0,00175	0,01445	0,01415	0,00481
16/01/19	-0,00113	0,00348	0,00693	0,00005	-0,00044	0,01094
17/01/19	0,01009	0,00978	0,00553	0,00753	0,00752	0,00636
18/01/19	0,01465	0,01482	0,01428	0,01094	0,01176	0,01615
19/01/19	0,00000	0,00000	0,00000	0,00000	0,00000	0,00000
20/01/19	0,00000	0,00000	0,00000	0,00000	0,00000	0,00000
21/01/19	0,00000	0,00000	0,00000	0,00000	0,00000	0,00000
22/01/19	-0,01340	-0,01488	-0,01107	-0,01608	-0,01385	-0,01371
23/01/19	0,00235	-0,00203	0,00189	0,00281	0,00381	-0,00083
24/01/19	0,00479	0,00785	0,01478	-0,00277	0,00287	0,00370
25/01/19	0,00888	0,01199	0,00883	0,01057	0,00602	0,00981
26/01/19	0,00000	0,00000	0,00000	0,00000	0,00000	0,00000
27/01/19	0,00000	0,00000	0,00000	0,00000	0,00000	0,00000
28/01/19	-0,00605	-0,00013	-0,00337	-0,01019	-0,01108	-0,00342
29/01/19	-0,00213	0,00297	0,00428	-0,00593	0,00001	0,00128
30/01/19	0,01665	0,01056	0,00708	0,02610	0,01638	0,00677
31/01/19	0,00955	0,00698	0,00400	0,00772	0,01749	0,00388

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01/06/19	0,00000	0,00000	0,00000	0,00000	0,00000	0,00000
02/06/19	0,00000	0,00000	0,00000	0,00000	0,00000	0,00000
03/06/19	-0,00196	0,00506	0,01219	-0,01012	-0,01295	0,01522
04/06/19	0,02455	0,02472	0,02271	0,02492	0,01685	0,02154
05/06/19	0,01431	0,01041	0,00437	0,01102	0,00509	0,00245
06/06/19	0,00615	0,00564	0,00305	0,00881	0,00360	0,00605
07/06/19	0,00719	0,00784	0,00158	0,01710	0,01228	0,00146
08/06/19	0,00000	0,00000	0,00000	0,00000	0,00000	0,00000
09/06/19	0,00000	0,00000	0,00000	0,00000	0,00000	0,00000
10/06/19	0,00665	0,00584	0,00192	0,00560	0,00625	0,00652
11/06/19	-0,00401	-0,00165	0,00153	0,00090	-0,00037	0,00043
12/06/19	0,00435	0,00063	-0,00444	-0,00069	-0,00154	-0,00794
13/06/19	0,00387	0,00669	0,00852	0,00151	0,00649	0,00551
14/06/19	-0,00665	-0,00263	-0,00219	-0,00267	-0,00174	0,00071
15/06/19	0,00000	0,00000	0,00000	0,00000	0,00000	0,00000
16/06/19	0,00000	0,00000	0,00000	0,00000	0,00000	0,00000
17/06/19	-0,00376	-0,00076	-0,00056	0,00372	0,00315	-0,00314
18/06/19	0,00833	0,00973	0,01354	0,01087	0,00831	0,01139
19/06/19	0,00942	0,00448	0,00311	0,00389	0,00303	-0,00153
20/06/19	0,00562	0,00761	0,01191	0,01136	0,00844	0,00825
21/06/19	-0,00718	-0,00400	-0,00197	-0,00328	0,00277	-0,00012
22/06/19	0,00000	0,00000	0,00000	0,00000	0,00000	0,00000
23/06/19	0,00000	0,00000	0,00000	0,00000	0,00000	0,00000
24/06/19	-0,00268	-0,00428	-0,00590	-0,00006	-0,00187	-0,00384
25/06/19	-0,00938	-0,00617	-0,00573	-0,01403	-0,01152	-0,00443
26/06/19	-0,00385	-0,00342	-0,00122	0,00230	-0,00488	0,00178
27/06/19	0,00903	0,00653	0,00979	0,00255	0,00241	0,00553
28/06/19	0,00745	0,01124	0,01150	0,00131	0,00470	0,01344
29/06/19	0,00000	0,00000	0,00000	0,00000	0,00000	0,00000
30/06/19	0,00000	0,00000	0,00000	0,00000	0,00000	0,00000

Figure 24 - Weighted return of each portfolio from 1 July 2018 to 30 June 2019

Source: Personal elaboration on Excel.

Upon establishing the returns for the S/L, S/N, S/H, B/L, B/N and B/H portfolios, the variables SMB and HML are calculated as follows:

- SMB is computed as the difference between the average return of the three small portfolios with the average return of the three large portfolios.

$$SMB = \frac{1}{3}(SL + SN + SH) - \frac{1}{3}(BL + BN + BG) \quad (8)$$

- HML is determined as the difference between the average return of the two value portfolios and the average return of the two growth portfolios.

$$HML = \frac{1}{2}(SH + BH) - \frac{1}{2}(SL + BL) \tag{9}$$

These vectors, as illustrated in Figure 23, are instrumental in constructing the SMB and HML factors using formulas (8) and (9). An extraction of the results obtained for the period spanning from 1 July 2018 to 30 June 2022 is provided in Figure 25.

	PTF SMALL LOW	PTF SMALL NEUTRAL	PTF SMALL HIGH	PTF BIG LOW	PTF BIG NEUTRAL	PTF BIG HIGH	SMB	HML
01/07/18								
02/07/18	0,0064	-0,0008	-0,0005	0,0048	0,0038	0,0016	-0,001716427	-0,005112037
03/07/18	-0,0046	-0,0010	-0,0005	-0,0059	-0,0075	-0,0041	0,003825994	0,002986359
04/07/18	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0	0
05/07/18	0,0111	0,0095	0,0078	0,0095	0,0125	0,0042	0,00075204	-0,004324579
06/07/18	0,0102	0,0062	0,0077	0,0089	0,0101	0,0050	5,43936E-05	-0,003211038
07/07/18	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0	0
08/07/18	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0	0
09/07/18	0,0074	0,0058	0,0116	0,0080	0,0073	0,0118	-0,000805044	0,004005621
10/07/18	0,0005	0,0035	0,0004	0,0051	0,0032	0,0038	-0,002596824	-0,000687731
11/07/18	-0,0010	-0,0076	-0,0099	-0,0046	-0,0058	-0,0090	0,000285854	-0,006659062
12/07/18	0,0121	0,0079	-0,0002	0,0131	0,0106	0,0035	-0,002486369	-0,010955536
13/07/18	-0,0008	0,0015	-0,0006	0,0031	0,0019	-0,0017	-0,001085203	-0,002326198
14/07/18	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0	0
15/07/18	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0	0
16/07/18	-0,0046	-0,0048	-0,0010	-0,0028	-0,0042	0,0083	-0,003909724	0,00733687
17/07/18	0,0051	0,0048	0,0035	0,0073	0,0056	-0,0011	0,000509994	-0,005034184
18/07/18	0,0023	0,0006	0,0050	-0,0016	0,0028	0,0090	-0,000797465	0,006632195
19/07/18	-0,0007	0,0054	-0,0035	-0,0035	-0,0029	-0,0083	0,005314244	-0,003790049
20/07/18	-0,0002	-0,0042	-0,0053	0,0013	-0,0014	-0,0017	-0,002634867	-0,004051238
21/07/18	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0	0
22/07/18	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0	0
23/07/18	0,0005	-0,0017	0,0042	0,0001	0,0029	0,0044	-0,001430992	0,003992118
24/07/18	-0,0081	-0,0059	0,0001	0,0046	0,0111	0,0063	-0,011955569	0,004893407
25/07/18	0,0130	0,0086	0,0027	0,0141	0,0095	0,0014	-0,000234897	-0,011485064
26/07/18	0,0040	0,0042	0,0049	-0,0039	-0,0046	0,0048	0,005633627	0,004777719
27/07/18	-0,0137	-0,0052	-0,0070	-0,0099	-0,0096	0,0024	-0,00295191	0,009497932
28/07/18	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0	0
29/07/18	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0	0
30/07/18	-0,0170	-0,0094	0,0023	-0,0118	-0,0063	0,0039	-0,003308917	0,017535544
31/07/18	0,0091	0,0121	0,0047	0,0067	0,0058	-0,0011	0,004812448	-0,006076787
01/08/18	0,0017	-0,0037	-0,0080	0,0074	-0,0033	-0,0033	-0,003601907	-0,010186042
02/08/18	0,0183	0,0087	-0,0012	0,0109	0,0046	-0,0006	0,003607695	-0,01555357
03/08/18	-0,0008	0,0033	0,0063	0,0041	0,0044	0,0073	-0,002356158	0,00515507
04/08/18	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0	0
05/08/18	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0	0
06/08/18	0,0090	0,0015	0,0013	0,0038	0,0047	0,0027	0,000183405	-0,004361476
07/08/18	0,0044	0,0029	0,0007	0,0015	0,0049	0,0046	-0,000999893	-0,000262218
08/08/18	0,0015	-0,0027	-0,0016	0,0004	-0,0001	-0,0010	-0,000708558	-0,002293832
09/08/18	0,0003	-0,0013	-0,0043	0,0002	-0,0017	-0,0036	-7,05625E-05	-0,004204843
10/08/18	-0,0024	-0,0097	-0,0101	-0,0053	-0,0072	-0,0095	-7,21332E-05	-0,005910294
11/08/18	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0	0
12/08/18	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0	0
13/08/18	-0,0043	-0,0053	-0,0070	-0,0012	-0,0025	-0,0092	-0,001221845	-0,005381916
14/08/18	0,0094	0,0082	0,0078	0,0057	0,0061	0,0049	0,002859766	-0,001186873
15/08/18	-0,0048	-0,0067	-0,0102	-0,0044	-0,0089	-0,0100	0,000571185	-0,005525162
16/08/18	0,0046	0,0074	0,0101	0,0073	0,0074	0,0105	-0,001056243	0,004342585
17/08/18	0,0053	0,0061	0,0061	0,0040	0,0010	0,0033	0,003052337	1,16476E-05

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01/01/19	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0	0
02/01/19	-0,0078	-0,0060	0,0056	-0,0005	-0,0001	0,0104	-0,006035094	0,012116296
03/01/19	-0,0275	-0,0211	-0,0095	-0,0367	-0,0236	-0,0192	0,007147731	0,017710209
04/01/19	0,0353	0,0303	0,0344	0,0390	0,0347	0,0308	-0,001496657	-0,004575218
05/01/19	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0	0
06/01/19	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0	0
07/01/19	0,0162	0,0119	0,0051	0,0086	0,0030	0,0070	0,004881322	-0,006304791
08/01/19	0,0126	0,0153	0,0095	0,0115	0,0106	0,0035	0,003917737	-0,005540223
09/01/19	0,0071	0,0088	0,0104	0,0047	0,0033	0,0034	0,004941694	0,001006608
10/01/19	0,0064	0,0095	0,0083	0,0041	0,0040	0,0036	0,004201791	0,000712471
11/01/19	0,0017	0,0010	0,0026	-0,0019	-0,0021	0,0022	0,002344136	0,002518433
12/01/19	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0	0
13/01/19	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0	0
14/01/19	-0,0083	-0,0072	-0,0134	-0,0094	-0,0054	0,0012	-0,005106396	0,002698259
15/01/19	0,0136	0,0064	0,0018	0,0145	0,0141	0,0048	-0,003881434	-0,010743678
16/01/19	-0,0011	0,0035	0,0069	0,0001	-0,0004	0,0109	-0,000424687	0,009467512
17/01/19	0,0101	0,0098	0,0055	0,0075	0,0075	0,0064	0,001325072	-0,002866453
18/01/19	0,0146	0,0148	0,0143	0,0109	0,0118	0,0161	0,001635562	0,002420805
19/01/19	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0	0
20/01/19	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0	0
21/01/19	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0	0
22/01/19	-0,0134	-0,0149	-0,0111	-0,0161	-0,0138	-0,0137	0,001428503	0,002347755
23/01/19	0,0023	-0,0020	0,0019	0,0028	0,0038	-0,0008	-0,001195215	-0,002047687
24/01/19	0,0048	0,0078	0,0148	-0,0028	0,0029	0,0037	0,007872347	0,008225807
25/01/19	0,0089	0,0120	0,0088	0,0106	0,0060	0,0098	0,001103042	-0,000407317
26/01/19	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0	0
27/01/19	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0	0
28/01/19	-0,0061	-0,0001	-0,0034	-0,0102	-0,0111	-0,0034	0,005046358	0,004726784
29/01/19	-0,0021	0,0030	0,0043	-0,0059	0,0000	0,0013	0,003252133	0,006807141
30/01/19	0,0166	0,0106	0,0071	0,0261	0,0164	0,0068	-0,004987704	-0,014445267
31/01/19	0,0096	0,0070	0,0040	0,0077	0,0175	0,0039	-0,002852197	-0,004690011

[…]

01/06/19	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0	0
02/06/19	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0	0
03/06/19	-0,0020	0,0051	0,0122	-0,0101	-0,0129	0,0152	0,007713603	0,019745972
04/06/19	0,0245	0,0247	0,0227	0,0249	0,0169	0,0215	0,002886167	-0,002604866
05/06/19	0,0143	0,0104	0,0044	0,0110	0,0051	0,0024	0,003513362	-0,009259431
06/06/19	0,0061	0,0056	0,0030	0,0088	0,0036	0,0061	-0,001205926	-0,00292598
07/06/19	0,0072	0,0078	0,0016	0,0171	0,0123	0,0015	-0,004740565	-0,010628269
08/06/19	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0	0
09/06/19	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0	0
10/06/19	0,0067	0,0058	0,0019	0,0056	0,0062	0,0065	-0,001316302	-0,001907554
11/06/19	-0,0040	-0,0016	0,0015	0,0009	-0,0004	0,0004	-0,001695186	0,002532658
12/06/19	0,0043	0,0006	-0,0044	-0,0007	-0,0015	-0,0079	0,003568293	-0,008019458
13/06/19	0,0039	0,0067	0,0085	0,0015	0,0065	0,0055	0,001852812	0,004326331
14/06/19	-0,0066	-0,0026	-0,0022	-0,0027	-0,0017	0,0007	-0,002589483	0,003920338
15/06/19	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0	0
16/06/19	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0	0
17/06/19	-0,0038	-0,0008	-0,0006	0,0037	0,0032	-0,0031	-0,002939967	-0,001831468
18/06/19	0,0083	0,0097	0,0135	0,0109	0,0083	0,0114	0,000345147	0,002862459
19/06/19	0,0094	0,0045	0,0031	0,0039	0,0030	-0,0015	0,00387499	-0,005868226
20/06/19	0,0056	0,0076	0,0119	0,0114	0,0084	0,0083	-0,000972001	0,00159145
21/06/19	-0,0072	-0,0040	-0,0020	-0,0033	0,0028	-0,0001	-0,004168695	0,00418669
22/06/19	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0	0
23/06/19	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0	0
24/06/19	-0,0027	-0,0043	-0,0059	-0,0001	-0,0019	-0,0038	-0,002360178	-0,003502903
25/06/19	-0,0094	-0,0062	-0,0057	-0,0140	-0,0115	-0,0044	0,002897694	0,006629146
26/06/19	-0,0038	-0,0034	-0,0012	0,0023	-0,0049	0,0018	-0,002562565	0,001052889
27/06/19	0,0090	0,0065	0,0098	0,0025	0,0024	0,0055	0,004953548	0,001868373
28/06/19	0,0075	0,0112	0,0115	0,0013	0,0047	0,0134	0,003580393	0,008088922
29/06/19	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0	0
30/06/19	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0	0

Figure 25 – SMB and HML factors.

Source: Personal elaboration on Excel.

It is necessary to clarify that the returns obtained for each portfolio are multiplied by 100. Additionally, to account for excess returns, the risk-free rate is subtracted from each dataset. Both the SMB and HML factors are also multiplied by 100 to maintain consistency in the analysis.

The third factor required is $E(r_{m,t}) - r_{f,t}$, which is necessary for conducting the regressions. This step involves calculating the excess return on the market portfolio, representing the difference between the actual return of a market portfolio and the return of a risk-free asset. To achieve this, it is necessary to download the risk-free rate[59] from the Kenneth R. French - Data Library website[60] for the specified period of interest, in addition to obtaining the daily closing prices of the S&P 500 index (Figure 26).

Date	RF	Adj Close	Mkt	Mkt*100-RF
02/07/18	0,008	2718,370	0,001	0,068
03/07/18	0,008	2726,710	0,003	0,299
05/07/18	0,008	2736,610	0,004	0,355
06/07/18	0,008	2759,820	0,008	0,840
09/07/18	0,008	2784,170	0,009	0,874
10/07/18	0,008	2793,840	0,003	0,339
11/07/18	0,008	2774,020	-0,007	-0,717
12/07/18	0,008	2798,290	0,009	0,867
13/07/18	0,008	2801,310	0,001	0,100
16/07/18	0,008	2798,430	-0,001	-0,111
17/07/18	0,008	2809,550	0,004	0,389
18/07/18	0,008	2815,620	0,002	0,208
19/07/18	0,008	2804,490	-0,004	-0,403
20/07/18	0,008	2801,830	-0,001	-0,103
23/07/18	0,008	2806,980	0,002	0,176
24/07/18	0,008	2820,400	0,005	0,470
25/07/18	0,008	2846,070	0,009	0,902

[…]

[59] Kenneth R. French Data Library: the Tbill return is the simple daily rate that, over the number of trading days in the month, compounds to 1-month TBill rate from Ibbotson and Associates Inc.

[60] Kenneth R. French Data Library: was created by Kenneth R. French, inventor of the Fama-French models, and is publicly available. The website is maintained by Dartmouth College in collaboration with Professor French. The library provides financial data and portfolios included to create the Fama-French factors. From the library one can derive the factor returns for Fama-French's three-factor model, the momentum factor and the risk-free rate for US stock market securities. The market return is the value-weighted US equity portfolio and the risk-free rate is the one-month T-bill rate.

10/06/22	0,003	3900,860	-0,029	-2,914
13/06/22	0,003	3749,630	-0,039	-3,880
14/06/22	0,003	3735,480	-0,004	-0,380
15/06/22	0,003	3789,990	0,015	1,456
16/06/22	0,003	3666,770	-0,033	-3,254
17/06/22	0,003	3674,840	0,002	0,217
21/06/22	0,003	3764,790	0,024	2,445
22/06/22	0,003	3759,890	-0,001	-0,133
23/06/22	0,003	3795,730	0,010	0,950
24/06/22	0,003	3911,740	0,031	3,053
27/06/22	0,003	3900,110	-0,003	-0,300
28/06/22	0,003	3821,550	-0,020	-2,017
29/06/22	0,003	3818,830	-0,001	-0,074
30/06/22	0,003	3785,380	-0,009	-0,879

Figure 26 – Mkt-RF factor

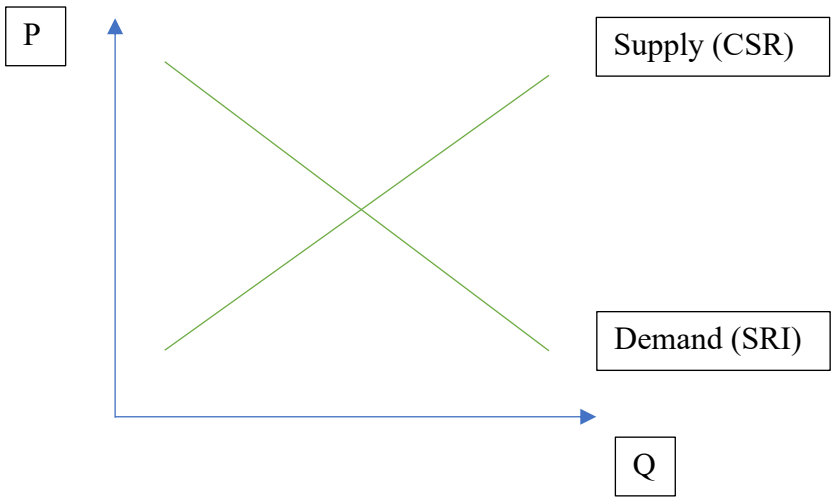
Source: personal elaboration on Excel.

3.3 Construction of ESG risk factor

The adoption of Environmental, Social, and Governance (ESG) strategies by companies involves a multifaceted interplay of costs and benefits. The market, driven by its demand dynamics, wields significant influence over these strategic decisions, subsequently affecting a company's profitability and, by extension, its cash flows. These intricate financial dynamics ultimately converge in the quoted stock price of a company. In their decision-making processes, investors synthesize the available information to inform their choices.

In traditional financial markets, a prominent piece of pertinent information is a company's credit rating, reflecting its financial merit. Analogously, ESG ratings independently evaluate a company's ESG choices and strategies, free from conflicts of interest. This information empowers consumers of ESG investments, including financial market investors, to gauge the depth and impact of a company's strategic ESG investments on its profitability and, ultimately, its cash flows, which invariably shape stock price levels in financial markets.

Corporate Social Responsibility (CSR) propels companies to adopt business strategies that encompass ESG criteria. These strategies extend beyond mere profit maximization, embracing a comprehensive array of actions aimed at addressing environmental, social, and corporate governance dimensions with a focus on stakeholders. The interaction between stakeholders and companies adopting ESG criteria generates value for Socially Responsible Investments (SRI) within the financial markets. This value materializes as returns, tethering stakeholder risk to ESG choices. The shift from mere profit maximisation to the minimisation of Stakeholder-risk is the crucial point in the Supply/Demand relationship and thus in the link between CSR and SRI (for given ESG levels).



The Stakeholder-risk resulting from ESG business strategies is thus the total risk that companies face. Stakeholder risk resulting from ESG-based business strategies encompasses a company's total risk profile. Within this overarching context, the ESG Risk Factor emerges alongside other specific risks such as market risk, size risk, and leverage risk.

To capture the additional effect of the ESG Risk Factor, we incorporate it into the Fama-French Three Factor model, as expressed by the equation:

$$E(r_{i,t}) - r_{f,t} = \alpha^{3F} + \beta_{mrkt} * [E(r_{m,t}) - r_{f,t}] + \beta_{SMB} * SMB_t + \beta_{HML} * HML_t + \beta_{ESG} * ESG_t$$

Inclusion of the ESG Risk Factor allows us to quantitatively account for the fluctuations in risk associated with socially responsible investments within the framework of the Fama-French model.

It's necessary to note that the Fama-French model, in its conventional form, does not inherently measure the responsibility effect - i.e., the variation in returns when transitioning from a portfolio comprised of the highest-rated ESG companies to one composed of the lowest-rated ESG companies. This limitation emanates from the model's omission of systematic risk linked to the CSR levels of companies. Consequently, the model doesn't capture the nuanced exposure to stakeholder risk that companies with varying ESG levels experience. To take this into consideration, it is necessary to create the ESG Risk Factor. To rectify this omission, the creation of the ESG Risk Factor becomes essential. The foundation for this factor rests on empirical evidence illustrating companies' differential exposure to stakeholder risk based on their degrees of ESG engagement.

Expanding upon this notion, it is crucial to highlight that the ESG Risk Factor is instrumental in augmenting the model's capacity to elucidate the intricate relationship between ESG factors and investment outcomes. By quantifying the risk associated with varying ESG levels, this factor facilitates a more comprehensive assessment of the impact of ESG considerations on portfolio returns and risk. Furthermore, it enables investors and researchers to better understand how companies' ESG practices influence their financial performance and, ultimately, their stock prices.

For the construction of the ESG Risk Factor, the same procedure is adopted as for the Fama-French HML risk factors:

1. in June of year "t" (where "t" ranges from 1 to T), companies are ranked in ascending order for each year within two dimensions:
    a) ESG Score Grade (ESG);
    b) Market Capitalisation (ME)[61];

ESG	Identifier (RIC)	Company Name	ESG Score Grade				
			FY0	FY-1	FY-2	FY-3	FY-4
ID			2022	2021	2020	2019	2018
1	AFL.N	Aflac Inc	57,48	54,2	59,58	55,06	60,41
2	AES.N	AES Corp	77,66	72,37	69,5	65,22	60,48
3	ABT.N	Abbott Labor	82,51	82,56	80,63	77,44	81,8
4	ATVI.OQ	Activision Bli	75,2	68,61	67,82	59,82	52,2
5	ADBE.OQ	Adobe Inc	77,05	75,56	65,2	78,46	78,58
6	AMD.OQ	Advanced Mi	69,2	66,53	65,76	69,75	70,54
7	APD.N	Air Products	85,19	81,11	80,02	85,69	78,99
8	ALK.N	Alaska Air Gr	56,01	49,35	55,15	54,8	60,97
9	ALB.N	Albemarle Cc	69,31	72,19	65,51	68,98	69,16
10	HON.OQ	Honeywell In	84,35	81,94	74,76	73,95	68,04
11	ALL.N	Allstate Corp	72,39	72,84	76,48	70,78	83,25
12	HWM.N	Howmet Aer	72,68	68,25	58,42	52,53	54,51
13	HES.N	Hess Corp	80,65	81,19	82,64	79,38	78,58
14	AEE.N	Ameren Corp	49,74	39,3	43,35	45,86	46,05
15	AEP.OQ	American Ele	76	73,18	61,83	66,52	61,99
16	AIG.N	American Int	66,09	60,61	63,83	63,02	68,02
17	AME.N	AMETEK Inc	58,18	46,35	42,07	26,26	30,78
18	AMGN.OQ	Amgen Inc	76,57	80,21	77,07	73,82	72,58
19	APH.N	Amphenol Cc	70,4	72,35	70,24	64,32	65,55
20	ADI.OQ	Analog Devic	74,41	73,03	72,21	76,86	71,51

[…]

[61] Data downloaded from Refinitiv.

453	SYF.N	Synchrony Fi	69,07	67,51	60,41	60,64	54,18
454	SEDG.OQ	Solaredge Te	72,63	74,15	70,8	58,37	34,2
455	CZR.OQ	Caesars Ente	71,12	64,68	19,68	20,59	19,14
456	KEYS.N	Keysight Tecl	72,94	77,57	73,39	74,77	75,01
457	QRVO.OQ	Qorvo Inc	63,59	61,16	60	46,4	32,07
458	ETSY.OQ	ETSY Inc	47,73	51,48	56,89	55,8	57,82
459	WRK.N	Westrock Co	73,66	71	65,25	61,77	57,87
460	KHC.OQ	Kraft Heinz C	69,96	66,76	66,13	54,74	46,93
461	PYPL.OQ	PayPal Holdir	81,29	82,16	76,88	69,77	58,84
462	HPE.N	Hewlett Pack	77,54	77,29	71,47	67,42	69,68
463	MTCH.OQ	Match Group	50,7	46,75	31,01	23,71	21,53
464	STE.N	STERIS plc	58,75	55,45	47,4	45,36	37,59
465	FTV.N	Fortive Corp	51,74	52,88	45,58	40,38	33,93
466	LW.N	Lamb Westo	66,87	63,5	60,93	34,35	34,26
467	INVH.N	Invitation Ho	54,61	45,19	32,68	24,44	16,94
468	IR.N	Ingersoll Ran	41,7	43,99	41,52	26,64	18,43
469	DD.N	Dupont De N	71,38	68,15	66,54	64	52,28
470	VICI.N	VICI Propertie	56,31	59,06	55,22	36,27	31,83
471	CDAY.N	Ceridian HCM	60,95	48,28	27,84	27,24	11,99
472	LIN.N	Linde PLC	91,78	86,73	85,74	86,73	75,67

Figure 27 - ESG Score Grade

Source: Refinitiv and own contribution

					Market cap	Esg score
		ID	Identifier (RIC)	Company Name	2018	2018
	SMALL	433	ENPH.OQ	Enphase Energ	502.931.946,11	39,16
	SMALL	454	SEDG.OQ	Solaredge Tecl	1.605.879.931,50	34,2
	SMALL	362	AXON.OQ	Axon Enterpri	2.572.973.462,50	21,71
	SMALL	455	CZR.OQ	Caesars Entert	2.802.336.945,24	19,14
	SMALL	419	GNRC.N	Generac Holdi	3.088.326.092,60	24,69
	SMALL	468	IR.N	Ingersoll Rand	4.064.697.971,65	18,43
	SMALL	223	PWR.N	Quanta Servic	4.410.156.703,40	30,29
	SMALL	401	FSLR.OQ	First Solar Inc	4.452.903.755,76	69,71
	SMALL	404	PODD.OQ	Insulet Corp	4.686.006.994,08	22,67
	SMALL	98	EQT.N	EQT Corp	4.806.107.140,00	45,91
	SMALL	471	CDAY.N	Ceridian HCM	4.809.758.457,90	11,99
	SMALL	386	MPWR.OQ	Monolithic Pc	4.930.395.000,00	28,27
	SMALL	347	CRL.N	Charles River L	5.373.332.042,40	59,5
	SMALL	240	SEE.N	Sealed Air Cor	5.467.271.320,16	38,97
	SMALL	376	AIZ.N	Assurant Inc	5.550.103.946,40	64,69

[…]

50th perc.	BIG	170	MKC.N	McCormick &	19.748.888.485,98	65,13
	BIG	406	DFS.N	Discover Finar	19.815.196.413,54	51,62
	BIG	151	K.N	Kellogg Co	19.866.960.494,00	77,14
	BIG	207	PCAR.OQ	Paccar Inc	19.966.727.099,44	63,38
	BIG	78	DTE.N	DTE Energy Co	20.066.330.147,20	62,71
	BIG	164	MTB.N	M&T Bank Cor	20.089.397.028,48	42,19
	BIG	29	AZO.N	Autozone Inc	20.369.543.772,00	56,07
	BIG	296	RCL.N	Royal Caribbe	20.376.320.019,44	77,47
	BIG	205	PPL.N	PPL Corp	20.403.263.790,26	43,76
	BIG	190	ES.N	Eversource En	20.610.252.952,32	65,47
	BIG	336	A.N	Agilent Techn	20.653.078.950,13	87,68
	BIG	209	PH.N	Parker-Hannif	20.721.727.321,35	56,78
	BIG	279	VTR.N	Ventas Inc	20.885.446.116,99	81,61
	BIG	352	ZBH.N	Zimmer Biome	21.156.422.976,92	45,58

Figure 28 – Companies ranked in ascending order for ME

Source: Refinitiv and own contribution

					Market cap	Esg score
		ID	Identifier (RIC)	Company Name	2018	2018
	GROWTH	382	EXR.N	Extra Space St	11.500.347.300,00	10,87
	GROWTH	471	CDAY.N	Ceridian HCM	4.809.758.457,90	11,99
	GROWTH	343	GPN.N	Global Payme	16.290.619.203,66	14,37
	GROWTH	434	FLT.N	Fleetcor Techr	15.943.197.287,68	14,49
	GROWTH	374	LKQ.OQ	LKQ Corp	7.502.147.285,22	14,69
	GROWTH	390	EXPE.OQ	Expedia Group	16.781.969.764,80	15,55
	GROWTH	467	INVH.N	Invitation Hor	10.454.611.378,16	16,94
	GROWTH	418	CHTR.OQ	Charter Comm	64.219.074.380,79	18,39
	GROWTH	468	IR.N	Ingersoll Rand	4.064.697.971,65	18,43
	GROWTH	455	CZR.OQ	Caesars Entert	2.802.336.945,24	19,14
	GROWTH	389	DXCM.OQ	Dexcom Inc	10.643.552.531,00	20,19
	GROWTH	332	TDY.N	Teledyne Tech	7.315.760.526,39	20,59
	GROWTH	117	GPC.N	Genuine Parts	14.091.825.393,46	20,86
	GROWTH	367	NFLX.OQ	Netflix Inc	116.859.980.473,02	20,95
	GROWTH	400	TDG.N	TransDigm Gr	19.593.662.776,20	21,43

[…]

30th perc.	NEUTRAL	396	PARA.OQ	Paramount Gl	16.369.064.002,34	49,61
	NEUTRAL	431	APTV.N	Aptiv PLC	16.221.988.956,87	49,7
	NEUTRAL	166	MMC.N	Marsh & McLe	40.170.720.656,00	49,74
	NEUTRAL	234	ROST.OQ	Ross Stores Inc	33.994.112.458,60	50,08
	NEUTRAL	257	TECH.OQ	Bio-Techne Co	5.559.053.326,75	50,2
	NEUTRAL	199	OKE.N	ONEOK Inc	22.192.951.684,15	50,25
	NEUTRAL	282	VMC.N	Vulcan Materi	13.046.324.220,80	50,35
	NEUTRAL	300	STLD.OQ	Steel Dynamic	6.895.748.869,04	50,45
	NEUTRAL	21	AON.N	Aon PLC	35.009.100.411,04	50,7
	NEUTRAL	370	WYNN.OQ	Wynn Resorts	10.755.326.815,38	50,9
	NEUTRAL	338	MET.N	MetLife Inc	40.519.578.627,12	51,26
	NEUTRAL	128	HOLX.OQ	Hologic Inc	11.151.591.032,64	51,39
	NEUTRAL	93	EA.OQ	Electronic Art	30.447.897.779,10	51,47

[…]

70th perc.	VALUE	160	LLY.N	Eli Lilly and Co	122.584.771.348,60	70,24
	VALUE	70	CAG.N	Conagra Branc	14.721.568.647,51	70,29
	VALUE	409	V.N	Visa Inc	333.967.503.145,68	70,33
	VALUE	213	PFE.N	Pfizer Inc	253.170.000.000,00	70,37
	VALUE	6	AMD.OQ	Advanced Mic	17.809.436.589,12	70,54
	VALUE	366	PRU.N	Prudential Fin	33.680.150.000,00	70,54
	VALUE	284	WBA.OQ	Walgreens Boo	68.039.754.516,32	70,65
	VALUE	171	MCD.N	McDonald's Co	136.890.533.092,50	70,73
	VALUE	124	WELL.N	Welltower Inc	26.073.478.845,15	70,75
	VALUE	69	DXC.N	DXC Technolo	17.252.520.035,97	70,77
	VALUE	262	TMO.N	Thermo Fisher	90.092.568.527,78	70,96
	VALUE	222	QCOM.OQ	Qualcomm Inc	105.820.068.139,17	70,98
	VALUE	319	CTSH.OQ	Cognizant Tec	36.756.698.011,32	71,17
	VALUE	230	RHI.N	Robert Half Int	6.948.371.830,40	71,32
	VALUE	92	EIX.N	Edison Interna	18.496.302.164,62	71,4

Figure 29 – Companies ranked in ascending order for ESG Score Grade

Source: Refinitiv and own contribution

2. each of these two dimensions is further categorized into subgroups:
    c) Three groups (Gj) are established, defined by threshold values corresponding to the 30th and 70th percentiles (ESG);
    d) two groups (Gh) are formed, defined by a threshold value corresponding to the 50th percentile (ME);
3. the intersection (I_{jh}) between each of the three groups (G_j) within the ESG dimension and each of the two groups (G_h) within the ME dimension is determined.

4. the companies within each intersection (I_{jh}) are utilized for the composition of their respective portfolio (P_{jh});
    - each company in the P_{jh} portfolio is assigned a weight proportional to its market capitalisation (an illustrative example for the 2018/2019 period is presented in Table 5 in the Appendix).

Tables provided subsequently detail the number of companies within each of the six portfolios and the corresponding percentage of stocks within these portfolios for each year throughout the review period:

	Number of Stocks In Portfolios						
Time Period	S/G	S/N	S/V	B/G	B/N	B/V	Total number
July 2018- June 2019	104	96	36	37	93	106	472
July 2019- June 2020	103	91	42	38	98	100	472
July 2020 - June 2021	98	86	52	43	103	90	472
July 2021 - June 2022	89	97	50	52	92	92	472

Figure 30: Number of stocks in each of the six portfolios.
Source: Personal elaboration on Excel.

	Percentage of Stocks					
Time Period	S/G	S/N	S/V	B/G	B/N	B/V
July 2018- June 2019	22%	20%	8%	8%	20%	22%
July 2019- June 2020	22%	19%	9%	8%	21%	21%
July 2020 - June 2021	21%	18%	11%	9%	22%	19%
July 2021 - June 2022	19%	21%	11%	11%	19%	19%

Figure 31: Percentage of Stocks In Six Size-B/M Portfolios[62].
Source: Personal elaboration on Excel.

5. For each portfolio (P_{jh}) the historical series of returns (R_{jh}) spanning from July of year t to June of year t + 1 is computed. This calculation method mirrors the steps used to establish S/L, S/N, S/H, B/L, B/N, B/H portfolios within the context of the 3-factor model, ultimately resulting in the creation of S/G, S/N, S/V, B/G, B/N, B/V portfolios: (Figure 32):

[62] Notes: S=Small Size // B=Big Size //L=Low BE/ME // N=Neutral BE/ME // H=High BE/ME

	Weighted portfolio return SG	Weighted portfolio return SN	Weighted portfolio return SV	Weighted portfolio return BG	Weighted portfolio return BN	Weighted portfolio return BV
01/07/18						
02/07/18	0,00305	0,00045	0,00003	0,00431	0,00626	0,00195
03/07/18	-0,00053	-0,00373	-0,00041	-0,00551	-0,00999	-0,00355
04/07/18	0,00000	0,00000	0,00000	0,00000	0,00000	0,00000
05/07/18	0,00876	0,00933	0,01116	0,00867	0,01115	0,00836
06/07/18	0,00771	0,00793	0,00820	0,00849	0,00920	0,00802
07/07/18	0,00000	0,00000	0,00000	0,00000	0,00000	0,00000
08/07/18	0,00000	0,00000	0,00000	0,00000	0,00000	0,00000
09/07/18	0,00943	0,00738	0,00689	0,01021	0,00777	0,00883
10/07/18	0,00023	0,00276	0,00198	0,00219	0,00231	0,00581
11/07/18	-0,00294	-0,00810	-0,01007	-0,00341	-0,00589	-0,00654
12/07/18	0,00981	0,00507	0,00280	-0,00047	0,01337	0,00999
13/07/18	-0,00002	0,00076	-0,00097	-0,00099	0,00193	0,00198
14/07/18	0,00000	0,00000	0,00000	0,00000	0,00000	0,00000
15/07/18	0,00000	0,00000	0,00000	0,00000	0,00000	0,00000
16/07/18	-0,00394	-0,00301	-0,00381	-0,00184	-0,00238	0,00035
17/07/18	0,00488	0,00331	0,00631	0,00098	0,00577	0,00502
18/07/18	0,00180	0,00380	0,00079	0,01153	0,00091	0,00143
19/07/18	0,00297	-0,00149	0,00137	-0,00789	-0,00182	-0,00539
20/07/18	-0,00337	-0,00229	-0,00610	-0,00348	-0,00148	0,00108
21/07/18	0,00000	0,00000	0,00000	0,00000	0,00000	0,00000
22/07/18	0,00000	0,00000	0,00000	0,00000	0,00000	0,00000
23/07/18	-0,00055	0,00143	0,00255	-0,00020	0,00356	0,00139
24/07/18	-0,00728	-0,00236	-0,00414	0,00019	0,01016	0,00677
25/07/18	0,01026	0,00642	0,00690	0,00876	0,00958	0,00997
26/07/18	0,00292	0,00133	0,01518	0,00266	-0,00422	-0,00190

[...]

10/06/19	0,00597	0,00533	0,00103	0,00706	0,00572	0,00604
11/06/19	-0,00355	-0,00015	0,00080	-0,00113	0,00115	0,00008
12/06/19	0,00247	-0,00146	-0,00141	-0,00832	-0,00205	-0,00180
13/06/19	0,00549	0,00711	0,00694	0,00205	0,00720	0,00251
14/06/19	-0,00362	-0,00427	-0,00231	-0,00589	-0,00062	-0,00143
15/06/19	0,00000	0,00000	0,00000	0,00000	0,00000	0,00000
16/06/19	0,00000	0,00000	0,00000	0,00000	0,00000	0,00000
17/06/19	-0,00087	-0,00262	-0,00063	0,00265	0,00332	0,00101
18/06/19	0,00884	0,01229	0,01005	0,01099	0,00876	0,01077
19/06/19	0,00724	0,00376	0,00584	0,00632	0,00114	0,00250
20/06/19	0,00710	0,00778	0,01282	0,01292	0,00951	0,00908
21/06/19	-0,00570	-0,00226	-0,00604	-0,00347	-0,00014	-0,00002
22/06/19	0,00000	0,00000	0,00000	0,00000	0,00000	0,00000
23/06/19	0,00000	0,00000	0,00000	0,00000	0,00000	0,00000
24/06/19	-0,00565	-0,00376	-0,00273	-0,00164	-0,00202	-0,00118
25/06/19	-0,00902	-0,00627	-0,00409	-0,00529	-0,01283	-0,01095
26/06/19	-0,00502	-0,00136	-0,00159	-0,00048	0,00048	-0,00097
27/06/19	0,00953	0,00817	0,00591	0,00878	0,00171	0,00303
28/06/19	0,01084	0,00896	0,01185	0,00765	0,00499	0,00479
29/06/19	0,00000	0,00000	0,00000	0,00000	0,00000	0,00000
30/06/19	0,00000	0,00000	0,00000	0,00000	0,00000	0,00000

Figure 32 - S/G, S/N, S/V, B/G, B/N, B/V portfolios

Source: Personal elaboration on Excel.

6. The computation of the ESG factor (as illustrated in Figure 33) adhered to the same mathematical framework utilized for deriving the HML factor:

$$ESG = \frac{1}{2} * (SV + BV) - \frac{1}{2} * (SG + BG) \quad (10)$$

	SG	SN	SV	BG	BN	BV	ESG
01/07/18							
02/07/18	0,00305	0,00045	0,00003	0,00431	0,00626	0,00195	-0,00269
03/07/18	-0,00053	-0,00373	-0,00041	-0,00551	-0,00999	-0,00355	0,00104
04/07/18	0,00000	0,00000	0,00000	0,00000	0,00000	0,00000	0,00000
05/07/18	0,00876	0,00933	0,01116	0,00867	0,01115	0,00836	0,00104
06/07/18	0,00771	0,00793	0,00820	0,00849	0,00920	0,00802	0,00002
07/07/18	0,00000	0,00000	0,00000	0,00000	0,00000	0,00000	0,00000
08/07/18	0,00000	0,00000	0,00000	0,00000	0,00000	0,00000	0,00000
09/07/18	0,00943	0,00738	0,00689	0,01021	0,00777	0,00883	-0,00196
10/07/18	0,00023	0,00276	0,00198	0,00219	0,00231	0,00581	0,00268
11/07/18	-0,00294	-0,00810	-0,01007	-0,00341	-0,00589	-0,00654	-0,00513
12/07/18	0,00981	0,00507	0,00280	-0,00047	0,01337	0,00999	0,00173
13/07/18	-0,00002	0,00076	-0,00097	-0,00099	0,00193	0,00198	0,00101
14/07/18	0,00000	0,00000	0,00000	0,00000	0,00000	0,00000	0,00000
15/07/18	0,00000	0,00000	0,00000	0,00000	0,00000	0,00000	0,00000
16/07/18	-0,00394	-0,00301	-0,00381	-0,00184	-0,00238	0,00035	0,00116
17/07/18	0,00488	0,00331	0,00631	0,00098	0,00577	0,00502	0,00273
18/07/18	0,00180	0,00380	0,00079	0,01153	0,00091	0,00143	-0,00555
19/07/18	0,00297	-0,00149	0,00137	-0,00789	-0,00182	-0,00539	0,00045
20/07/18	-0,00337	-0,00229	-0,00610	-0,00348	-0,00148	0,00108	0,00091
21/07/18	0,00000	0,00000	0,00000	0,00000	0,00000	0,00000	0,00000
22/07/18	0,00000	0,00000	0,00000	0,00000	0,00000	0,00000	0,00000
23/07/18	-0,00055	0,00143	0,00255	-0,00020	0,00356	0,00139	0,00235
24/07/18	-0,00728	-0,00236	-0,00414	0,00019	0,01016	0,00677	0,00486
25/07/18	0,01026	0,00642	0,00690	0,00876	0,00958	0,00997	-0,00107
26/07/18	0,00292	0,00133	0,01518	0,00266	-0,00422	-0,00190	0,00385
27/07/18	-0,00995	-0,00669	-0,00842	-0,00607	-0,00954	-0,00565	0,00098
28/07/18	0,00000	0,00000	0,00000	0,00000	0,00000	0,00000	0,00000
29/07/18	0,00000	0,00000	0,00000	0,00000	0,00000	0,00000	0,00000
30/07/18	-0,01333	-0,00467	-0,00368	-0,00640	-0,00794	-0,00541	0,00532
31/07/18	0,00792	0,00979	0,00868	0,00389	0,00471	0,00486	0,00086

[…]

01/06/22	-0,00818	-0,01317	-0,00720	-0,01150	-0,01138	-0,00455	0,00397
02/06/22	0,02473	0,01532	0,01109	0,02435	0,02508	0,02071	-0,00864
03/06/22	-0,01354	-0,01113	-0,00711	-0,01513	-0,02263	-0,01909	0,00123
04/06/22	0,00000	0,00000	0,00000	0,00000	0,00000	0,00000	0,00000
05/06/22	0,00000	0,00000	0,00000	0,00000	0,00000	0,00000	0,00000
06/06/22	0,00707	0,00410	0,00156	0,00132	0,00413	0,00572	-0,00055
07/06/22	0,01011	0,00871	0,00975	0,00789	0,00929	0,00711	-0,00057
08/06/22	-0,01486	-0,01453	-0,01653	-0,01084	-0,00866	-0,00948	-0,00016
09/06/22	-0,02201	-0,02344	-0,02450	-0,02648	-0,02255	-0,02510	-0,00055
10/06/22	-0,02912	-0,02732	-0,02715	-0,02994	-0,02836	-0,03277	-0,00043
11/06/22	0,00000	0,00000	0,00000	0,00000	0,00000	0,00000	0,00000
12/06/22	0,00000	0,00000	0,00000	0,00000	0,00000	0,00000	0,00000
13/06/22	-0,04859	-0,04213	-0,04438	-0,04103	-0,04085	-0,03892	0,00316
14/06/22	-0,00615	-0,00452	-0,00694	-0,00023	-0,00382	-0,00254	-0,00155
15/06/22	0,01300	0,00624	0,00792	0,01447	0,01634	0,02175	0,00110
16/06/22	-0,04429	-0,03763	-0,04136	-0,03471	-0,03648	-0,02970	0,00397
17/06/22	0,00446	0,00591	-0,00487	0,00447	0,00428	0,00530	-0,00425
18/06/22	0,00000	0,00000	0,00000	0,00000	0,00000	0,00000	0,00000
19/06/22	0,00000	0,00000	0,00000	0,00000	0,00000	0,00000	0,00000
20/06/22	0,00000	0,00000	0,00000	0,00000	0,00000	0,00000	0,00000
21/06/22	0,01526	0,01258	0,02136	0,01601	0,02329	0,02758	0,00884
22/06/22	-0,00033	-0,00289	-0,00751	0,00275	0,00167	-0,00121	-0,00557
23/06/22	0,01058	0,00474	-0,00355	0,00828	0,01216	0,01132	-0,00555
24/06/22	0,03303	0,03421	0,03505	0,03625	0,03382	0,03270	-0,00076
25/06/22	0,00000	0,00000	0,00000	0,00000	0,00000	0,00000	0,00000
26/06/22	0,00000	0,00000	0,00000	0,00000	0,00000	0,00000	0,00000
27/06/22	0,00199	0,00261	0,00411	-0,00417	-0,00278	-0,00774	-0,00072
28/06/22	-0,01776	-0,00946	-0,00935	-0,02087	-0,02317	-0,02558	0,00185
29/06/22	-0,00849	-0,00871	-0,01270	-0,00191	0,00034	0,00149	-0,00041
30/06/22	-0,00510	-0,00840	-0,00862	-0,00438	-0,00651	-0,01458	-0,00686

Figure 33 – ESG Factor

Source: Personal elaboration on Excel.

7. This entire process, comprising steps 1 through 6, is reiterated annually for each “t” within the analyzed time span.

At this point, as done previously for the Fama-French Three Factor model we proceed to calculate the market excess return using the same risk-free values as previously.

It is imperative to underscore that, for each dataset, Sundays and public holidays—periods when the stock market remains closed—have been rigorously excluded. This meticulous curation of the dataset ensures the accuracy and reliability of the financial analysis, as it concentrates solely on trading days when market activity is observed.

Subsequent to the construction of the ESG factor, the forthcoming sections will delve into a comparative analysis, contrasting the regression outcomes achieved by incorporating the ESG factor.

3.4 Construction of the portfolios on which to perform the regressions

3.4.1 Construction of portfolios: Top 25% ESG and Bottom 25% ESG

The construction of portfolios for regression testing of the Fama-French model is a crucial step in this analysis. This process involves sorting companies within the S&P 500 index in descending order based on their ESG (Environmental, Social, and Governance) Score Grade. By doing so, we group companies with similar ESG performance levels, allowing us to examine how their financial performance is influenced by these ESG assessments. This procedure provides us with a clear view of companies excelling in ESG and those with room for improvement.

The use of specific percentages, such as 25% for TOP and BOTTOM portfolios is necessary to ensure the representativeness of our samples. These percentages enable to identify companies with the best and worst ESG ratings within the S&P 500, avoiding distortions related to company size.

Company	PTF TOP 25%	equally weight
Microsoft Corp	176	0,008474576
Campbell Soup Co	53	0,008474576
Colgate-Palmolive Co	67	0,008474576
Waste Management Inc	271	0,008474576
CBRE Group Inc	377	0,008474576
Johnson Controls International PLC	295	0,008474576
S&P Global Inc	172	0,008474576
General Motors Co	427	0,008474576
Target Corp	81	0,008474576
Chevron Corp	60	0,008474576
3M Co	180	0,008474576
Cisco Systems Inc	63	0,008474576
Altria Group Inc	214	0,008474576
Agilent Technologies Inc	336	0,008474576
Newmont Corporation	187	0,008474576
Hasbro Inc	122	0,008474576
Intel Corp	142	0,008474576
Intuit Inc	147	0,008474576
State Street Corp	251	0,008474576
Best Buy Co Inc	40	0,008474576
Citigroup Inc	266	0,008474576
PG&E Corp	203	0,008474576
Lockheed Martin Corp	162	0,008474576
Becton Dickinson and Co	36	0,008474576

Company	PTF BOTTOM 25%	equally weight
Verisign Inc	280	0,008474576
Kraft Heinz Co	460	0,008474576
Gartner Inc	113	0,008474576
Cboe Global Markets Inc	421	0,008474576
Oracle Corp	200	0,008474576
Stanley Black & Decker Inc	248	0,008474576
Chipotle Mexican Grill Inc	398	0,008474576
Newell Brands Inc	305	0,008474576
Ameren Corp	14	0,008474576
Willis Towers Watson PLC	363	0,008474576
EQT Corp	98	0,008474576
Charles Schwab Corp	239	0,008474576
Zimmer Biomet Holdings Inc	352	0,008474576
Synopsys Inc	254	0,008474576
Cadence Design Systems Inc	51	0,008474576
Huntington Ingalls Industries Inc	428	0,008474576
Bio Rad Laboratories Inc	41	0,008474576
Dollar General Corp	416	0,008474576
Trimble Inc	268	0,008474576
Norwegian Cruise Line Holdings Ltd	435	0,008474576
Fidelity National Information Services Inc	351	0,008474576
Travelers Companies Inc	236	0,008474576
CenterPoint Energy Inc	304	0,008474576
Arista Networks Inc	450	0,008474576

[…]

Hershey Co	126	0,008474576
Tractor Supply Co	265	0,008474576
NXP Semiconductors NV	423	0,008474576
Trane Technologies PLC	141	0,008474576
Home Depot Inc	129	0,008474576
Hilton Worldwide Holdings Inc	447	0,008474576
Eaton Corporation PLC	90	0,008474576
Gen Digital Inc	253	0,008474576
J M Smucker Co	368	0,008474576
Applied Materials Inc	24	0,008474576
Morgan Stanley	182	0,008474576
Marriott International Inc	167	0,008474576
Xcel Energy Inc	191	0,008474576
Essex Property Trust Inc	307	0,008474576
Amgen Inc	18	0,008474576
Amazon.com Inc	315	0,008474576
Raytheon Technologies Corp	275	0,008474576
Walmart Inc	283	0,008474576
American Airlines Group Inc	448	0,008474576
Norfolk Southern Corp	189	0,008474576

Paycom Software Inc	451	0,008474576
Generac Holdings Inc	419	0,008474576
Insulet Corp	404	0,008474576
Axon Enterprise Inc	362	0,008474576
Match Group Inc	463	0,008474576
TransDigm Group Inc	400	0,008474576
Netflix Inc	367	0,008474576
Genuine Parts Co	117	0,008474576
Teledyne Technologies Inc	332	0,008474576
Dexcom Inc	389	0,008474576
Caesars Entertainment Inc	455	0,008474576
Ingersoll Rand Inc	468	0,008474576
Charter Communications Inc	418	0,008474576
Invitation Homes Inc	467	0,008474576
Expedia Group Inc	390	0,008474576
LKQ Corp	374	0,008474576
Fleetcor Technologies Inc	434	0,008474576
Global Payments Inc	343	0,008474576
Ceridian HCM Holding Inc	471	0,008474576
Extra Space Storage Inc	382	0,008474576

Figure 34 – Extraction of portfolio compositions comprising the top 25% of companies with the highest ESG score grades and the bottom 25% of companies with the lowest ESG score grades.
Source: Personal elaboration on Excel.

In the context of portfolio construction, it is crucial to calculate a weight vector for each portfolio. This weight vector represents a key element in defining the composition of a particular portfolio. Essentially, it indicates the proportional allocation of stocks from each company within the specific portfolio. To achieve this, an approach known as “equally weighted” is adopted, where all companies in the portfolio have the same weight (as in Figure 34).

Following the weight allocation, the next step involves applying this weight vector to the daily returns matrix. Given that the data has been segmented by individual years, a specific annual returns submatrix is extracted and then multiplied by the weight vector. This operation can be efficiently performed using MMULT Excel’s functions, designed to handle matrix-vector multiplication.
By executing this multiplication, we effectively compute the daily weighted returns for the selected year, considering the weight of each asset in the portfolio.

	PTF TOP 25%	PTF BOTTOM 25%
01/07/18		
02/07/18	-0,000424	0,003679
03/07/18	-0,001566	-0,000802
04/07/18	0,000000	0,000000
05/07/18	0,008587	0,008930
06/07/18	0,008489	0,008194
07/07/18	0,000000	0,000000
08/07/18	0,000000	0,000000
09/07/18	0,007876	0,009269
10/07/18	0,004815	0,000063
11/07/18	-0,009925	-0,004911
12/07/18	0,006246	0,007606
13/07/18	0,001340	-0,000229
14/07/18	0,000000	0,000000
15/07/18	0,000000	0,000000
16/07/18	-0,003380	-0,004026
17/07/18	0,004296	0,004656
18/07/18	0,002433	0,001632
19/07/18	-0,002277	0,002641
20/07/18	-0,002934	-0,004173

[…]

10/06/19	0,003359	0,006066
11/06/19	-0,000151	-0,003353
12/06/19	-0,001328	-0,000620
13/06/19	0,005482	0,005502
14/06/19	-0,002570	-0,004606
15/06/19	0,000000	0,000000
16/06/19	0,000000	0,000000
17/06/19	-0,000231	0,000848
18/06/19	0,010619	0,010063
19/06/19	0,003649	0,005954
20/06/19	0,011731	0,007684
21/06/19	-0,002337	-0,005376
22/06/19	0,000000	0,000000
23/06/19	0,000000	0,000000
24/06/19	-0,003024	-0,005769
25/06/19	-0,008237	-0,009704
26/06/19	-0,001970	-0,004175
27/06/19	0,006013	0,009656
28/06/19	0,007371	0,011092
29/06/19	0,000000	0,000000
30/06/19	0,000000	0,000000

Figure 35 – Extraction of portfolio compositions.

Source: Personal elaboration on Excel.

The data are also multiplied by 100 for consistency in the analysis and the risk-free rate is subtracted from each data to account for the excess returns.

	Rf	PTF TOP 25%	PTF BOTTOM 25%
01/07/18			
02/07/18	0,008	-0,050	0,360
03/07/18	0,008	-0,165	-0,088
04/07/18	0,000	0,000	0,000
05/07/18	0,008	0,851	0,885
06/07/18	0,008	0,841	0,811
07/07/18	0,000	0,000	0,000
08/07/18	0,000	0,000	0,000
09/07/18	0,008	0,780	0,919
10/07/18	0,008	0,474	-0,002
11/07/18	0,008	-1,000	-0,499
12/07/18	0,008	0,617	0,753
13/07/18	0,008	0,126	-0,031
14/07/18	0,000	0,000	0,000
15/07/18	0,000	0,000	0,000
16/07/18	0,008	-0,346	-0,411
17/07/18	0,008	0,422	0,458
18/07/18	0,008	0,235	0,155
19/07/18	0,008	-0,236	0,256
20/07/18	0,008	-0,301	-0,425
[…]			
15/06/22	0,003	1,067	1,341
16/06/22	0,003	-3,411	-4,134
17/06/22	0,003	-0,052	0,347
18/06/22	0,000	0,000	0,000
19/06/22	0,000	0,000	0,000
20/06/22	0,003	-0,003	-0,003
21/06/22	0,003	2,155	1,733
22/06/22	0,003	-0,460	0,090
23/06/22	0,003	0,216	1,195
24/06/22	0,003	3,106	3,275
25/06/22	0,000	0,000	0,000
26/06/22	0,000	0,000	0,000
27/06/22	0,003	-0,010	-0,030
28/06/22	0,003	-1,410	-1,803
29/06/22	0,003	-0,642	-0,617
30/06/22	0,003	-0,990	-0,546

Figure 36 – Extraction of portfolio compositions.

Source: Personal elaboration on Excel.

For each data, Sundays and public holidays, when the stock market remains closed, have been systematically excluded.

Once the portfolios are constructed, we perform multivariate regressions using the three-factor Fama-French model. This model takes into account market returns (Rm-rf), the value factor (HML), and the size factor (SMB). The regressions enable us to evaluate how these factors influence the performance of TOP and BOTTOM portfolios. Specifically, we can determine whether companies with higher or lower ESG scores exhibit significant differences in their financial performance.

Date	Rm-rf	SMB	HML	ESG	PTF TOP 25%	PTF BOTTOM 25%
02/07/18	0,0678	-0,1716	-0,5112	-0,2688	-0,0504	0,3599
03/07/18	0,2988	0,3826	0,2986	0,1038	-0,1646	-0,0882
05/07/18	0,3551	0,0752	-0,4325	0,1045	0,8507	0,8850
06/07/18	0,8401	0,0054	-0,3211	0,0016	0,8409	0,8114
09/07/18	0,8743	-0,0805	0,4006	-0,1957	0,7796	0,9189
10/07/18	0,3393	-0,2597	-0,0688	0,2681	0,4735	-0,0017
11/07/18	-0,7174	0,0286	-0,6659	-0,5129	-1,0005	-0,4991
12/07/18	0,8669	-0,2486	-1,0956	0,1726	0,6166	0,7526
13/07/18	0,0999	-0,1085	-0,2326	0,1010	0,1260	-0,0309
16/07/18	-0,1108	-0,3910	0,7337	0,1163	-0,3460	-0,4106
17/07/18	0,3894	0,0510	-0,5034	0,2733	0,4216	0,4576
18/07/18	0,2081	-0,0797	0,6632	-0,5555	0,2353	0,1552
19/07/18	-0,4033	0,5314	-0,3790	0,0452	-0,2357	0,2561
20/07/18	-0,1028	-0,2635	-0,4051	0,0914	-0,3014	-0,4253
[…]						
14/06/22	-0,3804	-0,1407	-0,6050	-0,1551	-0,7577	-0,5808
15/06/22	1,4563	-0,6430	-1,3313	0,1100	1,0667	1,3409
16/06/22	-3,2542	-0,9615	0,5681	0,3975	-3,4106	-4,1339
17/06/22	0,2171	0,1858	-1,3906	-0,4249	-0,0522	0,3468
21/06/22	2,4447	-0,9802	0,0144	0,8836	2,1552	1,7332
22/06/22	-0,1332	-0,1074	-0,8022	-0,5567	-0,4600	0,0899
23/06/22	0,9502	-0,1069	-2,2003	-0,5547	0,2157	1,1948
24/06/22	3,0533	0,1339	-0,3770	-0,0762	3,1059	3,2747
27/06/22	-0,3003	0,6545	0,8035	-0,0723	-0,0105	-0,0299
28/06/22	-2,0173	0,6463	2,1780	0,1847	-1,4103	-1,8034
29/06/22	-0,0742	-0,7954	-0,8889	-0,0408	-0,6422	-0,6173
30/06/22	-0,8789	0,3807	-0,0735	-0,6865	-0,9898	-0,5461

Figure 37 – Extraction of data for regressions.

Source: Personal elaboration on Excel.

Multivariate regression analysis is a valuable statistical tool for systematically examining and describing complex phenomena influenced by multiple factors. In this context, multivariate or multiple regression is employed to analyze and model a phenomenon where the dependent variable is affected by several potentially explanatory or predictive independent variables. This analytical approach finds extensive application in financial modeling and investment analysis.
Mathematically, the relationship can be expressed as follows:

$$Y = f(X_1, X_2, \dots, X_K)$$

In this equation, Y represents the dependent variable, which is the phenomenon under investigation, while X_1, X_2, ..., X_k denote the independent variables, each with the potential to contribute to the variability of the dependent variable.

In the financial context, the dependent variables encompass the portfolios: 25% top/bottom ESG. These portfolios are constructed based on specific criteria and are crucial for evaluating the effects of various factors on portfolio performance. The independent variables considered in this analysis include market excess returns, SMB (Size Minus Big), and HML (High Minus Low) factors. These factors are integral components of the Fama-French model, widely used in finance to understand and interpret portfolio returns.

In this case, it will be necessary to evaluate the goodness of fit of the adopted estimated model should be checked, then the degree of approximation between the actual value Y and the theoretical one $\hat{Y}$. The index of determination r^2 measures the proportion of variability in the actual phenomenon Y explained by the theoretical regression model constructed with X variables. The index of determination is between zero and one. It will be equal to zero when the regression deviance is zero, so the model linear model will not provide reasons for the variations in the phenomenon; it will be equal to one when the residual deviance is zero, so the model will completely explains the variations in the phenomenon.

In financial analysis, a high r^2 indicates that the regression model effectively explains portfolio performance based on the selected independent variables, offering valuable insights into the factors influencing investment outcomes.
Overall, multivariate regression analysis, combined with the evaluation of the coefficient of determination, plays an important role in enhancing our understanding of the intricate relationship

between independent variables and financial phenomena, ultimately supporting more informed investment decisions.

Python is used to run the regressions via this code:

1. Importing libraries:

```
import pandas as pd
import statsmodels.api as sm
```

In this part of the code, two essential libraries are imported for data manipulation and performing statistical analysis: **`pandas`** (abbreviated as pd) for handling tabular data and **`statsmodels.api`** (abbreviated as sm) for executing statistical analyses, including linear regression.

2. Loading the Excel File:

```
file_excel =
pd.read_excel("/Users/michelascuccimarra/Desktop/Dati per
regressione.xlsx", sheet_name="FF Factors")
```

3. Selecting Independent Variables:

```
X = file_excel[['Rm-rf', 'SMB', 'HML']]
```

Here, independent variables are extracted from the file_excel DataFrame. These variables include “Rm-rf” (Market Risk Premium), “SMB” (Small Minus Big), and “HML” (High Minus Low).

4. Selecting Dependent Variables:

```
Y1 = file_excel['PTF TOP 25%']
Y2 = file_excel['PTF BOTTOM 25%']
```

Two separate dependent variables, one named “PTF TOP 25%” and the other “PTF BOTTOM 25%”, are selected from the file_excel DataFrame.

5. Adding the Intercept (Constant):

```
X = sm.add_constant(X)
```

Here, a constant column (intercept) is added to the matrix of independent variables X using the **`sm.add_constant()`** function.

6. Performing Regressions:

```
model_TOP = sm.OLS(Y1, X).fit()
model_BOTTOM = sm.OLS(Y2, X).fit()
```

In these two lines of code, two separate linear regressions are performed. The first line calculates the regression for “PTF TOP 25%”, and the second line calculates the regression for “PTF BOTTOM 25%”. The results of the regression are stored in the model_TOP and model_BOTTOM models.

7. Printing Results:

```
print("Regression PTF TOP 25%:")
print(model_TOP.summary())

print("\nRegression PTF BOTTOM 25%:")
print(model_BOTTOM.summary())
```

These last four lines of code print the summaries of the two regressions.

```
Regression PTF TOP 25%:
                            OLS Regression Results
==============================================================================
Dep. Variable:            PTF TOP 25%   R-squared:                       0.986
Model:                            OLS   Adj. R-squared:                  0.986
Method:                 Least Squares   F-statistic:                 2.301e+04
Date:                Wed, 20 Sep 2023   Prob (F-statistic):               0.00
Time:                        12:01:46   Log-Likelihood:                329.19
No. Observations:                1007   AIC:                            -650.4
Df Residuals:                    1003   BIC:                            -630.7
Df Model:                           3
Covariance Type:            nonrobust
==============================================================================
                 coef    std err          t      P>|t|      [0.025      0.975]
------------------------------------------------------------------------------
const          0.0099      0.006      1.787      0.074      -0.001       0.021
Rm-rf          0.9717      0.004    246.942      0.000       0.964       0.979
SMB            0.4422      0.014     32.668      0.000       0.416       0.469
HML            0.2541      0.005     46.327      0.000       0.243       0.265
==============================================================================
Omnibus:                       46.219   Durbin-Watson:                   2.017
Prob(Omnibus):                  0.000   Jarque-Bera (JB):              112.180
Skew:                           0.224   Prob(JB):                     4.37e-25
Kurtosis:                       4.573   Cond. No.                         3.52
==============================================================================

Notes:
[1] Standard Errors assume that the covariance matrix of the errors is correctly specified.
```

Figure 38 – Regression PTF TOP 25%.

Source: Personal elaboration on Python

The Rm-rf coefficient of 0.9717 for the top 25% ESG portfolio suggests that this portfolio is highly correlated with the market factor (Rm-rf)[63].

A positive Rm-rf coefficient close to 1 indicates that the top 25% ESG portfolio tends to closely follow stock market fluctuations; when the overall stock market rises (the Rm-rf is positive), the top 25% ESG portfolio is expected to show a similar increase in returns. Conversely, when the stock market declines, this portfolio may decline accordingly.

However, it is important to note that the Rm-rf ratio alone does not provide a complete overview of portfolio performance. Other factors such as the intercept, other coefficients of the independent variables, the p-value and the r^2 must also be considered.

In this case, the r^2 is 0.986, which means that the model explains 98.6% of the variation in the returns of the "PTF TOP 25% ESG" portfolio. This is a very high value and suggests that the model has very good predictive ability for this portfolio.

[63] The Rm-rf factor represents the stock market return relative to the risk-free rate of return.

The intercept has a value of 0.0099; this suggests that even in the absence of risk factors such as market (Rm-rf), company style (SMB), and value (HML), the portfolio has a minimum positive return.

The SMB coefficient takes a value of 0.4422. This positive value indicates that the "PTF TOP 25%" portfolio benefits from higher returns when small-cap stocks outperform large-cap stocks. Finally, the HML coefficient takes on a value of 0.2541, which indicates that the "PTF TOP 25%" portfolio benefits from higher returns when value stocks outperform growth stocks.

Regression PTF BOTTOM 25%:

OLS Regression Results

Dep. Variable:	PTF BOTTOM 25%	R-squared:	0.975
Model:	OLS	Adj. R-squared:	0.975
Method:	Least Squares	F-statistic:	1.312e+04
Date:	Wed, 20 Sep 2023	Prob (F-statistic):	0.00
Time:	12:01:46	Log-Likelihood:	8.6115
No. Observations:	1007	AIC:	-9.223
Df Residuals:	1003	BIC:	10.44
Df Model:	3		
Covariance Type:	nonrobust		

	coef	std err	t	P>|t|	[0.025	0.975]
const	0.0230	0.008	3.034	0.002	0.008	0.038
Rm-rf	1.0115	0.005	186.960	0.000	1.001	1.022
SMB	0.8395	0.019	45.112	0.000	0.803	0.876
HML	0.0528	0.008	7.002	0.000	0.038	0.068

Omnibus:	143.591	Durbin-Watson:	1.935
Prob(Omnibus):	0.000	Jarque-Bera (JB):	1163.098
Skew:	0.367	Prob(JB):	2.73e-253
Kurtosis:	8.214	Cond. No.	3.52

Notes:
[1] Standard Errors assume that the covariance matrix of the errors is correctly specified.

Figure 39 – Regression PTF BOTTOM 25%.

Source: Personal elaboration on Python

Also, for PTF BOTTOM 25% the r^2 is very high, standing at 0.975. This means that the regression model can account for 97.5% of the variation in the returns of this portfolio. Such a high r^2 suggests that the model possesses remarkable predictive capability for this specific portfolio.

For the "PTF TOP 25% ESG", a one-unit change in HML (holding other factors constant) is associated with a change in returns of approximately 0.2541 units. On the other hand, for the "PTF BOTTOM 25% ESG", a one-unit change in HML is associated with a change in returns of approximately 0.0528 units.

This implies that the "PTF TOP 25% ESG" is more sensitive to changes in the value factor (HML) compared to the "PTF BOTTOM 25% ESG".
Since the "PTF BOTTOM 25% ESG" is made up of smaller market capitalization companies, it may be weighted more heavily towards small-cap stocks, which are often classified as value stocks. This composition may result in a lower HML ratio, indicating that the portfolio is less sensitive to changes in value factors than the “PTF TOP 25% ESG” portfolio.

Subsequently, to examine the specific effect of ESG, we include the ESG factor in our regression models. This means we now consider four factors: market returns (Rm-rf), the value factor (HML), the size factor (SMB), and the ESG factor. Four-factor regressions allow us to assess how ESG significantly influences portfolio performance. We can observe whether companies with higher or lower ESG ratings show an even greater difference in their financial performance when the ESG factor is included in the model.
This analytical approach holds significant implications for investors and financial professionals. It helps us better understand how companies’ ESG choices can impact their financial results and, consequently, portfolio returns. This information is crucial for investors looking to incorporate ESG criteria into their investment decisions, as it provides a solid basis for risk and opportunity assessment. Furthermore, by comparing the results of three-factor and four-factor regressions, we can accurately gauge the effect of ESG on investment returns. This aids in measuring the systemic risk associated with companies’ ESG levels, contributing to more informed portfolio management and the evaluation of corporate responsibility within the realm of investments.

Python is used once again to conduct regressions on the two portfolios: the top 25% ESG and bottom 25% ESG (Figure 40).

```python
import pandas as pd
import statsmodels.api as sm

file_excel = pd.read_excel("/Users/michelascuccimarra/Desktop/Dati per regressione.xlsx", sheet_name="FF Factors")

X = file_excel[['Rm-rf', 'SMB', 'HML', 'ESG']]

Y1 = file_excel['PTF TOP 25%']
Y2 = file_excel['PTF BOTTOM 25%']

X = sm.add_constant(X)

model_TOP = sm.OLS(Y1, X).fit()
print("Regression PTF TOP 25%:")
print(model_TOP.summary())

model_BOTTOM = sm.OLS(Y2, X).fit()
print("\nRegression PTF BOTTOM 25%:")
print(model_BOTTOM.summary())
```

Figure 40 – Code for regressions PTF TOP/BOTTOM 25% with ESG risk factor.

Source: Personal elaboration on Python

```
Regression PTF TOP 25% with ESG Factor:
                            OLS Regression Results
==============================================================================
Dep. Variable:            PTF TOP 25%   R-squared:                       0.987
Model:                            OLS   Adj. R-squared:                  0.987
Method:                 Least Squares   F-statistic:                 1.926e+04
Date:                Wed, 20 Sep 2023   Prob (F-statistic):               0.00
Time:                        12:51:29   Log-Likelihood:                 384.17
No. Observations:                1007   AIC:                            -758.3
Df Residuals:                    1002   BIC:                            -733.8
Df Model:                           4
Covariance Type:            nonrobust
==============================================================================
                 coef    std err          t      P>|t|      [0.025      0.975]
------------------------------------------------------------------------------
const          0.0095      0.005      1.825      0.068      -0.001       0.020
Rm-rf          0.9762      0.004    260.263      0.000       0.969       0.984
SMB            0.4803      0.013     36.102      0.000       0.454       0.506
HML            0.2303      0.006     40.780      0.000       0.219       0.241
ESG            0.1856      0.017     10.752      0.000       0.152       0.220
==============================================================================
Omnibus:                       87.422   Durbin-Watson:                   2.044
Prob(Omnibus):                  0.000   Jarque-Bera (JB):              415.457
Skew:                           0.227   Prob(JB):                     6.09e-91
Kurtosis:                       6.114   Cond. No.                         4.91
==============================================================================

Notes:
[1] Standard Errors assume that the covariance matrix of the errors is correctly specified.
```

Figure 41 – Regression PTF TOP 25% with ESG Factor.

Source: Personal elaboration on Python

In the first regression without the ESG factor, the r^2 is 0.986, indicating that the model explains 98.6% of the variation in returns of the "PTF TOP 25%" portfolio. In the second ESG regression, the r^2 is

slightly higher at 0.987, indicating that the model explains 98.7% of the variation in returns. Therefore, adding the ESG factor slightly improves the explanatory power of the model.

In the second regression with the ESG factor, there is an additional coefficient for ESG. The ESG coefficient has a value of 0.1856 and its positive value suggests that higher ESG scores are associated with higher returns for the "PTF TOP 25%" portfolio.

Overall, both regressions show very high r^2 values, indicating strong predictive ability. The second regression considers the ESG factor, which has a positive impact on portfolio returns, suggesting that companies with higher ESG scores contribute positively to portfolio performance.

Regression PTF BOTTOM 25% with ESG Factor:

OLS Regression Results

Dep. Variable:	PTF BOTTOM 25%	R-squared:	0.983
Model:	OLS	Adj. R-squared:	0.983
Method:	Least Squares	F-statistic:	1.432e+04
Date:	Wed, 20 Sep 2023	Prob (F-statistic):	0.00
Time:	12:51:29	Log-Likelihood:	193.92
No. Observations:	1007	AIC:	-377.8
Df Residuals:	1002	BIC:	-353.3
Df Model:	4		
Covariance Type:	nonrobust		

	coef	std err	t	P>|t|	[0.025	0.975]
const	0.0238	0.006	3.766	0.000	0.011	0.036
Rm-rf	1.0009	0.005	220.919	0.000	0.992	1.010
SMB	0.7492	0.016	46.623	0.000	0.718	0.781
HML	0.1093	0.007	16.013	0.000	0.096	0.123
ESG	-0.4403	0.021	-21.114	0.000	-0.481	-0.399

Omnibus:	76.927	Durbin-Watson:	2.029
Prob(Omnibus):	0.000	Jarque-Bera (JB):	263.944
Skew:	0.305	Prob(JB):	4.84e-58
Kurtosis:	5.433	Cond. No.	4.91

Notes:
[1] Standard Errors assume that the covariance matrix of the errors is correctly specified.

Figure 42 – Regression PTF BOTTOM 25% with ESG Factor.
Source: Personal elaboration on Python

Even in the regression on "PTF 25% BOTTOM ESG" without the ESG factor, the r^2 is 0.975, indicating that the model explains 97.5% of the variation in returns of the "PTF BOTTOM 25%" portfolio. In the second ESG regression, the r^2 is slightly higher at 0.983, suggesting that the model explains 98.3% of the variation in returns. Even in this second case, the addition of the ESG factor slightly improves the explanatory power of the model.

In the regression in which the ESG risk factor is also considered as an independent variable, the ESG coefficient has a value of -0.4403 and its negative value suggests that higher ESG scores are associated with lower returns for the "PTF BOTTOM 25 %".

This result is consistent with expectations because the "PTF BOTTOM 25%" portfolio includes companies classified as the worst performers based on their ESG scores. Companies with lower ESG scores are often considered to have higher risks in terms of environmental, social, and governance sustainability, and investors may demand a premium to hold such securities, which could translate into lower returns.

3.4.2 Construction of portfolios: Top 10% ESG and Bottom 10% ESG

In addition to constructing portfolios that encompass the top 25% of companies based on their ESG score grade and the bottom 25% of companies based on the same criteria, we will also create portfolios that comprise solely the top 10% of companies with the highest ESG score grades and the bottom 10% of companies with the lowest ESG score grades. This broader strategy allows for a more comprehensive analysis of investment performance across varying levels of ESG performance.

The construction process and subsequent execution of the regressions on the various portfolios follows the same procedure as before.

Date	Rm-rf	SMB	HML	ESG	PTF TOP 10%	PTF BOTTOM 10%
02/07/18	0,0678	-0,1716	-0,5112	-0,2688	-0,0036	0,2901
03/07/18	0,2988	0,3826	0,2986	0,1038	-0,0342	-0,0218
05/07/18	0,3551	0,0752	-0,4325	0,1045	0,8379	0,8798
06/07/18	0,8401	0,0054	-0,3211	0,0016	0,7126	0,8703
09/07/18	0,8743	-0,0805	0,4006	-0,1957	0,6182	0,9604
10/07/18	0,3393	-0,2597	-0,0688	0,2681	0,3974	0,0767
11/07/18	-0,7174	0,0286	-0,6659	-0,5129	-0,9333	-0,5563
12/07/18	0,8669	-0,2486	-1,0956	0,1726	0,5401	0,9107
13/07/18	0,0999	-0,1085	-0,2326	0,1010	-0,1144	-0,1524
16/07/18	-0,1108	-0,3910	0,7337	0,1163	-0,2060	-0,4079
17/07/18	0,3894	0,0510	-0,5034	0,2733	0,3431	0,4409
18/07/18	0,2081	-0,0797	0,6632	-0,5555	-0,0141	0,1992
19/07/18	-0,4033	0,5314	-0,3790	0,0452	-0,3020	0,2345
20/07/18	-0,1028	-0,2635	-0,4051	0,0914	-0,3009	-0,5075

[…]

14/06/22	-0,3804	-0,1407	-0,6050	-0,1551	-0,8919	-0,2961
15/06/22	1,4563	-0,6430	-1,3313	0,1100	0,8673	-0,2587
16/06/22	-3,2542	-0,9615	0,5681	0,3975	-2,9142	-0,7218
17/06/22	0,2171	0,1858	-1,3906	-0,4249	-0,5159	0,2535
21/06/22	2,4447	-0,9802	0,0144	0,8836	2,2670	1,7639
22/06/22	-0,1332	-0,1074	-0,8022	-0,5567	-0,5609	0,2401
23/06/22	0,9502	-0,1069	-2,2003	-0,5547	0,0228	-0,0283
24/06/22	3,0533	0,1339	-0,3770	-0,0762	2,8422	0,6901
27/06/22	-0,3003	0,6545	0,8035	-0,0723	0,1181	-0,0030
28/06/22	-2,0173	0,6463	2,1780	0,1847	-1,0722	-0,2125
29/06/22	-0,0742	-0,7954	-0,8889	-0,0408	-0,3615	0,0198
30/06/22	-0,8789	0,3807	-0,0735	-0,6865	-0,8411	0,1682

Figure 43 – Extraction of data for regressions.

Source: Personal elaboration on Excel.

In this second case, the dependent variables are the Top 10% ESG and Bottom 10% ESG portfolios obtained, while the independent variables are the market excess returns, SMB, HML and ESG factors.

Python is used once again to conduct regressions on the two portfolios: the top 10% ESG and bottom 10% ESG (Figure 44).

```
import pandas as pd
import statsmodels.api as sm

file_excel = pd.read_excel("/Users/michelascuccimarra/Desktop/Dati per regressione 10%.xlsx", sheet_name="FF Factors")

X = file_excel[['Rm-rf', 'SMB', 'HML']]

Y1 = file_excel['PTF TOP 10%']
Y2 = file_excel['PTF BOTTOM 10%']

X = sm.add_constant(X)

model_TOP = sm.OLS(Y1, X).fit()
print("Regression PTF TOP 10%:")
print(model_TOP.summary())

model_BOTTOM = sm.OLS(Y2, X).fit()
print("\nRegression PTF BOTTOM 10%:")
print(model_BOTTOM.summary())
```

Figure 44 – Code for regressions PTF TOP/BOTTOM 10% without ESG risk factor.

Source: Personal elaboration on Python

Regression PTF TOP 10%:

OLS Regression Results

Dep. Variable:	PTF TOP 10%	R-squared:	0.967
Model:	OLS	Adj. R-squared:	0.967
Method:	Least Squares	F-statistic:	9892.
Date:	Wed, 20 Sep 2023	Prob (F-statistic):	0.00
Time:	15:13:37	Log-Likelihood:	-96.219
No. Observations:	1007	AIC:	200.4
Df Residuals:	1003	BIC:	220.1
Df Model:	3		
Covariance Type:	nonrobust		

	coef	std err	t	P>|t|	[0.025	0.975]
const	0.0140	0.008	1.666	0.096	-0.002	0.031
Rm-rf	0.9623	0.006	160.280	0.000	0.950	0.974
SMB	0.3412	0.021	16.519	0.000	0.301	0.382
HML	0.3278	0.008	39.165	0.000	0.311	0.344

Omnibus:	60.562	Durbin-Watson:	1.969
Prob(Omnibus):	0.000	Jarque-Bera (JB):	158.638
Skew:	0.300	Prob(JB):	3.57e-35
Kurtosis:	4.849	Cond. No.	3.52

Notes:
[1] Standard Errors assume that the covariance matrix of the errors is correctly specified.

Figure 45 – Regression PTF TOP 10% without ESG risk factor.

Source: Personal elaboration on Python.

Regression PTF BOTTOM 10%:

OLS Regression Results

Dep. Variable:	PTF BOTTOM 10%	R-squared:	0.693
Model:	OLS	Adj. R-squared:	0.692
Method:	Least Squares	F-statistic:	753.0
Date:	Wed, 20 Sep 2023	Prob (F-statistic):	2.89e-256
Time:	15:13:37	Log-Likelihood:	-1255.6
No. Observations:	1007	AIC:	2519.
Df Residuals:	1003	BIC:	2539.
Df Model:	3		
Covariance Type:	nonrobust		

	coef	std err	t	P>|t|	[0.025	0.975]
const	0.0753	0.027	2.825	0.005	0.023	0.128
Rm-rf	0.8551	0.019	45.035	0.000	0.818	0.892
SMB	0.5938	0.065	9.092	0.000	0.466	0.722
HML	0.0890	0.026	3.364	0.001	0.037	0.141

Omnibus:	130.429	Durbin-Watson:	2.011
Prob(Omnibus):	0.000	Jarque-Bera (JB):	1150.332
Skew:	-0.223	Prob(JB):	1.62e-250
Kurtosis:	8.217	Cond. No.	3.52

Notes:
[1] Standard Errors assume that the covariance matrix of the errors is correctly specified.

Figure 46 – Regression PTF BOTTOM 10% without ESG risk factor.

Source: Personal elaboration on Python

From the analysis carried out, a comparison can be made between the regression obtained previously, without the addition of the ESG risk factor, and the regression carried out with the implementation of this factor together with the factors of Fama-French Three Factor model.

```python
import pandas as pd
import statsmodels.api as sm

file_excel = pd.read_excel("/Users/michelascuccimarra/Desktop/Dati per regressione 10%.xlsx", sheet_name="FF Factors")

X = file_excel[['Rm-rf', 'SMB', 'HML', 'ESG']]


Y1 = file_excel['PTF TOP 10%']
Y2 = file_excel['PTF BOTTOM 10%']

X = sm.add_constant(X)

# Regression for "PTF TOP 10%"
model_TOP = sm.OLS(Y1, X).fit()
print("Regression PTF TOP 10% with ESG Factor:")
print(model_TOP.summary())

# Regression for "PTF BOTTOM 10%"
model_BOTTOM = sm.OLS(Y2, X).fit()
print("\nRegression PTF BOTTOM 10% with ESG Factor:")
print(model_BOTTOM.summary())
```

Figure 47 – Code for regressions PTF TOP/BOTTOM 10% with ESG risk factor.

Source: Personal elaboration on Python

```
Regression PTF TOP 10% with ESG Factor:
                            OLS Regression Results
==============================================================================
Dep. Variable:            PTF TOP 10%   R-squared:                       0.971
Model:                            OLS   Adj. R-squared:                  0.971
Method:                 Least Squares   F-statistic:                     8324.
Date:                Wed, 20 Sep 2023   Prob (F-statistic):               0.00
Time:                        15:15:14   Log-Likelihood:                -39.602
No. Observations:                1007   AIC:                             89.20
Df Residuals:                    1002   BIC:                             113.8
Df Model:                           4
Covariance Type:            nonrobust
==============================================================================
                 coef    std err          t      P>|t|      [0.025      0.975]
------------------------------------------------------------------------------
const          0.0135      0.008      1.699      0.090      -0.002       0.029
Rm-rf          0.9692      0.006    169.635      0.000       0.958       0.980
SMB            0.4001      0.020     19.743      0.000       0.360       0.440
HML            0.2910      0.009     33.820      0.000       0.274       0.308
ESG            0.2872      0.026     10.920      0.000       0.236       0.339
==============================================================================
Omnibus:                       66.865   Durbin-Watson:                   1.977
Prob(Omnibus):                  0.000   Jarque-Bera (JB):              195.844
Skew:                           0.300   Prob(JB):                     2.97e-43
Kurtosis:                       5.075   Cond. No.                         4.91
==============================================================================

Notes:
[1] Standard Errors assume that the covariance matrix of the errors is correctly specified.
```

Figure 48 – Regression PTF TOP 10% with ESG Factor.

Source: Personal elaboration on Python

Regression PTF BOTTOM 10% with ESG Factor:

OLS Regression Results

Dep. Variable:	PTF BOTTOM 10%	R-squared:	0.702
Model:	OLS	Adj. R-squared:	0.701
Method:	Least Squares	F-statistic:	590.8
Date:	Wed, 20 Sep 2023	Prob (F-statistic):	8.70e-262
Time:	15:15:14	Log-Likelihood:	-1239.4
No. Observations:	1007	AIC:	2489.
Df Residuals:	1002	BIC:	2513.
Df Model:	4		
Covariance Type:	nonrobust		

	coef	std err	t	P>|t|	[0.025	0.975]
const	0.0761	0.026	2.903	0.004	0.025	0.128
Rm-rf	0.8432	0.019	44.831	0.000	0.806	0.880
SMB	0.4922	0.067	7.378	0.000	0.361	0.623
HML	0.1526	0.028	5.386	0.000	0.097	0.208
ESG	-0.4956	0.087	-5.724	0.000	-0.665	-0.326

Omnibus:	142.452	Durbin-Watson:	2.047
Prob(Omnibus):	0.000	Jarque-Bera (JB):	1327.632
Skew:	-0.290	Prob(JB):	5.11e-289
Kurtosis:	8.595	Cond. No.	4.91

Notes:

[1] Standard Errors assume that the covariance matrix of the errors is correctly specified.

Figure 49 – Regression PTF BOTTOM 10% with ESG Factor.

Source: Personal elaboration on Python

The regressions carried out with and without the ESG factor return very similar results to those observed for the regressions carried out on the 25% TOP/BOTTOM ESG PTFs. Specifically, in the first regression for the PTF 10% TOP without the ESG factor, the r^2 is 0.967, indicating that the model explains 96.7% of the variation in returns of the "PTF TOP 10%" portfolio. In the second ESG regression, the r^2 is slightly higher at 0.971, suggesting that the model explains 97.1% of the variation in returns. So as before, adding the ESG factor slightly improves the explanatory power of the model.

The addition of the ESG risk factor in the second regression of the PTF 10% TOP ESG results in a coefficient with a value equal to 0.2872 and its positive value suggests, as in the previously analyzed case, that higher ESG scores are associated with higher returns for the "PTF TOP 10%" portfolio. This implies that companies with higher ESG scores in this portfolio tend to perform better.

Even for the regressions carried out on the PTF 10% BOTTOM ESG, without the implementation of the ESG risk factor and then subsequently with its addition; the results are in line with those obtained for the PTF 25% BOTTOM ESG. In fact, going into detail in the first regression without the ESG risk factor, the r^2 is 0.693, which means that the model explains 69.3% of the variation in returns of the "PTF BOTTOM 10%" portfolio. At the same time, in the second regression with the ESG risk factor, the r^2 is slightly higher, equal to 0.702. in this regard, it is possible to reach the same conclusions, i.e. that the addition of the ESG factor slightly improves the explanatory power of the model for this portfolio too.

Once more, it's notable that the supplementary coefficient for the ESG risk factor exhibits a value of -0.4956, and its negative sign signifies that higher ESG scores are linked to diminished returns within the "PTF BOTTOM 10%" portfolio.
This outcome aligns with the anticipated behavior of companies with the lowest ESG scores, often regarded as having a higher degree of environmental, social, and governance risk. Investors may perceive these companies as less sustainable and more susceptible to various risks, potentially demanding a higher return for holding such investments. Consequently, the negative coefficient underscores the impact of ESG factors on the returns of this portfolio, reinforcing the idea that lower ESG scores correspond to decreased financial performance.

3.4.3 Regression analysis on individual assets within the top 10% ESG and bottom 10% ESG portfolios

Following the regression analyses conducted on portfolios categorized into the top 25% and bottom 25% based on ESG scores, as well as the top 10% and bottom 10% ESG portfolios, a more detailed examination was pursued by applying regression analyses to individual assets within the 10% top and bottom ESG portfolios. This analytical approach aimed to facilitate a nuanced exploration of the outcomes derived from portfolio assessments, allowing for an in-depth investigation into the specific attributes and behaviors of individual assets.

The regression analyses of individual assets were executed in two distinct phases. Initially, regressions were carried out without the inclusion of the ESG factor, with a primary focus on market, size, and value factors. This initial step facilitated an assessment of the extent to which these three factors contributed to the performance outcomes of individual assets.

Subsequently, the regression analyses were repeated, this time incorporating the ESG factor as an independent variable. This strategic decision was necessary in scrutinizing the unique influence of ESG on asset performance, in addition to the other factors that were considered. The overarching objective was to identify any significant alterations in the relationships between ESG and asset performance when the ESG factor was incorporated into the analytical framework.

It is noteworthy that given the substantial volume of assets involved (comprising 47 assets for both the top 10% and bottom 10% portfolios), the computational aspects of the regressions were efficiently managed through the utilization of the Python programming language. Python's robust capabilities in handling sizable datasets and intricate statistical computations proved instrumental during this phase of the research endeavor.

To conduct regressions simultaneously for all 47 assets within the two distinct 10% TOP/BOTTOM ESG portfolios, the "for" loop proves instrumental. This control structure serves the purpose of iterating through sequences of elements, encompassing lists, tuples, strings, dictionaries, and various other iterable objects. It systematically executes a designated code block a predetermined number of times, each iteration corresponding to an element within the given sequence.

The provided code is an example of how to perform multiple regression analysis on financial data using Python, specifically using the Pandas and Statsmodels libraries.

Here is a detailed explanation of the code:

1. Importing the libraries:

```
import pandas as pd
import statsmodels.api as sm
```

   This part of the code imports the necessary libraries, Pandas for data handling and Statsmodels for conducting regression analysis.

2. Loading the data:

```
data = pd.read_excel("/Users/michelascuccimarra/Desktop/dati
regressione top.xlsx")
```

Here, the code loads an Excel file containing financial data into a Pandas DataFrame.

3. Defining the independent variables (X):

```
X = data[['Rm-rf', 'SMB', 'HML']]
```

This step defines the independent variables (factors) used for regression analysis.

4. Identifying the dependent variables (Y):

```
company_columns = [col for col in data.columns if col.endswith("_")]
```

The code automatically searches for data columns representing dependent variables for each company. It assumes that these columns have names ending with "_"

5. Running the regressions:

```
for company_column in company_columns:
    Y = data[company_column]
    X = sm.add_constant(X)
    model = sm.OLS(Y, X).fit()
    print(f"Company: {company_column}")
    print(model.summary())
```

This for loop performs multiple regressions iteratively for each dependent variable (Y). For each company represented by the "_" columns, the code calculates a multiple regression using the factors defined in X. Subsequently, it prints a summary of the regression results for each company.

After completing the regression analyses for the 94 assets, which are divided into 47 assets within the PTF TOP 10% ESG and 47 assets within the PTF BOTTOM 10% ESG portfolios, the analysis proceeds to assess the impact of introducing the ESG risk factor on the models' explanatory power. This assessment is facilitated by the code snippet provided in Figure 50.

```python
import pandas as pd
import statsmodels.api as sm

data = pd.read_excel("/Users/michelascuccimarra/Desktop/dati regressione top.xlsx")

X_without_ESG = data[['SMB', 'HML', 'Rm-rf']]  #Exclude ESG from the X variable

#Get a list of all Y variable columns (assuming they all end with "_")
company_columns = [col for col in data.columns if col.endswith("_")]

results = {}

#Iterate through each company's Y variable
for company_column in company_columns:
    Y = data[company_column]

    #Perform regression without ESG
    X_without_ESG = sm.add_constant(X_without_ESG)
    model_without_ESG = sm.OLS(Y, X_without_ESG).fit()
    #Perform regression with ESG
    X_with_ESG = data[['SMB', 'HML', 'Rm-rf', 'ESG']]
    X_with_ESG = sm.add_constant(X_with_ESG)
    model_with_ESG = sm.OLS(Y, X_with_ESG).fit()
    #Store the R-squared values for both regressions
    r_squared_without_ESG = model_without_ESG.rsquared
    r_squared_with_ESG = model_with_ESG.rsquared
    # Compare R-squared values and store the result in the dictionary
    if r_squared_with_ESG > r_squared_without_ESG:
        results[company_column] = "R-squared increased with ESG"
    else:
        results[company_column] = "R-squared did not increase with ESG"

for company, result in results.items():
    print(f"Company: {company}, Result: {result}")
```

Figure 50 –. Compare R-squared values of all assets in PTF 10% TOP ESG.

Source: Personal elaboration on Python

```
Company: Microsoft Corp_, Result: R-squared increased with ESG
Company: 3M Co_, Result: R-squared increased with ESG
Company: PepsiCo Inc_, Result: R-squared increased with ESG
Company: Walgreens Boots Alliance Inc_, Result: R-squared increased with ESG
Company: Colgate-Palmolive Co_, Result: R-squared increased with ESG
Company: Healthpeak Properties Inc_, Result: R-squared increased with ESG
Company: Elevance Health Inc_, Result: R-squared increased with ESG
Company: Baker Hughes Co_, Result: R-squared increased with ESG
Company: Philip Morris International Inc_, Result: R-squared increased with E
SG
Company: Intel Corp_, Result: R-squared increased with ESG
Company: Waste Management Inc_, Result: R-squared increased with ESG
Company: Johnson & Johnson_, Result: R-squared increased with ESG
Company: Target Corp_, Result: R-squared increased with ESG
Company: Kinder Morgan Inc_, Result: R-squared increased with ESG
Company: Schlumberger NV_, Result: R-squared increased with ESG
Company: Cisco Systems Inc_, Result: R-squared increased with ESG
Company: Agilent Technologies Inc_, Result: R-squared increased with ESG
Company: Citigroup Inc_, Result: R-squared increased with ESG
Company: Humana Inc_, Result: R-squared increased with ESG
Company: Linde PLC_, Result: R-squared increased with ESG
Company: Amazon.com Inc_, Result: R-squared increased with ESG
```

```
Company: Newmont Corporation_, Result: R-squared increased with ESG
Company: CBRE Group Inc_, Result: R-squared increased with ESG
Company: Halliburton Co_, Result: R-squared increased with ESG
Company: Edison International_, Result: R-squared increased with ESG
Company: Texas Instruments Inc_, Result: R-squared increased with ESG
Company: Cadence Design Systems Inc_, Result: R-squared increased with ESG
Company: International Flavors & Fragrances Inc_, Result: R-squared increase
d with ESG
Company: Marriott International Inc_, Result: R-squared increased with ESG
Company: Realty Income Corp_, Result: R-squared increased with ESG
Company: JPMorgan Chase & Co_, Result: R-squared increased with ESG
Company: Jacobs Solutions Inc_, Result: R-squared increased with ESG
Company: Royal Caribbean Cruises Ltd_, Result: R-squared increased with ESG
Company: Archer-Daniels-Midland Co_, Result: R-squared increased with ESG
Company: Goldman Sachs Group Inc_, Result: R-squared increased with ESG
Company: Walmart Inc_, Result: R-squared increased with ESG
Company: Xcel Energy Inc_, Result: R-squared increased with ESG
Company: Accenture PLC_, Result: R-squared increased with ESG
Company: Host Hotels & Resorts Inc_, Result: R-squared increased with ESG
Company: Juniper Networks Inc_, Result: R-squared increased with ESG
Company: S&P Global Inc_, Result: R-squared increased with ESG
Company: Caterpillar Inc_, Result: R-squared increased with ESG
Company: Regency Centers Corp_, Result: R-squared increased with ESG
Company: Chevron Corp_, Result: R-squared increased with ESG
Company: Ventas Inc_, Result: R-squared increased with ESG
Company: Kellogg Co_, Result: R-squared increased with ESG
Company: Motorola Solutions Inc_, Result: R-squared increased with ESG
```

The same code used is also applied to the assets within the “PTF 10% BOTTOM ESG” (Figure 51).

```python
import pandas as pd
import statsmodels.api as sm

data = pd.read_excel("/Users/michelascuccimarra/Desktop/dati per regressione bottom.xlsx")

X_without_ESG = data[['SMB', 'HML', 'Rm-rf']]

company_columns = [col for col in data.columns if col.endswith("_")]

results = {}

for company_column in company_columns:
    Y = data[company_column]

    # Perform regression without ESG
    X_without_ESG = sm.add_constant(X_without_ESG)
    model_without_ESG = sm.OLS(Y, X_without_ESG).fit()
    # Perform regression with ESG
    X_with_ESG = data[['SMB', 'HML', 'Rm-rf', 'ESG']]
    X_with_ESG = sm.add_constant(X_with_ESG)
    model_with_ESG = sm.OLS(Y, X_with_ESG).fit()
    # Store the R-squared values for both regressions
    r_squared_without_ESG = model_without_ESG.rsquared
    r_squared_with_ESG = model_with_ESG.rsquared
    # Compare R-squared values and store the result in the dictionary
    if r_squared_with_ESG > r_squared_without_ESG:
        results[company_column] = "R-squared increased with ESG"
    else:
        results[company_column] = "R-squared did not increase with ESG"

for company, result in results.items():
    print(f"Company: {company}, Result: {result}")
```

Figure 51 – Compare R-squared values of all assets in PTF 10% BOTTOM ESG.

Source: Personal elaboration on Python

```
Company: EQT Corp_, Result: R-squared increased with ESG
Company: AMETEK_, Result: R-squared increased with ESG
Company: Snap-On_, Result: R-squared increased with ESG
Company: Martin Marietta Materials_, Result: R-squared increased with ESG
Company: Copart_, Result: R-squared increased with ESG
Company: Domino's Pizza_, Result: R-squared increased with ESG
Company: Paycom Software_, Result: R-squared increased with ESG
Company: Teradyne_, Result: R-squared increased with ESG
Company: Quanta Services_, Result: R-squared increased with ESG
Company: Invitation Homes_, Result: R-squared increased with ESG
Company: Constellation Brands_, Result: R-squared increased with ESG
Company: Vulcan Materials_, Result: R-squared increased with ESG
Company: Universal Health Services_, Result: R-squared increased with ESG
Company: Zebra Technologies_, Result: R-squared increased with ESG
Company: Ingersoll Rand_, Result: R-squared increased with ESG
Company: Dollar General_, Result: R-squared increased with ESG
Company: CH Robinson Worldwide_, Result: R-squared increased with ESG
Company: TransDigm Group_, Result: R-squared increased with ESG
Company: Monster Beverage_, Result: R-squared increased with ESG
Company: Take-Two Interactive Software_, Result: R-squared increased with ES
G
Company: PTC_, Result: R-squared increased with ESG
Company: Palo Alto Networks_, Result: R-squared increased with ESG
Company: Genuine Parts_, Result: R-squared increased with ESG
Company: Global Payments_, Result: R-squared increased with ESG
Company: Huntington Ingalls Industries_, Result: R-squared increased with ES
G
Company: Fleetcor Technologies_, Result: R-squared increased with ESG
Company: Charter Communications_, Result: R-squared increased with ESG
Company: Fastenal_, Result: R-squared increased with ESG
Company: Ameren_, Result: R-squared increased with ESG
Company: O'Reilly Automotive_, Result: R-squared increased with ESG
Company: Atmos Energy_, Result: R-squared increased with ESG
Company: Teledyne Technologies_, Result: R-squared increased with ESG
Company: Old Dominion Freight Line_, Result: R-squared increased with ESG
Company: Fiserv_, Result: R-squared increased with ESG
Company: Extra Space Storage_, Result: R-squared increased with ESG
Company: CenterPoint Energy_, Result: R-squared increased with ESG
Company: NVR_, Result: R-squared increased with ESG
Company: Monolithic Power Systems_, Result: R-squared increased with ESG
Company: Generac Holdings_, Result: R-squared increased with ESG
Company: Coterra Energy_, Result: R-squared increased with ESG
Company: Berkshire Hathaway_, Result: R-squared increased with ESG
Company: LKQ_, Result: R-squared increased with ESG
Company: Netflix_, Result: R-squared increased with ESG
Company: Rollins_, Result: R-squared increased with ESG
Company: Axon Enterprise_, Result: R-squared increased with ESG
Company: Lennar_, Result: R-squared increased with ESG
Company: Expedia Group_, Result: R-squared increased with ESG
```

As observed, the R-squared value increases, albeit slightly, with the inclusion of the ESG factor for all assets in both the top 10% ESG portfolio and the bottom 10% ESG portfolio. This phenomenon may suggest that the ESG factor is making a positive contribution to explaining variations in asset returns within both portfolios.

3.4.4 Regression analysis on individual assets within the S&P500 index

Following the construction of the ESG risk factor, based on construction of the HML (High Minus Low) factor, and considering the sample of companies, regression analysis will be conducted on all assets contained within the S&P 500 index.
Conducting regression analysis on each asset in the S&P 500 index with respect to the variables Mkt-RF, SMB, HML, and ESG makes sense because it considers the specific characteristics of companies and the market, size, value, and ESG risks that can influence their financial performance. This analysis can provide valuable insights to investors interested in gaining a better understanding of how these factors impact companies within the stock market.

The regression analyses on individual assets represent an advanced stage of the comprehensive examination into the ramifications of ESG on investment performance. This approach serves to provide a rigorous evaluation of the correlations and specific dynamics inherent to individual assets. Consequently, it yields enhanced insights into the implications of ESG on asset performance within financial markets.

Since we are tasked with conducting nearly 500 regressions, we leverage Python code to streamline this process. This approach proves invaluable in handling the sheer volume of analyses required to comprehensively examine individual assets within the S&P 500 index against a backdrop of various risk factors. Leveraging Python's libraries, such as Pandas for data manipulation and Statsmodels for regression analysis, we automate the otherwise labor-intensive process of running each regression individually. This not only expedites the analysis but also minimizes the likelihood of errors associated with manual execution.
Python's flexibility permits us to seamlessly integrate the ESG risk factor into the regression framework alongside established factors like Mkt-RF, SMB, and HML. This facilitates a holistic evaluation of each asset's response to an evolving landscape of risk factors, including those associated with environmental, social, and governance considerations.

The use of Python in this extensive regression analysis significantly enhances efficiency, accuracy, and consistency, enabling us to gain deeper insights into the dynamics of the S&P 500 index constituents. Through automation, we can efficiently navigate the complex terrain of nearly 500 regressions, ultimately contributing to a more robust understanding of how these assets respond to market, size, value, and ESG-related factors.

The code used is the following:

```
data =
pd.read_excel('/Users/michelascuccimarra/Desktop/Assets.xlsx')

companies = ['Aflac Inc', 'AES Corp', 'Abbott Laboratories',
'Activision Blizzard Inc','Adobe Inc', 'Advanced Micro Devices
Inc', 'Air Products and Chemicals Inc','Alaska Air Group Inc',
'Albemarle Corp', […] 'Wynn Resorts Ltd', 'Comcast Corp', 'CME
Group Inc','Seagate Technology Holdings PLC', 'Molina Healthcare
Inc', 'LKQ Corp', 'NRG Energy Inc', 'Assurant Inc', 'CBRE Group
Inc', 'Salesforce Inc', 'Regions Financial Corp']

regression_results = []

X_without_ESG = data[['Mkt-RF', 'SMB', 'HML']]
X_without_ESG = sm.add_constant(X_without_ESG)

for company in companies:
    Y = data[company]

    model_without_ESG = sm.OLS(Y, X_without_ESG).fit()

    X_with_ESG = data[['Mkt-RF', 'SMB', 'HML', 'ESG']]
    X_with_ESG = sm.add_constant(X_with_ESG)

    model_with_ESG = sm.OLS(Y, X_with_ESG).fit()
```

```
    regression_results.append((company, model_without_ESG,
model_with_ESG))

for company, model_without_ESG, model_with_ESG in
regression_results:
    print(f"Company: {company}")
    print("Regression without ESG:")
    print(model_without_ESG.summary())
    print("\nRegression with ESG:")
    print(model_with_ESG.summary())
    print("\n")
```

Given the extensive nature of this analysis, involving almost 500 individual regression models, we will focus on examining a select subset of these regressions to illustrate our approach and findings. The selection process for these exemplar regressions will be guided by several criteria, including the diversity of sectors represented, the statistical significance of results, and the distinct patterns observed.

The provided regression results show the analysis of the company “Campbell Soup Co” both without and with the addition of the ESG factor as an independent variable.

```
Company: Campbell Soup Co
Regression without ESG:
                            OLS Regression Results
==============================================================================
Dep. Variable:       Campbell Soup Co   R-squared:                       0.070
Model:                            OLS   Adj. R-squared:                  0.068
Method:                 Least Squares   F-statistic:                     25.32
Date:                Thu, 21 Sep 2023   Prob (F-statistic):           8.58e-16
Time:                        19:55:13   Log-Likelihood:                -1919.8
No. Observations:                1007   AIC:                             3848.
Df Residuals:                    1003   BIC:                             3867.
Df Model:                           3
Covariance Type:            nonrobust
==============================================================================
                 coef    std err          t      P>|t|      [0.025      0.975]
------------------------------------------------------------------------------
const          0.0199      0.052      0.386      0.699      -0.081       0.121
Mkt-RF         0.3171      0.037      8.636      0.000       0.245       0.389
SMB           -0.1905      0.126     -1.508      0.132      -0.438       0.057
HML           -0.0034      0.051     -0.066      0.948      -0.104       0.097
==============================================================================
Omnibus:                      139.463   Durbin-Watson:                   1.926
Prob(Omnibus):                  0.000   Jarque-Bera (JB):             1636.597
Skew:                           0.035   Prob(JB):                         0.00
Kurtosis:                       9.245   Cond. No.                         3.52
==============================================================================

Notes:
[1] Standard Errors assume that the covariance matrix of the errors is correctly specified.
```

Figure 52 – Campbell Soup Co regression without ESG.

Source: Personal elaboration on Python

In this regression, without ESG risk factor, Mkt-RF (Market Risk Premium) has a positive and statistically significant impact on Campbell Soup Co's returns, while SMB (Size Factor) and HML (Value Factor) do not appear to have a significant impact.

Regression with ESG:

OLS Regression Results

Dep. Variable:	Campbell Soup Co	R-squared:	0.114
Model:	OLS	Adj. R-squared:	0.111
Method:	Least Squares	F-statistic:	32.25
Date:	Thu, 21 Sep 2023	Prob (F-statistic):	2.58e-25
Time:	19:55:13	Log-Likelihood:	-1895.6
No. Observations:	1007	AIC:	3801.
Df Residuals:	1002	BIC:	3826.
Df Model:	4		
Covariance Type:	nonrobust		

	coef	std err	t	P>|t|	[0.025	0.975]
const	0.0179	0.050	0.355	0.723	-0.081	0.117
Mkt-RF	0.3451	0.036	9.564	0.000	0.274	0.416
SMB	0.0490	0.128	0.383	0.702	-0.202	0.300
HML	-0.1530	0.054	-2.815	0.005	-0.260	-0.046
ESG	1.1674	0.166	7.028	0.000	0.841	1.493

Omnibus:	136.814	Durbin-Watson:	1.976
Prob(Omnibus):	0.000	Jarque-Bera (JB):	1496.031
Skew:	-0.108	Prob(JB):	0.00
Kurtosis:	8.967	Cond. No.	4.91

Notes:
[1] Standard Errors assume that the covariance matrix of the errors is correctly specified.

Figure 53 – Campbell Soup Co regression with ESG.

Source: Personal elaboration on Python

While in the regression with ESG risk factor, Mkt-RF, HML, and ESG all have statistically significant impacts on Campbell Soup Co's returns. Mkt-RF and HML have positive and negative effects, respectively. Notably, the addition of the ESG factor has a positive and statistically significant impact on returns.

The r^2 value in the model with ESG (0.114) is higher than the model without ESG (0.070). A percentage change in R-squared of 62.85% when comparing the model with ESG factor to the model without ESG factor. This indicates that the inclusion of ESG factors in the model has led to a substantial improvement in explaining the variability in the dependent variable (Y) compared to the model without ESG factors. This suggests that the model with ESG explains a larger portion of the variability in Campbell Soup Co's returns.

The p-value for the ESG coefficient in the model with ESG is very low (close to zero), indicating strong statistical significance. This implies that the ESG factor is an important predictor in explaining returns for Campbell Soup Co.

The next regression results show the analysis of the company "General Mills Inc" both without and with the addition of the ESG factor as an independent variable.

```
Company: General Mills Inc
Regression without ESG:
                            OLS Regression Results
==============================================================================
Dep. Variable:      General Mills Inc   R-squared:                       0.120
Model:                            OLS   Adj. R-squared:                  0.117
Method:                 Least Squares   F-statistic:                     45.42
Date:                Fri, 22 Sep 2023   Prob (F-statistic):           1.58e-27
Time:                        09:23:35   Log-Likelihood:                -1790.6
No. Observations:                1007   AIC:                             3589.
Df Residuals:                    1003   BIC:                             3609.
Df Model:                           3
Covariance Type:            nonrobust
==============================================================================
                 coef    std err          t      P>|t|      [0.025      0.975]
------------------------------------------------------------------------------
const          0.0563      0.045      1.243      0.214      -0.033       0.145
Mkt-RF         0.3663      0.032     11.343      0.000       0.303       0.430
SMB           -0.3680      0.111     -3.313      0.001      -0.586      -0.150
HML            0.0673      0.045      1.495      0.135      -0.021       0.156
==============================================================================
Omnibus:                      174.248   Durbin-Watson:                   1.957
Prob(Omnibus):                  0.000   Jarque-Bera (JB):             1809.788
Skew:                          -0.446   Prob(JB):                         0.00
Kurtosis:                       9.507   Cond. No.                         3.52
==============================================================================

Notes:
[1] Standard Errors assume that the covariance matrix of the errors is correctly specified.
```

Figure 54 – General Mills Inc regression without ESG.

Source: Personal elaboration on Python

The model without ESG factors has an R-squared value of 0.120, indicating that it explains 12.0% of the variability in the returns of General Mills Inc. The HML factor measures the performance difference between high book-to-market (value) stocks and low book-to-market (growth) stocks. In the model without ESG, the positive coefficient (0.0673) suggests that when value stocks outperform growth stocks (as indicated by a positive HML factor), General Mills Inc. tends to have a higher return.

Regression with ESG:

OLS Regression Results

Dep. Variable:	General Mills Inc	R-squared:	0.156
Model:	OLS	Adj. R-squared:	0.153
Method:	Least Squares	F-statistic:	46.46
Date:	Fri, 22 Sep 2023	Prob (F-statistic):	7.63e-36
Time:	09:23:35	Log-Likelihood:	-1769.1
No. Observations:	1007	AIC:	3548.
Df Residuals:	1002	BIC:	3573.
Df Model:	4		
Covariance Type:	nonrobust		

	coef	std err	t	P>|t|	[0.025	0.975]
const	0.0546	0.044	1.231	0.219	-0.032	0.142
Mkt-RF	0.3896	0.032	12.241	0.000	0.327	0.452
SMB	-0.1693	0.113	-1.500	0.134	-0.391	0.052
HML	-0.0569	0.048	-1.187	0.235	-0.151	0.037
ESG	0.9689	0.146	6.614	0.000	0.681	1.256

Omnibus:	174.755	Durbin-Watson:	2.000
Prob(Omnibus):	0.000	Jarque-Bera (JB):	1571.255
Skew:	-0.504	Prob(JB):	0.00
Kurtosis:	9.036	Cond. No.	4.91

Notes:
[1] Standard Errors assume that the covariance matrix of the errors is correctly specified.

Figure 55 – General Mills Inc regression with ESG.

Source: Personal elaboration on Python

In the model that includes ESG factors, the R-squared value is 0.156, meaning that approximately 15.6% of the variation in General Mills Inc's returns can be explained by the model's independent variables, including ESG. A positive Mkt-RF coefficient (0.3663 in the model without ESG and 0.3896 in the model with ESG) suggests that, on average, an increase in the market risk factor is associated with an increase in General Mills Inc's stock return. SMB coefficient represents the relationship between General Mills Inc's return and the SMB risk factor (which measures the difference between small-cap and large-cap stock returns). A negative coefficient (-0.3680 in the model without ESG and -0.1693 in the model with ESG) indicates that, on average, an increase in the SMB risk factor is associated with a decrease in General Mills Inc's stock return. This suggests that General Mills Inc has a larger market capitalization.

In the model with ESG, the ESG coefficient (0.9689) represents the relationship between General Mills Inc's return and the ESG factor. A positive coefficient indicates that an increase in ESG scores is associated with an increase in General Mills Inc's stock return.

The next regression results show the analysis of the company “Kellogg Co” both without and with the addition of the ESG factor as an independent variable.

Company: Kellogg Co
Regression without ESG:

OLS Regression Results

Dep. Variable:	Kellogg Co	R-squared:	0.115
Model:	OLS	Adj. R-squared:	0.113
Method:	Least Squares	F-statistic:	43.54
Date:	Thu, 21 Sep 2023	Prob (F-statistic):	1.89e-26
Time:	19:55:13	Log-Likelihood:	-1793.5
No. Observations:	1007	AIC:	3595.
Df Residuals:	1003	BIC:	3615.
Df Model:	3		
Covariance Type:	nonrobust		

	coef	std err	t	P>|t|	[0.025	0.975]
const	0.0100	0.045	0.220	0.826	-0.079	0.099
Mkt-RF	0.3512	0.032	10.844	0.000	0.288	0.415
SMB	-0.3310	0.111	-2.971	0.003	-0.550	-0.112
HML	0.1518	0.045	3.362	0.001	0.063	0.240

Omnibus:	233.485	Durbin-Watson:	1.905
Prob(Omnibus):	0.000	Jarque-Bera (JB):	5027.178
Skew:	-0.490	Prob(JB):	0.00
Kurtosis:	13.902	Cond. No.	3.52

Notes:
[1] Standard Errors assume that the covariance matrix of the errors is correctly specified.

Figure 56 – Kellogg Co regression without ESG.
Source: Personal elaboration on Python

For Kellogg Co without ESG, r^2 is 0.115, indicating that about 11.5% of the variation in the dependent variable (Kellogg Co’s returns) can be explained by the independent variables (Mkt-RF, SMB, and HML).

The p-values associated with each coefficient indicate the statistical significance of these variables. In this case, “Mkt-RF” is highly statistically significant, suggesting that market risk premium plays a crucial role in explaining Kellogg Co’s performance. On the other hand, “SMB” is also statistically significant but has a negative coefficient, implying that the size factor (small minus big) has a negative impact on Kellogg Co’s performance. “HML” is statistically significant with a positive coefficient, indicating that the high-minus-low factor positively influences Kellogg Co.

Regression with ESG:

OLS Regression Results

Dep. Variable:	Kellogg Co	R-squared:	0.175
Model:	OLS	Adj. R-squared:	0.172
Method:	Least Squares	F-statistic:	53.11
Date:	Thu, 21 Sep 2023	Prob (F-statistic):	1.28e-40
Time:	19:55:13	Log-Likelihood:	-1758.3
No. Observations:	1007	AIC:	3527.
Df Residuals:	1002	BIC:	3551.
Df Model:	4		
Covariance Type:	nonrobust		

	coef	std err	t	P>|t|	[0.025	0.975]
const	0.0078	0.044	0.178	0.859	-0.078	0.094
Mkt-RF	0.3808	0.031	12.096	0.000	0.319	0.443
SMB	-0.0779	0.112	-0.697	0.486	-0.297	0.141
HML	-0.0064	0.047	-0.135	0.893	-0.099	0.087
ESG	1.2343	0.145	8.517	0.000	0.950	1.519

Omnibus:	191.709	Durbin-Watson:	1.947
Prob(Omnibus):	0.000	Jarque-Bera (JB):	2847.845
Skew:	-0.397	Prob(JB):	0.00
Kurtosis:	11.200	Cond. No.	4.91

Notes:
[1] Standard Errors assume that the covariance matrix of the errors is correctly specified.

Figure 57 – Kellogg Co regression with ESG.

Source: Personal elaboration on Python

In the second regression analysis, the ESG factor is introduce as an additional independent variable. The r^2 value increases to 0.175 with the inclusion of the ESG factor. This indicates that the model now explains approximately 17.5% of Kellogg Co's performance, which is an improvement compared to the previous model. The percentage change in R-squared with ESG is approximately 52.17%.

In this regression, the "ESG" coefficient has a low p-value, emphasizing its significance in the model. This suggests that the ESG factor has a statistically significant and positive impact on Kellogg Co's performance. The ESG coefficient is not only statistically significant but also positive, implying that higher ESG scores are associated with better performance for Kellogg Co.

The next regression results show the analysis of the company "Kroger Co" both without and with the addition of the ESG factor as an independent variable.

```
Company: Kroger Co
Regression without ESG:
                            OLS Regression Results
==============================================================================
Dep. Variable:              Kroger Co   R-squared:                       0.042
Model:                            OLS   Adj. R-squared:                  0.039
Method:                 Least Squares   F-statistic:                     14.64
Date:                Thu, 21 Sep 2023   Prob (F-statistic):           2.46e-09
Time:                        19:55:13   Log-Likelihood:                -2107.0
No. Observations:                1007   AIC:                             4222.
Df Residuals:                    1003   BIC:                             4242.
Df Model:                           3
Covariance Type:            nonrobust
==============================================================================
                 coef    std err          t      P>|t|      [0.025      0.975]
------------------------------------------------------------------------------
const          0.0638      0.062      1.028      0.304      -0.058       0.186
Mkt-RF         0.2867      0.044      6.484      0.000       0.200       0.374
SMB           -0.2509      0.152     -1.649      0.099      -0.549       0.048
HML            0.0527      0.062      0.855      0.393      -0.068       0.174
==============================================================================
Omnibus:                      141.455   Durbin-Watson:                   1.989
Prob(Omnibus):                  0.000   Jarque-Bera (JB):             1492.286
Skew:                           0.203   Prob(JB):                         0.00
Kurtosis:                       8.950   Cond. No.                         3.52
==============================================================================

Notes:
[1] Standard Errors assume that the covariance matrix of the errors is correctly specified.
```

Figure 58 – Kroger Co regression without ESG.

Source: Personal elaboration on Python

In the initial regression analysis without the consideration of ESG factors, we examine Kroger Co's performance based on three independent variables: Mkt-RF, SMB, and HML.

Without ESG, the r^2 is 4.2%, indicating that the selected factors have limited explanatory power in elucidating Kroger Co's performance. This suggests that a substantial portion of the company's performance remains unaccounted for.

The p-values associated with each coefficient assess the statistical significance of the respective variables. In this context, Mkt-RF is statistically significant with a p-value of < 0.001, implying that it plays a significant role in explaining Kroger Co's performance. On the other hand, both "SMB" and "HML" exhibit p-values greater than 0.05, indicating a lack of statistical significance.

Regression with ESG:

OLS Regression Results

Dep. Variable:	Kroger Co	R-squared:	0.072
Model:	OLS	Adj. R-squared:	0.068
Method:	Least Squares	F-statistic:	19.39
Date:	Thu, 21 Sep 2023	Prob (F-statistic):	2.22e-15
Time:	19:55:13	Log-Likelihood:	-2091.0
No. Observations:	1007	AIC:	4192.
Df Residuals:	1002	BIC:	4217.
Df Model:	4		
Covariance Type:	nonrobust		

	coef	std err	t	P>|t|	[0.025	0.975]
const	0.0618	0.061	1.011	0.312	-0.058	0.182
Mkt-RF	0.3142	0.044	7.171	0.000	0.228	0.400
SMB	-0.0159	0.155	-0.102	0.919	-0.321	0.289
HML	-0.0942	0.066	-1.428	0.154	-0.224	0.035
ESG	1.1459	0.202	5.682	0.000	0.750	1.542

Omnibus:	134.381	Durbin-Watson:	2.009
Prob(Omnibus):	0.000	Jarque-Bera (JB):	1362.906
Skew:	0.156	Prob(JB):	1.12e-296
Kurtosis:	8.691	Cond. No.	4.91

Notes:
[1] Standard Errors assume that the covariance matrix of the errors is correctly specified.

Figure 59 – Kroger Co regression without ESG.

Source: Personal elaboration on Python

In the subsequent regression analysis, we introduce the ESG factor alongside the previously mentioned variables to assess its impact on Kroger Co's performance. Here are the key findings:

With the inclusion of the ESG factor, the r^2 increases to 7.2%. This indicates an improvement in the model's ability to explain Kroger Co's performance when ESG is considered.

"Mkt-RF" remains statistically significant ($p < 0.001$), indicating its continued importance in explaining Kroger Co's performance. Importantly, the ESG factor demonstrates statistical significance with a p-value of < 0.001, signifying its substantial role in the model. Conversely, "SMB" and "HML" remain statistically less significant.

The coefficient associated with the ESG factor is 1.1459, and it is statistically significant. This coefficient signifies that, for each unit increase in the ESG factor, Kroger Co's performance is estimated to improve by approximately 1.15 units. This underscores the positive relationship between ESG considerations and the company's performance.

The next regression results show the analysis of the company “Newmont Corporation” both without and with the addition of the ESG factor as an independent variable.

Company: Newmont Corporation
Regression without ESG:

OLS Regression Results

Dep. Variable:	Newmont Corporation	R-squared:	0.045
Model:	OLS	Adj. R-squared:	0.042
Method:	Least Squares	F-statistic:	15.60
Date:	Fri, 22 Sep 2023	Prob (F-statistic):	6.38e-10
Time:	09:23:35	Log-Likelihood:	-2166.0
No. Observations:	1007	AIC:	4340.
Df Residuals:	1003	BIC:	4360.
Df Model:	3		
Covariance Type:	nonrobust		

	coef	std err	t	P>|t|	[0.025	0.975]
const	0.0524	0.066	0.796	0.426	-0.077	0.181
Mkt-RF	0.2749	0.047	5.863	0.000	0.183	0.367
SMB	0.5119	0.161	3.174	0.002	0.195	0.828
HML	-0.0745	0.065	-1.140	0.254	-0.203	0.054

Omnibus:	135.466	Durbin-Watson:	1.991
Prob(Omnibus):	0.000	Jarque-Bera (JB):	1158.912
Skew:	0.284	Prob(JB):	2.22e-252
Kurtosis:	8.225	Cond. No.	3.52

Notes:
[1] Standard Errors assume that the covariance matrix of the errors is correctly specified.

Figure 60 – Newmont Corporation regression without ESG.

Source: Personal elaboration on Python

In the model without ESG, the R-squared value is 0.045, indicating that only 4.5% of the variation in the returns of Newmont Corporation can be explained by the three factors (Mkt-RF, SMB, HML) included in the model. This suggests a relatively weak relationship between these factors and Newmont Corporation’s returns.

Regression with ESG:

OLS Regression Results

Dep. Variable:	Newmont Corporation	R-squared:	0.063
Model:	OLS	Adj. R-squared:	0.060
Method:	Least Squares	F-statistic:	16.96
Date:	Fri, 22 Sep 2023	Prob (F-statistic):	1.84e-13
Time:	09:23:35	Log-Likelihood:	-2155.9
No. Observations:	1007	AIC:	4322.
Df Residuals:	1002	BIC:	4346.
Df Model:	4		
Covariance Type:	nonrobust		

	coef	std err	t	P>|t|	[0.025	0.975]
const	0.0507	0.065	0.778	0.437	-0.077	0.179
Mkt-RF	0.2980	0.047	6.378	0.000	0.206	0.390
SMB	0.7099	0.166	4.283	0.000	0.385	1.035
HML	-0.1983	0.070	-2.817	0.005	-0.336	-0.060
ESG	0.9653	0.215	4.488	0.000	0.543	1.387

Omnibus:	131.475	Durbin-Watson:	2.010
Prob(Omnibus):	0.000	Jarque-Bera (JB):	1159.613
Skew:	0.233	Prob(JB):	1.56e-252
Kurtosis:	8.236	Cond. No.	4.91

Notes:
[1] Standard Errors assume that the covariance matrix of the errors is correctly specified.

Figure 61 – Newmont Corporation regression with ESG.

Source: Personal elaboration on Python

In the model with ESG, the R-squared value increases to 0.063. Adding the ESG factor has resulted in a 40% increase in the R-squared value, indicating that the ESG factor contributes to a better explanation of Newmont Corporation's returns compared to the model without ESG. the coefficient for SMB is 0.7099. This positive coefficient indicates that Newmont Corporation’s returns are positively influenced by the small-minus-big factor. When smaller stocks outperform larger stocks (as indicated by a positive SMB factor), Newmont Corporation’s returns tend to be higher. the coefficient for HML is -0.1983. This negative coefficient suggests that Newmont Corporation’s returns have an inverse relationship with the high-minus-low factor. When value stocks outperform growth stocks (as indicated by a positive HML factor), Newmont Corporation's returns tend to be lower.

The last regression results show the analysis of the company “J M Smucker Co” both without and with the addition of the ESG factor as an independent variable.

```
Company: J M Smucker Co
Regression without ESG:
                            OLS Regression Results
==============================================================================
Dep. Variable:          J M Smucker Co   R-squared:                       0.083
Model:                             OLS   Adj. R-squared:                  0.080
Method:                  Least Squares   F-statistic:                     30.10
Date:                 Thu, 21 Sep 2023   Prob (F-statistic):           1.23e-18
Time:                         19:55:13   Log-Likelihood:                -1890.7
No. Observations:                 1007   AIC:                             3789.
Df Residuals:                     1003   BIC:                             3809.
Df Model:                            3
Covariance Type:             nonrobust
==============================================================================
                 coef    std err          t      P>|t|      [0.025      0.975]
------------------------------------------------------------------------------
const          0.0236      0.050      0.472      0.637      -0.075       0.122
Mkt-RF         0.3307      0.036      9.270      0.000       0.261       0.401
SMB           -0.1056      0.123     -0.861      0.390      -0.346       0.135
HML            0.0949      0.050      1.909      0.057      -0.003       0.193
==============================================================================
Omnibus:                      164.820   Durbin-Watson:                   1.953
Prob(Omnibus):                  0.000   Jarque-Bera (JB):             1710.789
Skew:                          -0.390   Prob(JB):                         0.00
Kurtosis:                       9.338   Cond. No.                         3.52
==============================================================================

Notes:
[1] Standard Errors assume that the covariance matrix of the errors is correctly specified.
```

Figure 62 – J M Smucker Co regression without ESG.

Source: Personal elaboration on Python

Without ESG, the r^2 is 8.3%, suggesting that chosen factors can only account for a limited portion of the company's performance. The p-values associated with each coefficient determine the statistical significance of the respective variables. In this context, "Mkt-RF" is statistically significant ($p < 0.001$), signifying its importance in explaining J M Smucker Co's performance; conversely, "SMB" and "HML" have p-values greater than 0.05.

Regression with ESG:

OLS Regression Results

Dep. Variable:	J M Smucker Co	R-squared:	0.118
Model:	OLS	Adj. R-squared:	0.115
Method:	Least Squares	F-statistic:	33.59
Date:	Thu, 21 Sep 2023	Prob (F-statistic):	2.51e-26
Time:	19:55:13	Log-Likelihood:	-1870.8
No. Observations:	1007	AIC:	3752.
Df Residuals:	1002	BIC:	3776.
Df Model:	4		
Covariance Type:	nonrobust		

	coef	std err	t	P>|t|	[0.025	0.975]
const	0.0218	0.049	0.444	0.657	-0.075	0.118
Mkt-RF	0.3554	0.035	10.096	0.000	0.286	0.425
SMB	0.1059	0.125	0.848	0.396	-0.139	0.351
HML	-0.0373	0.053	-0.703	0.482	-0.141	0.067
ESG	1.0314	0.162	6.365	0.000	0.713	1.349

Omnibus:	150.585	Durbin-Watson:	1.975
Prob(Omnibus):	0.000	Jarque-Bera (JB):	1418.186
Skew:	-0.342	Prob(JB):	1.11e-308
Kurtosis:	8.773	Cond. No.	4.91

Notes:
[1] Standard Errors assume that the covariance matrix of the errors is correctly specified.

Figure 63 – J M Smucker Co regression with ESG.

Source: Personal elaboration on Python

With the inclusion of the ESG factor, the r^2 increases to 11.8%. This signals an enhanced ability of the model to explain J M Smucker Co's performance when ESG is considered. The percentage increase is 42.17%; this means that the model with the ESG factor is able to explain 42.2% more of the data variability compared to the model without the ESG factor. "Mkt-RF" remains statistically significant ($p < 0.001$), indicating its continued role in explaining J M Smucker Co's performance. The ESG factor exhibits statistical significance with a p-value of < 0.001, underscoring its substantial impact. "SMB" and "HML" continue to have p-values greater than 0.05, implying a lack of statistical significance.

The coefficient associated with the ESG factor is 1.0314 and is statistically significant. This coefficient suggests that, for every unit increase in the ESG factor, J M Smucker Co's performance is estimated to improve by approximately 1.03 units.

Overall, regressions with the ESG factor appear to provide a better fit for the data and suggest that the inclusion of ESG considerations may have a positive impact on returns.

In addition to examining the influence of ESG factor on the overall explanatory power of asset regression models, an analysis was conducted to assess whether the inclusion of ESG factors led to a decrease in the intercept values, specifically in absolute terms. This analysis aimed to explore the unique contribution of ESG factors in explaining the asset returns beyond the traditional market risk factors. The intercept in a regression model represents the expected value of the dependent variable when all independent variables are set to zero. In finance, the intercept is often associated with the asset's expected return when the market risk factors (e.g., Mkt-RF, SMB, HML) are zero.
For each of the selected assets, regression analyses was performed under two scenarios: one without ESG factors and one with ESG factors.

The code used is the following:

```
interest_companies = ['Campbell Soup Co','General Mills Inc',
'Kellogg Co', 'Kroger Co', 'Newmont Corporation','J M Smucker Co',]

for company in interest_companies:
    Y = data[company]

    # Model without ESG
    X_without_ESG = data[['Mkt-RF', 'SMB', 'HML']]
    X_without_ESG = sm.add_constant(X_without_ESG)
    model_without_ESG = sm.OLS(Y, X_without_ESG).fit()

    # Model with ESG
    X_with_ESG = data[['Mkt-RF', 'SMB', 'HML', 'ESG']]
    X_with_ESG = sm.add_constant(X_with_ESG)
    model_with_ESG = sm.OLS(Y, X_with_ESG).fit()

    # Check if the intercept decreases in absolute value
    coeff_const_without_ESG = model_without_ESG.params['const']
    coeff_const_with_ESG = model_with_ESG.params['const']

    if abs(coeff_const_with_ESG) < abs(coeff_const_without_ESG):
        print(f"For {company}, the intercept decreased in absolute
value with the addition of ESG.")
```

```
    else:
        print(f"For {company}, the intercept did not decrease in absolute value with the addition of ESG.")
```

These are the results:

```
For Campbell Soup Co, the intercept decreased in absolute value with the addition of ESG.
For General Mills Inc, the intercept decreased in absolute value with the addition of ESG.
For Kellogg Co, the intercept decreased in absolute value with the addition of ESG.
For Kroger Co, the intercept decreased in absolute value with the addition of ESG.
For Newmont Corporation, the intercept decreased in absolute value with the addition of ESG.
For J M Smucker Co, the intercept decreased in absolute value with the addition of ESG.
```

It appears that for all the selected companies, including Campbell Soup Co, General Mills Inc, Kellogg Co, Kroger Co, Newmont Corporation, and J M Smucker Co, the intercept values decreased in absolute terms with the addition of ESG factors to the regression models. This consistent trend suggests that ESG factors have a significant impact on the expected returns of these companies' assets

At this point, after having conducted two sets of regression analyzes for each asset present in the S&P500 index: one without the ESG factor and another with the ESG factor as an additional independent variable, the R square values of the two regression models are compared. The percentage increase in R squared when ESG was included for all assets was calculated as follows:

```
asset_columns = [
    "Aflac Inc",
    "AES Corp",
    "Abbott Laboratories",
        […]
    "STERIS plc",
    "Fortive Corp",
    "Lamb Weston Holdings Inc",
    "Invitation Homes Inc",
    "Ingersoll Rand Inc",
```

```
    "Dupont De Nemours Inc",
    "VICI Properties Inc",
    "Ceridian HCM Holding Inc",
    "Linde PLC"

percentage_r_squared_increase = []
asset_names = []

for asset in asset_columns:
    Y = data[asset]

    # Regression without ESG
    X_without_ESG = data[['Mkt-RF', 'SMB', 'HML']]
    X_without_ESG = sm.add_constant(X_without_ESG)
    model_without_ESG = sm.OLS(Y, X_without_ESG).fit()
    r_squared_without_ESG = model_without_ESG.rsquared

    # Regression with ESG
    X_with_ESG = data[['Mkt-RF', 'SMB', 'HML', 'ESG']]
    X_with_ESG = sm.add_constant(X_with_ESG)
    model_with_ESG = sm.OLS(Y, X_with_ESG).fit()
    r_squared_with_ESG = model_with_ESG.rsquared

    # Calculate the percentage increase in R-squared
    percentage_increase = ((r_squared_with_ESG -
r_squared_without_ESG) / r_squared_without_ESG) * 100

    percentage_r_squared_increase.append(percentage_increase)
    asset_names.append(asset)

# Calculate the average percentage increase in R-squared
average_percentage_increase = sum(percentage_r_squared_increase) /
len(percentage_r_squared_increase)

# Print the individual and average percentage increases
```

```
for asset, increase in zip(asset_names,
percentage_r_squared_increase):
    print(f"{asset}: {increase:.2f}%")

print(f"Average percentage increase in R-squared:
{average_percentage_increase:.2f}%")
```

After calculating the percentage increase for each asset, the average percentage increase in R-squared across all S&P 500 assets was calculated, obtaining the following result:

```
Average percentage increase in R-squared: 2.33%
```

The inclusion of the ESG factor as an independent variable in the Fama-French model led to an average percentage increase in R-squared of 2.33%. While any increase in R-squared is considered an improvement in a model's ability to explain asset returns, a 2.33% increase might be viewed as moderate in the context of financial analysis. The S&P 500 consists of a wide range of companies from various sectors, each with its own unique characteristics and market dynamics. The moderate increase suggests that the impact of ESG on asset returns is not uniform across all companies within the index. Financial markets are influenced by a multitude of factors, including economic conditions, geopolitical events, industry-specific trends, and more. The 2.33% increase may be overshadowed by other dominant drivers of asset returns. Also, the quality and availability of ESG data can vary from company to company. Inaccuracies or inconsistencies in ESG data can dampen the overall impact of the factor on asset returns. The analysis is based on a specific time frame, and the impact of ESG on asset returns may fluctuate over time. A longer observation period might yield different results.

Assumptions and limitations

This thesis used exclusively ESG ratings and economic and accounting data proposed by the data provider Refinitiv in order to present a consistent methodology for constructing sample portfolios.
The frequency with which rating agencies rate a company can have an important impact on the discrepancies between scores. The recent popularity of ESG ratings and especially the limited amount of publicly available data to measure their quantitative impact limited the study to only four years.
Incorporating the ESG factor into the Fama-French model, using data from Refinitiv or another ESG data provider, and basing portfolio construction on the S&P 500 index comes with some challenges.
Firstly, the availability and quality of ESG data can vary significantly among companies and over time. Some companies may lack ESG data, and data quality can be influenced by differences in data collection methodologies.
Secondly, ESG data is subject to changes due to corporate events, evolving information, or revisions to ESG scores. These changes can make it challenging to maintain data consistency and stability.
Selecting companies from the S&P 500 index may introduce bias toward large-cap companies, potentially not accurately representing the broader market and overlooking dynamics among small and mid-cap companies. The market-cap weighting of the S&P 500 index means that larger companies have more influence on the index. This can impact the portfolio's composition and its relative performance.
The analysis is time-bound (2018-2022), and market dynamics and ESG factors can fluctuate over time, potentially limiting the applicability of the results to different periods.
When comparing the Fama-French model with the addition of the ESG factor to the base model, it is essential to control for variables that could confound the results.
The choice of specific ESG indicators for inclusion in the model can influence the results, and the relative weighting of ESG factor may vary based on assessment choices.
Lastly, the Fama-French model itself is grounded in certain assumptions, including the efficient market hypothesis and the linearity of factors, which may not fully apply in real-world markets.
Considering these limitations, it is crucial to conduct a thorough analysis of the results and assess whether the addition of the ESG factor genuinely enhances portfolio analysis and management.

Conclusion

It can be shown that the presence of high ethical standards is a necessary condition for the sustainability of development, i.e., to ensure that the economy is able to meet the needs of present generations without jeopardizing those of future generations. In fact, sustainability of development is based on a criterion of fairness in the distribution of economic and environmental resources aimed at ensuring equal opportunities for all present and future generations and all individuals. The principles underpinning the idea-structure of sustainable development are ethical in nature and can only be ensured if the behaviour of economic and financial agents complies with appropriate ethical standards.

The transition towards an ESG model appears to be a path, certainly started and sustained, but also conditioned not only by recent abrupt changes in the global geopolitical framework, but also by the outcomes of certain challenges. First of all, it is essential that sustainability should not be an issue left to the sensitivity of individual, albeit many, stakeholders, but should become a structural approach to be applied to all spheres of the economy. The "sustainable" revolution can only be achieved through a "cultural" revolution that, by appealing to the expectations of the younger generations, leads to a general increase in environmental and social awareness and knowledge of the tools associated with it. The offer of products and services that comply with the EGS principles should certainly be encouraged by providing incentive systems that make the complex adaptation not just a burden for companies but a "golden opportunity", an opportunity for improvement from which to draw. an opportunity for improvement from which to draw advantages in terms of profit and competitiveness because "companies that do not know how to adapt products and production processes in the direction of environmental sustainability" will have "increasing difficulty in remaining on the market"[64].

For these reasons, building an ESG (Environmental, Social, and Governance) factor to integrate into an economic model, such as the renowned Fama-French model, holds significant importance for several key reasons.

[64] Visco I. (2021), *Considerazioni finali in occasione della Relazione annuale sul 2020*, Banca d'Italia.

First and foremost, the growing focus on environmental, social, and governance issues has transformed the investment landscape. Investors, increasingly aware of the impact of companies on society and the environment, demand investment strategies that align with their ethical and ESG values. Integrating an ESG factor into an economic model allows meeting this rising demand and creating investment portfolios more aligned with sustainable objectives.
Secondly, adding an ESG factor enriches the understanding of risk and return factors in financial markets. Companies distinguished by their ESG policies can offer unique opportunities and challenges to investors; indeed, integrating an ESG factor into the Fama-French model provides greater precision in assessing asset risk and return, enabling investors to make more informed decisions.
Another crucial reason is the growing empirical evidence suggesting that companies with high ESG scores tend to achieve better financial performance in the long run. Integrating an ESG factor into the Fama-French model allows investors to identify and capitalize on ESG-related investment opportunities that might otherwise go unnoticed.

Constructing an ESG factor promotes corporate responsibility. Companies, aware of the impact of their ESG practices on their market values, are compelled to enhance their ESG policies. This can contribute to promoting more sustainable and responsible corporate behavior. Creating an ESG factor integrated into a well-established economic model like the Fama-French model opens the door to greater academic research and encourages further developments in the field of sustainable finance. This is crucial for adapting traditional financial theory to the needs of the current globalized and socially responsible financial landscape. It is important because it addresses the growing demand for sustainable investments, enhances the understanding of risk and return factors, offers investment opportunities, promotes responsible corporate behavior, and stimulates academic research and innovation in the field of sustainable finance, thus helping shape the future of financial investments.

The addition of an ESG factor can bring benefits but also presents some important challenges and considerations:

Benefits of including an ESG factor:

1. broader considerations: incorporating an ESG factor allows for the assessment of not only a company’s financial performance but also its social and environmental impact. This can be

significant for investors looking to integrate ethical or sustainable considerations into their investment strategy.

2. Risk diversification: the ESG factor can help identify non-financial risks that could affect company performance. This knowledge can assist investors in diversifying risk more comprehensively.
3. Market trends: ESG considerations are becoming increasingly relevant in financial markets and among investors. The growing focus on ESG could influence stock prices and market trends.

Challenges and considerations:

1. ESG data: access to accurate and reliable ESG data is essential for analysis. The quality of ESG data can vary significantly, and its availability may be limited for some companies or sectors.
2. ESG integration methodology: it's important to determine how the ESG factor will be integrated into the Fama and French three-factor model. For example, ESG scores could be used as an additional variable in the model, or companies with strong ESG practices could be considered preferred investments.
3. Market risks: adding an ESG factor can impact the model's behavior and the expected returns of stocks. Consideration should be given to how this might affect the portfolio and its risk management.

The inclusion of an ESG factor can enhance investment decision-making by providing a more holistic view of companies' performance and risks, but careful handling of data and methodology is crucial to realizing these benefits.

The integration of an ESG factor within the Fama and French model can bring several positive aspects that enrich financial analysis and stock evaluation. One of the primary advantages of constructing and adding an ESG factor to this model is the attainment of a more comprehensive view of company performance. The inclusion of the ESG factor allows for the assessment of companies' performance not only from a financial perspective but also in terms of their environmental, social, and governance aspects. This broader approach better reflects the overall impact of companies on society and the environment.

Another advantage is the detection of non-financial risks. The ESG factor helps identify non-financial risks that can influence company performance. These risks may arise from environmental issues (such as climate change or stricter environmental regulations), social concerns (like diversity and inclusion issues), or governance matters (including conflicts of interest or lack of transparency). Recognizing these risks is crucial for more prudent portfolio management.

Furthermore, it becomes attractive to responsible investors. Investors who prioritize ethical and sustainable considerations often prefer companies with high ESG scores. Adding an ESG factor can make the Fama and French model more appealing to this type of investor, encouraging greater interest and participation in the market.

In recent years, there has been a growing focus on ESG considerations in financial markets. Investors and companies alike are increasingly recognizing the importance of addressing sustainable and social issues. Integrating an ESG factor into the model can reflect this trend, contributing to greater relevance and alignment with the market context. The addition of an ESG factor provides an additional dimension of data to consider in the analysis. This data diversification can lead to a better understanding of corporate dynamics and their impact on portfolio returns.

Investors can use the ESG factor to assess companies' long-term resilience. Companies with robust ESG policies may be better positioned to address future challenges, such as stricter regulations or changing consumer preferences. Institutional investors, such as pension funds, are increasingly considering ESG considerations in their capital allocation. Adding the ESG factor can help align the Fama and French model with the investment strategies of these key players, making the model more relevant in the context of institutional investments.

In this thesis, the process of constructing the ESG (Environmental, Social, and Governance) risk factor was described. It was modeled based on the concept of the HML (High Minus Low) factor and used to conduct regression analyses on all the companies in our sample listed in the S&P 500 index. The regression analysis was carried out, considering various independent variables, including the market factor Mkt-RF, the size factor SMB, the value factor HML, and, of course, the ESG factor. This approach aimed to capture the effect of these factors on the companies' performance, taking into account the specific characteristics of each company and its market context.

To manage the analysis on such a large sample of companies (almost 500), automation was leveraged through the Python programming language. This automated approach accelerated the analysis and reduced the risk of errors associated with manual execution.
Subsequently, examples of results obtained through regression analysis on some companies were provided, such as Campbell Soup Co, General Mills Inc, Kellogg Co, Kroger Co, Newmont Corporation, and J M Smucker Co. In particular, the results obtained from analyses with and without the ESG factor were compared.

The examples showed that the addition of the ESG factor often improves the model's ability to explain variations in company returns. For example, it was observed that the R-squared (the coefficient of determination) increases when the ESG factor is included in the model, suggesting that the ESG factor contributes to explaining financial performance.

Subsequently, the overall impact of ESG factors on regression analyses conducted on all the companies in the S&P 500 index was evaluated. Although the average percentage increase in the R square of all assets contained in the S&P500, with the implementation of the ESG risk factor as an independent variable as it was constructed, is 2.33%, it suggests that the introduction of the ESG factor may not be very significant for the entire S&P 500 index. This highlights the multifaceted nature of ESG integration in financial modeling.

In some cases, the addition of the ESG factor to the Fama-French model may not significantly increase the R-squared when regressing portfolios for various reasons:

1. company differences: the ESG factor can have a heterogeneous impact on companies. Some firms may be highly influenced by ESG considerations, while others may be less sensitive. This can reduce the overall variation explained by the model.
2. Residual variance: even if the ESG factor is added to the model, there will still be other unaccounted variables contributing to the residual variance in portfolio returns. These could include macroeconomic factors, specific company news, and other market events.
3. ESG data limitations: the quality and completeness of ESG data can vary significantly. If ESG data is inaccurate, it can affect the model's ability to explain performance.
4. Long-term effects: some ESG-related effects may be long-term and not immediately visible in short-term portfolio returns.
5. Interaction with other factors: the ESG factor may interact with other risk and return factors in the model. These interactions can be complex and influence the explained variance.

6. Portfolio diversification: if the portfolio is sufficiently diversified, the specific effects of individual companies may be attenuated, reducing the model's ability to explain variation.

In this first analysis, the ESG factor was constructed using a specific methodology based on the construction of the HML (High Minus Low) factor. However, it is crucial to acknowledge the existence of diverse methodologies for formulating ESG factors, and these methodological variations can exert a substantial influence on the outcomes of our analysis. The construction of an ESG factor may involve accessing different data sources, assigning varying weights to ESG criteria, and selecting different sets of ESG indicators for inclusion. Further investigations could delve deeper into alternative methodologies for constructing the ESG factor. These methodologies might incorporate more comprehensive data sources, experiment with different weighting schemes, or adapt to evolving industry standards in ESG reporting.

In conclusion, the integration of ESG factors into financial analysis is a dynamic and evolving field. By continually refining methodologies and expanding research horizons, it is possible to better comprehend the multifaceted relationship between ESG factors and asset performance, ultimately enhancing investment decision-making processes.

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Appendix - Tables

Table 1 - Sample of 472 companies listed in the S&P 500 used for the analysis:

ID	Identifier	Company Name
1	AFL.N	Aflac Inc
2	AES.N	AES Corp
3	ABT.N	Abbott Laboratories
4	ATVI.OQ	Activision Blizzard Inc
5	ADBE.OQ	Adobe Inc
6	AMD.OQ	Advanced Micro Devices Inc
7	APD.N	Air Products and Chemicals Inc
8	ALK.N	Alaska Air Group Inc
9	ALB.N	Albemarle Corp
10	HON.OQ	Honeywell International Inc
11	ALL.N	Allstate Corp
12	HWM.N	Howmet Aerospace Inc
13	HES.N	Hess Corp
14	AEE.N	Ameren Corp
15	AEP.OQ	American Electric Power Company Inc
16	AIG.N	American International Group Inc
17	AME.N	AMETEK Inc
18	AMGN.OQ	Amgen Inc
19	APH.N	Amphenol Corp
20	ADI.OQ	Analog Devices Inc
21	AON.N	Aon PLC
22	APA.OQ	APA Corp (US)

23	AAPL.OQ	Apple Inc
24	AMAT.OQ	Applied Materials Inc
25	ADM.N	Archer-Daniels-Midland Co
26	ATO.N	Atmos Energy Corp
27	ADSK.OQ	Autodesk Inc
28	ADP.OQ	Automatic Data Processing Inc
29	AZO.N	Autozone Inc
30	AVB.N	Avalonbay Communities Inc
31	AVY.N	Avery Dennison Corp
32	TFC.N	Truist Financial Corp
33	BKR.OQ	Baker Hughes Co
34	BALL.N	Ball Corp
35	BAX.N	Baxter International Inc
36	BDX.N	Becton Dickinson and Co
37	VZ.N	Verizon Communications Inc
38	WRB.N	W R Berkley Corp
39	BRKb.N	Berkshire Hathaway Inc
40	BBY.N	Best Buy Co Inc
41	BIO.N	Bio Rad Laboratories Inc
42	BA.N	Boeing Co
43	BWA.N	Borgwarner Inc
44	BSX.N	Boston Scientific Corp
45	BMY.N	Bristol-Myers Squibb Co
46	BFb.N	Brown-Forman Corp
47	CI.N	Cigna Group
48	CMS.N	CMS Energy Corp
49	CSX.OQ	CSX Corp
50	CTRA.N	Coterra Energy Inc
51	CDNS.OQ	Cadence Design Systems Inc
52	CPT.N	Camden Property Trust
53	CPB.N	Campbell Soup Co
54	STZ.N	Constellation Brands Inc
55	COF.N	Capital One Financial Corp
56	CAH.N	Cardinal Health Inc

57	CCL.N	Carnival Corp
58	CAT.N	Caterpillar Inc
59	JPM.N	JPMorgan Chase & Co
60	CVX.N	Chevron Corp
61	CHD.N	Church & Dwight Co Inc
62	CINF.OQ	Cincinnati Financial Corp
63	CSCO.OQ	Cisco Systems Inc
64	CTAS.OQ	Cintas Corp
65	CLX.N	Clorox Co
66	KO.N	Coca-Cola Co
67	CL.N	Colgate-Palmolive Co
68	CMA.N	Comerica Inc
69	DXC.N	DXC Technology Co
70	CAG.N	Conagra Brands Inc
71	ED.N	Consolidated Edison Inc
72	COO.N	Cooper Companies Inc
73	TAP.N	Molson Coors Beverage Co
74	CPRT.OQ	Copart Inc
75	GLW.N	Corning Inc
76	CMI.N	Cummins Inc
77	DHI.N	DR Horton Inc
78	DTE.N	DTE Energy Co
79	DHR.N	Danaher Corp
80	DRI.N	Darden Restaurants Inc
81	TGT.N	Target Corp
82	DE.N	Deere & Co
83	XRAY.OQ	DENTSPLY SIRONA Inc
84	DIS.N	Walt Disney Co
85	DLTR.OQ	Dollar Tree Inc
86	D.N	Dominion Energy Inc
87	DOV.N	Dover Corp
88	DUK.N	Duke Energy Corp
89	EMN.N	Eastman Chemical Co
90	ETN.N	Eaton Corporation PLC

91	ECL.N	Ecolab Inc
92	EIX.N	Edison International
93	EA.OQ	Electronic Arts Inc
94	EMR.N	Emerson Electric Co
95	EOG.N	EOG Resources Inc
96	ETR.N	Entergy Corp
97	EFX.N	Equifax Inc
98	EQT.N	EQT Corp
99	EQR.N	Equity Residential
100	RE.N	Everest Re Group Ltd
101	EXPD.OQ	Expeditors International of Washington Inc
102	XOM.N	Exxon Mobil Corp
103	FMC.N	FMC Corp
104	NEE.N	Nextera Energy Inc
105	FAST.OQ	Fastenal Co
106	FDX.N	FedEx Corp
107	FRT.N	Federal Realty Investment Trust
108	FITB.OQ	Fifth Third Bancorp
109	FI.N	Fiserv Inc
110	FE.N	FirstEnergy Corp
111	BEN.N	Franklin Resources Inc
112	FCX.N	Freeport-McMoRan Inc
113	IT.N	Gartner Inc
114	GD.N	General Dynamics Corp
115	GE.N	General Electric Co
116	GIS.N	General Mills Inc
117	GPC.N	Genuine Parts Co
118	GILD.OQ	Gilead Sciences Inc
119	GWW.N	WW Grainger Inc
120	HAL.N	Halliburton Co
121	HIG.N	Hartford Financial Services Group Inc
122	HAS.OQ	Hasbro Inc
123	PEAK.N	Healthpeak Properties Inc
124	WELL.N	Welltower Inc

125	JKHY.OQ	Jack Henry & Associates Inc
126	HSY.N	Hershey Co
127	HPQ.N	HP Inc
128	HOLX.OQ	Hologic Inc
129	HD.N	Home Depot Inc
130	HRL.N	Hormel Foods Corp
131	HST.OQ	Host Hotels & Resorts Inc
132	HUM.N	Humana Inc
133	JBHT.OQ	J B Hunt Transport Services Inc
134	HBAN.OQ	Huntington Bancshares Inc
135	BIIB.OQ	Biogen Inc
136	MOS.N	Mosaic Co
137	IEX.N	IDEX Corp
138	IDXX.OQ	IDEXX Laboratories Inc
139	ITW.N	Illinois Tool Works Inc
140	INCY.OQ	Incyte Corp
141	TT.N	Trane Technologies PLC
142	INTC.OQ	Intel Corp
143	IBM.N	International Business Machines Corp
144	IFF.N	International Flavors & Fragrances Inc
145	IP.N	International Paper Co
146	IPG.N	Interpublic Group of Companies Inc
147	INTU.OQ	Intuit Inc
148	J.N	Jacobs Solutions Inc
149	JNJ.N	Johnson & Johnson
150	KLAC.OQ	KLA Corp
151	K.N	Kellogg Co
152	KEY.N	KeyCorp
153	KMB.N	Kimberly-Clark Corp
154	KIM.N	Kimco Realty Corp
155	KR.N	Kroger Co
156	LH.N	Laboratory Corporation of America Holdings
157	LRCX.OQ	Lam Research Corp
158	EL.N	Estee Lauder Companies Inc

159	LEN.N	Lennar Corp
160	LLY.N	Eli Lilly and Co
161	LNC.N	Lincoln National Corp
162	LMT.N	Lockheed Martin Corp
163	LOW.N	Lowe's Companies Inc
164	MTB.N	M&T Bank Corp
165	MGM.N	MGM Resorts International
166	MMC.N	Marsh & McLennan Companies Inc
167	MAR.OQ	Marriott International Inc
168	MLM.N	Martin Marietta Materials Inc
169	MAS.N	Masco Corp
170	MKC.N	McCormick & Company Inc
171	MCD.N	McDonald's Corp
172	SPGI.N	S&P Global Inc
173	MCK.N	Mckesson Corp
174	MDT.N	Medtronic PLC
175	BK.N	Bank of New York Mellon Corp
176	MSFT.OQ	Microsoft Corp
177	MCHP.OQ	Microchip Technology Inc
178	MU.OQ	Micron Technology Inc
179	MAA.N	Mid-America Apartment Communities Inc
180	MMM.N	3M Co
181	MHK.N	Mohawk Industries Inc
182	MS.N	Morgan Stanley
183	MSI.N	Motorola Solutions Inc
184	VTRS.OQ	Viatris Inc
185	NVR.N	NVR Inc
186	NTAP.OQ	NetApp Inc
187	NEM.N	Newmont Corporation
188	NDSN.OQ	Nordson Corp
189	NSC.N	Norfolk Southern Corp
190	ES.N	Eversource Energy
191	XEL.OQ	Xcel Energy Inc
192	NTRS.OQ	Northern Trust Corp

193	NOC.N	Northrop Grumman Corp
194	WFC.N	Wells Fargo & Co
195	NUE.N	Nucor Corp
196	OXY.N	Occidental Petroleum Corp
197	ODFL.OQ	Old Dominion Freight Line Inc
198	OMC.N	Omnicom Group Inc
199	OKE.N	ONEOK Inc
200	ORCL.N	Oracle Corp
201	ORLY.OQ	O'Reilly Automotive Inc
202	EXC.OQ	Exelon Corp
203	PCG.N	PG&E Corp
204	PNC.N	PNC Financial Services Group Inc
205	PPL.N	PPL Corp
206	PPG.N	PPG Industries Inc
207	PCAR.OQ	Paccar Inc
208	PTC.OQ	PTC Inc
209	PH.N	Parker-Hannifin Corp
210	PAYX.OQ	Paychex Inc
211	PNR.N	Pentair PLC
212	PEP.OQ	PepsiCo Inc
213	PFE.N	Pfizer Inc
214	MO.N	Altria Group Inc
215	COP.N	Conocophillips
216	PXD.N	Pioneer Natural Resources Co
217	TROW.OQ	T Rowe Price Group Inc
218	PG.N	Procter & Gamble Co
219	PGR.N	Progressive Corp
220	PSA.N	Public Storage
221	PHM.N	Pultegroup Inc
222	QCOM.OQ	Qualcomm Inc
223	PWR.N	Quanta Services Inc
224	RJF.N	Raymond James Financial Inc
225	O.N	Realty Income Corp
226	REGN.OQ	Regeneron Pharmaceuticals Inc

227	REG.OQ	Regency Centers Corp
228	RMD.N	Resmed Inc
229	ACGL.OQ	Arch Capital Group Ltd
230	RHI.N	Robert Half International Inc
231	ROK.N	Rockwell Automation Inc
232	ROL.N	Rollins Inc
233	ROP.N	Roper Technologies Inc
234	ROST.OQ	Ross Stores Inc
235	T.N	AT&T Inc
236	TRV.N	Travelers Companies Inc
237	HSIC.OQ	Henry Schein Inc
238	SLB.N	Schlumberger NV
239	SCHW.N	Charles Schwab Corp
240	SEE.N	Sealed Air Corp
241	SRE.N	Sempra
242	SHW.N	Sherwin-Williams Co
243	SPG.N	Simon Property Group Inc
244	AOS.N	A O Smith Corp
245	SNA.N	Snap-On Inc
246	SO.N	Southern Co
247	LUV.N	Southwest Airlines Co
248	SWK.N	Stanley Black & Decker Inc
249	USB.N	US Bancorp
250	SBUX.OQ	Starbucks Corp
251	STT.N	State Street Corp
252	SYK.N	Stryker Corp
253	GEN.OQ	Gen Digital Inc
254	SNPS.OQ	Synopsys Inc
255	SYY.N	Sysco Corp
256	TJX.N	TJX Companies Inc
257	TECH.OQ	Bio-Techne Corp
258	TFX.N	Teleflex Inc
259	TER.OQ	Teradyne Inc
260	TXN.OQ	Texas Instruments Inc

261	TXT.N	Textron Inc
262	TMO.N	Thermo Fisher Scientific Inc
263	GL.N	Globe Life Inc
264	DVA.N	DaVita Inc
265	TSCO.OQ	Tractor Supply Co
266	C.N	Citigroup Inc
267	YUM.N	Yum! Brands Inc
268	TRMB.OQ	Trimble Inc
269	TSN.N	Tyson Foods Inc
270	MRO.N	Marathon Oil Corp
271	WM.N	Waste Management Inc
272	UNP.N	Union Pacific Corp
273	UDR.N	UDR Inc
274	UNH.N	UnitedHealth Group Inc
275	RTX.N	Raytheon Technologies Corp
276	UHS.N	Universal Health Services Inc
277	VFC.N	VF Corp
278	VLO.N	Valero Energy Corp
279	VTR.N	Ventas Inc
280	VRSN.OQ	Verisign Inc
281	VRTX.OQ	Vertex Pharmaceuticals Inc
282	VMC.N	Vulcan Materials Co
283	WMT.N	Walmart Inc
284	WBA.OQ	Walgreens Boots Alliance Inc
285	WAT.N	Waters Corp
286	WDC.OQ	Western Digital Corp
287	WAB.N	Westinghouse Air Brake Technologies Corp
288	WY.N	Weyerhaeuser Co
289	WHR.N	Whirlpool Corp
290	WMB.N	Williams Companies Inc
291	WEC.N	WEC Energy Group Inc
292	ZBRA.OQ	Zebra Technologies Corp
293	ZION.OQ	Zions Bancorporation NA
294	CB.N	Chubb Ltd

295	JCI.N	Johnson Controls International PLC
296	RCL.N	Royal Caribbean Cruises Ltd
297	AMT.N	American Tower Corp
298	MCO.N	Moody's Corp
299	DGX.N	Quest Diagnostics Inc
300	STLD.OQ	Steel Dynamics Inc
301	FDS.N	Factset Research Systems Inc
302	PLD.N	Prologis Inc
303	URI.N	United Rentals Inc
304	CNP.N	CenterPoint Energy Inc
305	NWL.OQ	Newell Brands Inc
306	BXP.N	Boston Properties Inc
307	ESS.N	Essex Property Trust Inc
308	ARE.N	Alexandria Real Estate Equities Inc
309	CHRW.OQ	CH Robinson Worldwide Inc
310	MTD.N	Mettler-Toledo International Inc
311	WST.N	West Pharmaceutical Services Inc
312	NI.N	NiSource Inc
313	SWKS.OQ	Skyworks Solutions Inc
314	BAC.N	Bank of America Corp
315	AMZN.OQ	Amazon.com Inc
316	RL.N	Ralph Lauren Corp
317	LNT.OQ	Alliant Energy Corp
318	TYL.N	Tyler Technologies Inc
319	CTSH.OQ	Cognizant Technology Solutions Corp
320	CCI.N	Crown Castle Inc
321	EBAY.OQ	eBay Inc
322	GS.N	Goldman Sachs Group Inc
323	NVDA.OQ	NVIDIA Corp
324	BKNG.OQ	Booking Holdings Inc
325	RSG.N	Republic Services Inc
326	CSGP.OQ	CoStar Group Inc
327	COST.OQ	Costco Wholesale Corp
328	DVN.N	Devon Energy Corp

329	RVTY.N	Revvity Inc
330	TTWO.OQ	Take-Two Interactive Software Inc
331	AKAM.OQ	Akamai Technologies Inc
332	TDY.N	Teledyne Technologies Inc
333	UPS.N	United Parcel Service Inc
334	JNPR.N	Juniper Networks Inc
335	EW.N	Edwards Lifesciences Corp
336	A.N	Agilent Technologies Inc
337	FFIV.OQ	F5 Inc
338	MET.N	MetLife Inc
339	PKG.N	Packaging Corp of America
340	SBAC.OQ	SBA Communications Corp
341	ON.OQ	ON Semiconductor Corp
342	F.N	Ford Motor Co
343	GPN.N	Global Payments Inc
344	TPR.N	Tapestry Inc
345	ALGN.OQ	Align Technology Inc
346	ANSS.OQ	ANSYS Inc
347	CRL.N	Charles River Laboratories International Inc
348	KMX.N	Carmax Inc
349	ILMN.OQ	Illumina Inc
350	ISRG.OQ	Intuitive Surgical Inc
351	FIS.N	Fidelity National Information Services Inc
352	ZBH.N	Zimmer Biomet Holdings Inc
353	ACN.N	Accenture PLC
354	ELV.N	Elevance Health Inc
355	IVZ.N	Invesco Ltd
356	BG.N	Bunge Ltd
357	EQIX.OQ	Equinix Inc
358	GRMN.N	Garmin Ltd
359	MNST.OQ	Monster Beverage Corp
360	MDLZ.OQ	Mondelez International Inc
361	PFG.OQ	Principal Financial Group Inc
362	AXON.OQ	Axon Enterprise Inc

363	WTW.OQ	Willis Towers Watson PLC
364	AAP.N	Advance Auto Parts Inc
365	CNC.N	Centene Corp
366	PRU.N	Prudential Financial Inc
367	NFLX.OQ	Netflix Inc
368	SJM.N	J M Smucker Co
369	NDAQ.OQ	Nasdaq Inc
370	WYNN.OQ	Wynn Resorts Ltd
371	CMCSA.OQ	Comcast Corp
372	STX.OQ	Seagate Technology Holdings PLC
373	MOH.N	Molina Healthcare Inc
374	LKQ.OQ	LKQ Corp
375	NRG.N	NRG Energy Inc
376	AIZ.N	Assurant Inc
377	CBRE.N	CBRE Group Inc
378	CRM.N	Salesforce Inc
379	RF.N	Regions Financial Corp
380	DPZ.N	Domino's Pizza Inc
381	TMUS.OQ	T-Mobile US Inc
382	EXR.N	Extra Space Storage Inc
383	GOOGL.OQ	Alphabet Inc
384	DLR.N	Digital Realty Trust Inc
385	MKTX.OQ	Marketaxess Holdings Inc
386	MPWR.OQ	Monolithic Power Systems Inc
387	LVS.N	Las Vegas Sands Corp
388	CE.N	Celanese Corp
389	DXCM.OQ	Dexcom Inc
390	EXPE.OQ	Expedia Group Inc
391	CF.N	CF Industries Holdings Inc
392	AMP.N	Ameriprise Financial Inc
393	MA.N	Mastercard Inc
394	ICE.N	Intercontinental Exchange Inc
395	LDOS.N	Leidos Holdings Inc
396	PARA.OQ	Paramount Global

397	LYV.N	Live Nation Entertainment Inc
398	CMG.N	Chipotle Mexican Grill Inc
399	UAL.OQ	United Airlines Holdings Inc
400	TDG.N	TransDigm Group Inc
401	FSLR.OQ	First Solar Inc
402	BR.N	Broadridge Financial Solutions Inc
403	DAL.N	Delta Air Lines Inc
404	PODD.OQ	Insulet Corp
405	TEL.N	TE Connectivity Ltd
406	DFS.N	Discover Financial Services
407	ULTA.OQ	Ulta Beauty Inc
408	PM.N	Philip Morris International Inc
409	V.N	Visa Inc
410	AWK.N	American Water Works Company Inc
411	KDP.OQ	Keurig Dr Pepper Inc
412	WBD.OQ	Warner Bros Discovery Inc
413	AVGO.OQ	Broadcom Inc
414	VRSK.OQ	Verisk Analytics Inc
415	MRK.N	Merck & Co Inc
416	DG.N	Dollar General Corp
417	FTNT.OQ	Fortinet Inc
418	CHTR.OQ	Charter Communications Inc
419	GNRC.N	Generac Holdings Inc
420	LYB.N	LyondellBasell Industries NV
421	CBOE.Z	Cboe Global Markets Inc
422	TSLA.OQ	Tesla Inc
423	NXPI.OQ	NXP Semiconductors NV
424	TRGP.N	Targa Resources Corp
425	KMI.N	Kinder Morgan Inc
426	HCA.N	HCA Healthcare Inc
427	GM.N	General Motors Co
428	HII.N	Huntington Ingalls Industries Inc
429	MPC.N	Marathon Petroleum Corp
430	XYL.N	Xylem Inc

431	APTV.N	Aptiv PLC
432	EPAM.N	Epam Systems Inc
433	ENPH.OQ	Enphase Energy Inc
434	FLT.N	Fleetcor Technologies Inc
435	NCLH.N	Norwegian Cruise Line Holdings Ltd
436	META.OQ	Meta Platforms Inc
437	FANG.OQ	Diamondback Energy Inc
438	NOW.N	ServiceNow Inc
439	PSX.N	Phillips 66
440	PANW.OQ	Palo Alto Networks Inc
441	ABBV.N	Abbvie Inc
442	ZTS.N	Zoetis Inc
443	IQV.N	IQVIA Holdings Inc
444	NWSA.OQ	News Corp
445	NWS.OQ	News Corp
446	ALLE.N	Allegion PLC
447	HLT.N	Hilton Worldwide Holdings Inc
448	AAL.OQ	American Airlines Group Inc
449	GOOG.OQ	Alphabet Inc
450	ANET.N	Arista Networks Inc
451	PAYC.N	Paycom Software Inc
452	CTLT.N	Catalent Inc
453	SYF.N	Synchrony Financial
454	SEDG.OQ	Solaredge Technologies Inc
455	CZR.OQ	Caesars Entertainment Inc
456	KEYS.N	Keysight Technologies Inc
457	QRVO.OQ	Qorvo Inc
458	ETSY.OQ	ETSY Inc
459	WRK.N	Westrock Co
460	KHC.OQ	Kraft Heinz Co
461	PYPL.OQ	PayPal Holdings Inc
462	HPE.N	Hewlett Packard Enterprise Co
463	MTCH.OQ	Match Group Inc
464	STE.N	STERIS plc

465	FTV.N	Fortive Corp
466	LW.N	Lamb Weston Holdings Inc
467	INVH.N	Invitation Homes Inc
468	IR.N	Ingersoll Rand Inc
469	DD.N	Dupont De Nemours Inc
470	VICI.N	VICI Properties Inc
471	CDAY.N	Ceridian HCM Holding Inc
472	LIN.N	Linde PLC

Table 2 - Companies divided according to ME into two groups (Small/ Big)

	ID	2018	percentiles
SMALL	433	502.931.946,11	1
SMALL	454	1.605.879.931,50	2
SMALL	362	2.572.973.462,50	3
SMALL	455	2.802.336.945,24	4
SMALL	419	3.088.326.092,60	5
SMALL	468	4.064.697.971,65	6
SMALL	223	4.410.156.703,40	7
SMALL	401	4.452.903.755,76	8
SMALL	404	4.686.006.994,08	9
SMALL	98	4.806.107.140,00	10
SMALL	471	4.809.758.457,90	11
SMALL	386	4.930.395.000,00	12
SMALL	347	5.373.332.042,40	13
SMALL	240	5.467.271.320,16	14
SMALL	376	5.550.103.946,40	15
SMALL	257	5.559.053.326,75	16
SMALL	452	5.586.839.181,09	17
SMALL	259	5.624.862.175,80	18
SMALL	458	5.730.284.245,51	19
SMALL	154	6.173.382.618,25	20
SMALL	432	6.273.843.073,92	21
SMALL	211	6.474.117.374,70	22
SMALL	287	6.787.199.956,50	23
SMALL	289	6.819.190.349,25	24
SMALL	355	6.885.762.848,82	25
SMALL	300	6.895.748.869,04	26
SMALL	41	6.946.495.180,94	27
SMALL	230	6.948.371.830,40	28
SMALL	341	6.949.539.688,65	29
SMALL	451	7.013.567.670,40	30
SMALL	188	7.133.098.084,92	31
SMALL	318	7.214.137.615,74	32
SMALL	43	7.235.394.153,84	33
SMALL	373	7.250.849.580,00	34

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BIG	266	127.137.642.484,78	439
BIG	171	136.890.533.092,50	440
BIG	441	138.673.703.186,13	441
BIG	371	154.109.023.874,10	442
BIG	212	155.780.644.480,00	443
BIG	200	172.933.292.400,00	444
BIG	84	173.918.149.176,24	445
BIG	42	183.143.031.502,50	446
BIG	393	194.836.659.975,65	447
BIG	218	196.289.635.096,56	448
BIG	415	198.694.768.365,00	449
BIG	63	200.201.707.769,58	450
BIG	66	201.545.933.070,30	451
BIG	235	207.714.120.000,00	452
BIG	60	207.873.143.603,51	453
BIG	129	208.251.032.004,98	454
BIG	142	213.367.000.000,00	455
BIG	194	216.909.811.261,44	456
BIG	37	232.301.888.978,22	457
BIG	314	238.251.216.156,80	458
BIG	274	239.661.959.904,00	459
BIG	213	253.170.000.000,00	460
BIG	283	278.411.071.453,97	461
BIG	102	288.703.310.922,30	462
BIG	59	324.626.594.974,50	463
BIG	409	333.967.503.145,68	464
BIG	149	341.335.336.114,63	465
BIG	436	376.724.818.057,08	466
BIG	39	502.599.567.547,08	467
BIG	383	723.465.248.599,33	468
BIG	449	723.465.248.599,33	469
BIG	315	734.416.210.197,16	470
BIG	176	757.640.105.770,83	471
BIG	23	1.090.307.495.240,00	472

Table 3 - Companies divided according to BE/ME into three groups (Growth/ Neutral/ Value)[65]

	ID	2018	percentili
GROWTH	380	-0,292396151	1
GROWTH	267	-0,276101987	2
GROWTH	340	-0,184067092	3
GROWTH	408	-0,120052015	4
GROWTH	426	-0,115571107	5
GROWTH	375	-0,107479783	6
GROWTH	400	-0,092298771	7
GROWTH	280	-0,077286177	8
GROWTH	29	-0,074638638	9
GROWTH	183	-0,068731825	10
GROWTH	240	-0,06376124	11
GROWTH	441	-0,060905563	12
GROWTH	171	-0,045718282	13
GROWTH	466	-0,034992152	14
GROWTH	127	-0,016728037	15
GROWTH	169	-0,012426154	16
GROWTH	448	-0,011427203	17
GROWTH	129	-0,009017963	18
GROWTH	153	-0,007273644	19
GROWTH	27	-0,006541949	20

[…]

[65] Growth=Low BE/ME // Value=High BE/ME.

NEUTRAL	318	0,18364579	142
NEUTRAL	428	0,185451789	143
NEUTRAL	10	0,185876474	144
NEUTRAL	94	0,185900517	145
NEUTRAL	166	0,188794223	146
NEUTRAL	206	0,188799069	147
NEUTRAL	370	0,189127028	148
NEUTRAL	91	0,18920512	149
NEUTRAL	330	0,191081787	150
NEUTRAL	58	0,191962132	151
NEUTRAL	311	0,192274057	152
NEUTRAL	193	0,192547099	153
NEUTRAL	257	0,194124779	154
NEUTRAL	452	0,1945107	155
NEUTRAL	252	0,199986848	156
NEUTRAL	272	0,200527268	157
NEUTRAL	432	0,201247622	158
NEUTRAL	188	0,203381614	159
NEUTRAL	137	0,205943628	160
NEUTRAL	133	0,206874637	161

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VALUE	203	1,026990751	453
VALUE	379	1,031577415	454
VALUE	152	1,035023676	455
VALUE	182	1,051637093	456
VALUE	159	1,056272027	457
VALUE	314	1,113635449	458
VALUE	401	1,17056269	459
VALUE	342	1,180771127	460
VALUE	73	1,211879827	461
VALUE	355	1,245875031	462
VALUE	338	1,301617682	463
VALUE	161	1,309299594	464
VALUE	266	1,398169704	465
VALUE	55	1,443091282	466
VALUE	366	1,443491196	467
VALUE	322	1,451361332	468
VALUE	437	1,459458037	469
VALUE	33	1,480557173	470
VALUE	16	1,616596092	471
VALUE	98	2,280063403	472

Table 4 - Composition of the S/L; S/N; S/H; B/L; B/N; B/H portfolios for the year 2018/2022

Composition of the S/L; S/N; S/H; B/L; B/N; B/H portfolios for the year 2018/2019 with the relative weights calculated as the ratio of the market capitalisation of each company to the total capitalisation of each portfolios[66]:

[66] The developed portfolios use developed size breaks, but we use the B/M breakpoints for the four regions to allocate the stocks of these regions to the developed portfolios. Similarly, the developed ex us portfolios use developed ex us size breaks and regional B/M breakpoints. The independent 2x3 sorts on size and B/M produce six value-weight portfolios, SG, SN, SV, BG, BN, and BV, where S and B indicate small or big and G, N, and V indicate growth (low B/M), neutral, and value (high B/M). http://mba.tuck.dartmouth.edu/pages/faculty/ken.french/Data_Library/f-f_developed.html

PTF SMALL LOW

ID	VALUE Weight
380	0,01305
340	0,02303
375	0,01441
400	0,02460
280	0,02251
183	0,02362
240	0,00686
466	0,01201
169	0,01121
448	0,01857
138	0,02014
463	0,01495
433	0,00063
65	0,02199
310	0,01778
404	0,00588
451	0,00881
440	0,02312
301	0,01105
232	0,01483
186	0,02229
389	0,01336
208	0,01571
458	0,00719
6	0,02236
113	0,01459
345	0,02103
385	0,00997
402	0,01704
417	0,01506
446	0,00951
150	0,02006
372	0,02035
407	0,02170
51	0,01535
337	0,01523
397	0,01296
285	0,01794
53	0,01545
414	0,02254
74	0,01674
398	0,01506
119	0,01980
31	0,00967
125	0,01265
386	0,00619
450	0,01995
309	0,01452
228	0,01856
140	0,01699
61	0,02033
230	0,00872
265	0,01275
105	0,01877
64	0,02442
198	0,02061
292	0,01077
170	0,02479
80	0,01855
101	0,01475
122	0,01289
396	0,02055
362	0,00323

PTF SMALL NEUTRAL

ID	VALUE Weight
318	0,00687
428	0,00779
370	0,01025
330	0,01018
311	0,00692
257	0,00530
452	0,00532
432	0,00598
188	0,00680
137	0,00923
133	0,00968
185	0,00831
434	0,01519
382	0,01096
40	0,01499
431	0,01546
258	0,01133
50	0,00918
128	0,01063
346	0,01138
373	0,00691
456	0,01020
34	0,01486
430	0,01143
244	0,00692
344	0,01281
390	0,01599
343	0,01552
347	0,00512
326	0,01171
419	0,00294
117	0,01343
388	0,01147
237	0,01132
313	0,01547
70	0,01403
72	0,01210
254	0,01268
197	0,00962
87	0,00989
273	0,01040
177	0,01873
107	0,00831
17	0,01498
259	0,00536
97	0,01070
211	0,00617
329	0,00819
464	0,01032
391	0,00957
421	0,01046
146	0,00756
332	0,00697
364	0,01080
471	0,00458
103	0,00932
331	0,00948
316	0,00972
348	0,00991
268	0,00764
2	0,00913
289	0,00650
48	0,01341
306	0,01658
339	0,00752
454	0,00153
358	0,01130
110	0,01830
410	0,01562
377	0,01301
455	0,00267
392	0,01386
245	0,00765
307	0,01544
253	0,01400
248	0,01711
282	0,01243
56	0,01446
52	0,00782
369	0,01275
303	0,00792
468	0,00387
395	0,00748
287	0,00647
144	0,01364
225	0,01825
264	0,00814
9	0,00780
123	0,01271
304	0,01348
145	0,01558
341	0,00662
26	0,00995
168	0,01027
299	0,01080
261	0,01057

PTF SMALL HIGH

ID	VALUE Weight
224	0,01551
317	0,01152
14	0,01840
457	0,01017
276	0,01245
8	0,00866
363	0,02261
165	0,01478
312	0,01089
334	0,01073
148	0,01254
179	0,01304
156	0,01472
288	0,01891
77	0,01837
92	0,02136
96	0,01801
192	0,02137
89	0,01180
187	0,02132
300	0,00796
368	0,01611
41	0,00802
43	0,00836
308	0,01431
38	0,01042
305	0,01002
131	0,01429
111	0,01851
83	0,00956
195	0,01828
62	0,01455
374	0,00866
112	0,01725
227	0,01148
435	0,01066
263	0,00960
221	0,00843
412	0,01433
68	0,01283
12	0,00941
69	0,01992
22	0,01151
424	0,00954
467	0,01207
13	0,01386
223	0,00509
121	0,01842
459	0,01574
356	0,00871
181	0,01002
184	0,01632
154	0,00713
328	0,01219
453	0,01947
229	0,01242
134	0,01441
100	0,01022
470	0,00868
361	0,01444
136	0,01300
376	0,00641
108	0,01782
293	0,00904
270	0,01377
444	0,01051
445	0,01051
203	0,01423
379	0,01598
152	0,01740
159	0,01594
401	0,00514
73	0,01287
355	0,00795
161	0,01266
437	0,01084
98	0,00555

PTF BIG LOW

ID	VALUE Weight
267	0,00335
408	0,01211
426	0,00500
29	0,00238
441	0,01619
171	0,01598
127	0,00446
129	0,02431
153	0,00461
27	0,00376
67	0,00603
42	0,02138
222	0,01235
201	0,00318
250	0,00895
172	0,00498
298	0,00313
162	0,00869
447	0,00249
393	0,02274
438	0,00373
333	0,00978
367	0,01364
147	0,00612
163	0,00910
442	0,00480
28	0,00690
315	0,08573
167	0,00432
126	0,00262
243	0,00606
46	0,00295
231	0,00270
255	0,00415
5	0,01430
297	0,00813
139	0,00491
109	0,00342
160	0,01431
256	0,00704
66	0,02353
422	0,00667
349	0,00512
180	0,01282
158	0,00611
212	0,01818
323	0,01140
353	0,01265
234	0,00397
335	0,00374
23	0,12727
260	0,01043
18	0,01448
242	0,00430
409	0,03898
281	0,00494
176	0,08844
324	0,00932
210	0,00275
21	0,00409
350	0,00638
277	0,00401
327	0,01193
200	0,02019
151	0,00232
359	0,00318
378	0,01357
415	0,02319
387	0,00476
461	0,01157
214	0,01080
19	0,00285
271	0,00443
45	0,00990
143	0,01184
149	0,03984
93	0,00355
44	0,00571

PTF BIG NEUTRAL

ID	VALUE Weight
10	0,01347
94	0,00663
166	0,00553
206	0,00338
91	0,00586
58	0,01007
193	0,00586
252	0,00808
272	0,01403
416	0,00417
24	0,00438
135	0,00835
274	0,03301
63	0,02758
226	0,00547
336	0,00284
35	0,00482
116	0,00436
436	0,05189
157	0,00395
37	0,03200
321	0,00372
49	0,00723
3	0,01750
85	0,00317
383	0,09965
449	0,09965
213	0,03487
114	0,00641
357	0,00390
130	0,00302
220	0,00486
283	0,03835
132	0,00535
82	0,00589
118	0,01115
218	0,02704
320	0,00621
217	0,00306
84	0,02396
233	0,00380
209	0,00285
443	0,00320
413	0,01257
465	0,00311
7	0,00505
199	0,00306
36	0,00962
351	0,00463
81	0,00512
262	0,01241
219	0,00485
319	0,00506
141	0,00309
239	0,00773
4	0,00489
420	0,00439
325	0,00322
20	0,00446
76	0,00296
142	0,02939
155	0,00308
405	0,00422
173	0,00309
247	0,00360
284	0,00937
95	0,00697
189	0,00552
54	0,00443
79	0,00996
403	0,00471
394	0,00591
120	0,00321
104	0,01144
99	0,00336
275	0,01266
354	0,00936
174	0,01613
86	0,00646
207	0,00275
423	0,00332
399	0,00314
360	0,00802
30	0,00332
106	0,00554
215	0,00989
291	0,00301
384	0,00303
381	0,00743
365	0,00327
196	0,00638
371	0,02123

PTF BIG HIGH

ID	VALUE Weight
115	0,01499
191	0,00576
279	0,00476
286	0,00527
78	0,00457
15	0,00839
178	0,01393
352	0,00482
216	0,00510
90	0,00678
296	0,00464
290	0,00608
190	0,00469
124	0,00594
406	0,00451
418	0,01462
47	0,01647
75	0,00551
205	0,00465
241	0,00674
269	0,00496
57	0,00947
472	0,01958
302	0,00842
249	0,01682
439	0,00905
411	0,00811
246	0,01029
295	0,00737
102	0,06574
1	0,00790
278	0,00724
39	0,11444
71	0,00542
202	0,00993
88	0,01401
236	0,00722
238	0,01136
60	0,04733
11	0,00648
164	0,00457
469	0,02763
59	0,07391
194	0,04939
427	0,01075
25	0,00523
294	0,01355
429	0,00928
175	0,01060
251	0,00546
204	0,01228
235	0,04729
32	0,00760
462	0,00511
460	0,01210
425	0,00773
182	0,01553
314	0,05425
342	0,00693
338	0,00923
266	0,02895
55	0,00815
366	0,00767
322	0,01415
33	0,00538
16	0,00794

Below is the composition of the S/L; S/N; S/H; B/L; B/N; B/H portfolios for 2019/2020 with the relative weights calculated as the ratio of the market capitalisation of each company to the total capitalisation of each portfolios:

PTF SMALL LOW

ID	Weight
380	0,0133067
280	0,0251789
240	0,0068499
169	0,0152801
285	0,0167565
448	0,0139833
466	0,0101150
253	0,0122220
404	0,0117799
138	0,0249319
463	0,0256582
231	0,0214620
310	0,0215030
186	0,0106002
65	0,0217051
451	0,0172090
389	0,0222835
385	0,0159402
345	0,0244773
301	0,0115854
446	0,0128796
113	0,0153425
398	0,0258971
417	0,0203231
440	0,0241993
397	0,0170004
232	0,0120850
402	0,0165044
458	0,0058422
433	0,0035593
53	0,0137291
386	0,0086069
74	0,0197705
119	0,0202282
51	0,0219518
31	0,0122318
151	0,0262560
370	0,0165931
228	0,0194757
407	0,0170447
362	0,0048399
105	0,0236115
64	0,0258184
259	0,0127185
292	0,0153534
432	0,0130318
140	0,0209340
125	0,0115075
318	0,0130185
150	0,0212624
311	0,0123800
34	0,0235462
265	0,0121619
277	0,0253887
257	0,0087884
97	0,0188836
208	0,0087404
170	0,0250327
61	0,0192123
428	0,0114207

PTF SMALL NEUTRAL

ID	Weight
326	0,0159014
230	0,0053188
309	0,0076730
456	0,0137321
40	0,0158993
346	0,0157219
128	0,0096205
198	0,0127978
419	0,0045657
101	0,0096393
372	0,0094637
375	0,0071804
388	0,0107965
185	0,0100370
258	0,0126433
137	0,0094908
188	0,0065402
454	0,0033534
87	0,0121469
133	0,0090293
382	0,0099255
450	0,0112735
330	0,0097600
471	0,0070741
103	0,0093507
254	0,0148006
336	0,0170066
197	0,0109901
122	0,0104987
430	0,0102933
337	0,0061255
332	0,0092026
244	0,0056374
347	0,0053831
17	0,0165406
264	0,0068499
2	0,0095854
373	0,0061721
173	0,0158479
80	0,0072420
117	0,0112038
455	0,0033649
395	0,0102166
273	0,0099805
468	0,0054453
421	0,0096855
72	0,0104656
211	0,0056004
390	0,0113667
358	0,0135873
107	0,0070548
329	0,0078223
331	0,0101269
348	0,0103490
306	0,0154811
392	0,0153110
209	0,0158224
130	0,0157160
410	0,0161148
391	0,0075305
48	0,0129400
464	0,0086123
452	0,0057307
339	0,0076905
282	0,0138258
268	0,0075025
50	0,0051523
85	0,0149492
377	0,0148844
303	0,0090929
168	0,0126795
237	0,0070878
313	0,0096501
146	0,0064978
307	0,0144233
369	0,0127359
364	0,0079564
341	0,0072644
22	0,0069810
289	0,0067642
177	0,0117822
12	0,0096644
123	0,0126341
52	0,0074534
288	0,0163255
245	0,0067324
120	0,0155830
344	0,0066787
179	0,0113180
299	0,0104354
155	0,0156004
83	0,0091311
317	0,0095415
14	0,0137078
145	0,0130998
26	0,0097662
13	0,0147687

PTF SMALL HIGH

ID	Weight
276	0,01236982
56	0,01382396
144	0,01356562
374	0,01078287
457	0,00919186
156	0,01617523
165	0,01648376
148	0,01210043
308	0,01832155
38	0,01249785
112	0,01874491
192	0,02216610
279	0,02119269
467	0,01598482
9	0,00762623
77	0,01912307
399	0,02194977
424	0,00935934
8	0,00821740
221	0,01035402
41	0,01090526
435	0,01225583
43	0,00882070
70	0,01379471
316	0,00493713
261	0,01005632
154	0,00880614
131	0,01310023
89	0,01061399
300	0,00722185
334	0,00811778
62	0,01691610
224	0,01127395
312	0,01024044
75	0,02204644
328	0,00982255
227	0,01040996
412	0,01615936
195	0,01680402
305	0,00801332
304	0,01348671
368	0,01290373
263	0,01122307
453	0,02291359
229	0,01713099
287	0,01468487
470	0,01159862
111	0,01431355
223	0,00570565
164	0,02205771
376	0,00782661
286	0,01371901
68	0,01003946
356	0,00802801
121	0,02156789
134	0,01514646
462	0,02109731
100	0,01111749
293	0,00871515
181	0,00961848
152	0,01963072
159	0,01819251
401	0,00581069
203	0,00566476
437	0,01454215
361	0,01503844
108	0,02148160
379	0,01630010
270	0,01069693
136	0,00807113
444	0,00786552
445	0,00786552
184	0,01021563
459	0,00923667
73	0,01058078
69	0,00326043
161	0,01152453
355	0,00803622
98	0,00274391

PTF BIG LOW

ID	Weight
267	0,0029479
340	0,0026256
400	0,0026890
408	0,0128098
29	0,0026147
441	0,0126694
250	0,0102350
426	0,0048509
171	0,0143994
42	0,0177391
127	0,0024906
183	0,0026714
447	0,0030280
129	0,0240752
27	0,0041909
153	0,0045624
67	0,0057086
172	0,0064570
201	0,0032083
298	0,0043370
167	0,0047903
393	0,0291471
160	0,0122099
163	0,0086207
162	0,0106272
333	0,0097161
438	0,0051519
442	0,0060995
297	0,0098496
147	0,0069560
139	0,0055863
222	0,0090136
243	0,0046186
367	0,0137382
6	0,0049760
126	0,0029712
158	0,0064114
214	0,0090216
18	0,0138596
315	0,0886454
46	0,0027880
255	0,0035170
324	0,0082303
21	0,0046767
5	0,0144979
260	0,0116035
200	0,0164071
28	0,0069624
242	0,0052120
212	0,0185573
323	0,0148324
66	0,0229459
234	0,0039267
256	0,0068733
335	0,0047080
422	0,0073288
210	0,0029833
23	0,0956829
414	0,0023577
409	0,0361632
349	0,0047263
321	0,0028424
387	0,0051306
176	0,0993233
180	0,0098184
281	0,0054478
353	0,0128853
415	0,0224051
327	0,0125430
350	0,0066106
359	0,0033062
461	0,0122895
63	0,0234145
19	0,0031049
166	0,0054402
272	0,0121436
271	0,0046779
10	0,0122372
434	0,0023759
193	0,0055863
149	0,0371160

PTF BIG NEUTRAL

ID	Weight
91	0,00616502
431	0,00268693
24	0,00570435
252	0,00871027
157	0,00312108
206	0,00349825
218	0,03048121
416	0,00432864
436	0,06486838
143	0,01315617
357	0,00551658
320	0,00654994
58	0,00900303
35	0,00473143
199	0,00346419
94	0,00455777
443	0,00332263
3	0,01702366
82	0,00614551
378	0,01792145
49	0,00627381
81	0,00621908
116	0,00423475
413	0,01303844
274	0,03086718
383	0,10228580
449	0,10228580
44	0,00698518
7	0,00541803
262	0,01443722
141	0,00351062
283	0,03599918
37	0,02814266
220	0,00411652
132	0,00537911
135	0,00593387
217	0,00315533
420	0,00349107
93	0,00321578
233	0,00408507
423	0,00394235
110	0,00291018
114	0,00565421
226	0,00449196
76	0,00303853
118	0,00911086
4	0,00505918
79	0,01182769
325	0,00317015
465	0,00284290
20	0,00447756
115	0,01080174
213	0,02402991
142	0,02896397
189	0,00560984
36	0,00756799
418	0,01128813
104	0,01311750
219	0,00469028
275	0,01432785
319	0,00376363
394	0,00571154
405	0,00345161
45	0,01667631
99	0,00333314
360	0,00878906
247	0,00314837
291	0,00322419
207	0,00303203
239	0,00675875
248	0,00279488
54	0,00363397
30	0,00324575
84	0,02594500
174	0,01474847
191	0,00377310
363	0,00288009
384	0,00276977
225	0,00272235
302	0,00624128
352	0,00341196
371	0,02269148
403	0,00419158
90	0,00433961
354	0,00848743
109	0,00871267
15	0,00517598
238	0,00616826
381	0,00744730
472	0,01267451
296	0,00310220

PTF BIG HIGH

ID	Weight
96	0,00472894
95	0,00965857
406	0,00527013
269	0,00615869
190	0,00545922
290	0,00569855
241	0,00846395
78	0,00494512
124	0,00656895
86	0,01351181
246	0,01324140
365	0,00517215
216	0,00496994
215	0,01398363
205	0,00514209
343	0,01086382
396	0,00514836
284	0,00916370
106	0,00676076
439	0,00981264
249	0,01835492
295	0,00692226
278	0,00762275
411	0,00807284
92	0,00536006
351	0,01694408
47	0,01513579
59	0,08666329
71	0,00596121
187	0,00706069
60	0,04495839
235	0,05658535
102	0,05852132
88	0,01369987
425	0,00950411
204	0,01386394
11	0,00722063
202	0,00878443
178	0,00977320
236	0,00700649
25	0,00511434
1	0,00769647
314	0,06279498
39	0,10974782
294	0,01398294
427	0,01036518
194	0,04510099
33	0,00521884
57	0,00601740
429	0,00775436
469	0,00939838
251	0,00560335
32	0,01497370
182	0,01640057
175	0,00919985
342	0,00730877
196	0,00729689
322	0,01613745
266	0,03457116
55	0,00931371
460	0,00765357
338	0,00929090
16	0,00885107
366	0,00746931

Composition of the S/L; S/N; S/H; B/L; B/N; B/H portfolios for 2020/2021 with the relative weights calculated as the ratio of the market capitalisation of each company to the total capitalisation of each portfolios:

PTF SMALL LOW

ID	Weight
448	0,0107195
22	0,0058585
380	0,0165246
400	0,0281687
127	0,0269804
280	0,0270082
253	0,0136327
397	0,0174493
370	0,0133120
169	0,0157213
285	0,0167909
433	0,0242456
240	0,0077704
451	0,0285069
466	0,0095933
458	0,0245357
417	0,0263714
404	0,0184330
231	0,0279906
186	0,0181846
385	0,0236909
440	0,0270018
232	0,0210083
403	0,0280471
386	0,0180641
454	0,0178746
301	0,0145609
113	0,0156436
446	0,0117156
119	0,0239691
311	0,0229077
402	0,0158470
419	0,0156303
432	0,0219444
292	0,0224120
264	0,0143814
125	0,0154212
259	0,0217747
265	0,0187152
318	0,0192537
210	0,0283585
74	0,0239453
31	0,0141518
56	0,0166673
362	0,0085167
64	0,0282188
407	0,0172388
471	0,0172263
97	0,0256566
390	0,0204852
257	0,0110397
140	0,0208339

PTF SMALL NEUTRAL

ID	Weight
61	0,0154783
197	0,0163556
151	0,0152761
434	0,0163027
372	0,0086765
309	0,0091140
208	0,0068600
80	0,0133845
450	0,0157016
188	0,0080173
170	0,0177965
430	0,0131025
128	0,0119026
330	0,0145352
101	0,0114977
373	0,0090074
382	0,0108695
456	0,0140163
137	0,0107705
2	0,0111633
347	0,0089422
230	0,0050861
313	0,0175163
53	0,0106974
258	0,0136879
133	0,0103137
375	0,0065495
87	0,0129934
103	0,0106177
185	0,0107682
244	0,0063218
457	0,0156040
268	0,0119301
117	0,0103494
332	0,0103451
348	0,0138735
72	0,0121544
198	0,0095772
122	0,0091163
388	0,0108482
329	0,0114759
211	0,0062966
464	0,0116114
358	0,0164184
339	0,0093403
331	0,0122068
392	0,0163741
395	0,0106849
209	0,0167825
341	0,0096126
303	0,0119479
9	0,0112161
428	0,0049302
273	0,0080825
12	0,0088382
316	0,0063793
452	0,0085819
369	0,0155511
337	0,0053638
120	0,0119326
85	0,0170762
282	0,0140359
48	0,0124765
146	0,0065518
455	0,0110477
13	0,0115776
364	0,0076332
168	0,0126298
421	0,0071361
377	0,0150265
289	0,0080626
50	0,0046377
288	0,0178746
391	0,0059140
52	0,0069504
199	0,0121813
237	0,0067127
155	0,0187594
465	0,0170551
107	0,0045988
307	0,0110564
306	0,0105090
145	0,0139587
179	0,0103483
245	0,0066265
123	0,0116233
165	0,0111158
299	0,0114700
305	0,0064334
83	0,0081729

PTF SMALL HIGH

ID	Weight
223	0,0075470
110	0,0125335
424	0,0045590
399	0,0101780
89	0,0102814
317	0,0097123
14	0,0145622
8	0,0048527
70	0,0127876
156	0,0149613
148	0,0092273
99	0,0166527
328	0,0045639
468	0,0143595
30	0,0169020
290	0,0183621
308	0,0181488
225	0,0169509
296	0,0133807
467	0,0125631
401	0,0079113
261	0,0083474
374	0,0080725
78	0,0177340
38	0,0089330
144	0,0087833
435	0,0060569
276	0,0087488
300	0,0058684
96	0,0150861
368	0,0108325
279	0,0138619
221	0,0087238
41	0,0130889
26	0,0088983
192	0,0146282
334	0,0056012
131	0,0077871
205	0,0163613
216	0,0141395
453	0,0152916
356	0,0069117
312	0,0066339
344	0,0026148
69	0,0060059
396	0,0173777
92	0,0179440
195	0,0121192
43	0,0071300
470	0,0103273
304	0,0088971
224	0,0075311
269	0,0163035
287	0,0105135
376	0,0060403
286	0,0095985
71	0,0186582
62	0,0106084
412	0,0102099
227	0,0058377
159	0,0174728
278	0,0174085
33	0,0162889
203	0,0186605
181	0,0075731
154	0,0048990
263	0,0075001
229	0,0110520
251	0,0193962
57	0,0159544
68	0,0058665
164	0,0123245
184	0,0174146
152	0,0120923
111	0,0076052
134	0,0096950
100	0,0070601
121	0,0132447
444	0,0052805
445	0,0052805
136	0,0065826
293	0,0053765
437	0,0057699
196	0,0121642
379	0,0116836
108	0,0148222
459	0,0068067
361	0,0102852
73	0,0069517
462	0,0083873
355	0,0060418
270	0,0039734
161	0,0073375
98	0,0026434

PTF BIG LOW

ID	Weight
267	0,0023415
340	0,0022413
42	0,0089122
408	0,0092181
250	0,0070458
171	0,0114313
447	0,0022070
29	0,0019860
463	0,0028752
183	0,0020612
173	0,0022195
201	0,0023442
333	0,0104074
172	0,0056549
167	0,0030591
67	0,0052405
426	0,0039787
310	0,0019389
129	0,0208460
163	0,0087408
153	0,0032789
138	0,0030485
27	0,0043616
393	0,0254416
200	0,0162333
438	0,0076780
298	0,0038971
65	0,0019752
422	0,0478246
23	0,1372934
160	0,0115474
214	0,0054477
297	0,0071288
255	0,0018981
204	0,0045137
367	0,0171225
222	0,0092364
442	0,0056237
139	0,0046138
389	0,0025384
398	0,0027741
323	0,0229953
6	0,0078947
324	0,0065218
242	0,0047723
315	0,1168379
5	0,0163614
158	0,0048564
162	0,0071009
260	0,0107718
147	0,0057121
387	0,0032548
51	0,0027208
212	0,0143327
441	0,0135225
18	0,0095700
126	0,0022669
21	0,0034410
461	0,0196195
409	0,0304226
46	0,0025511
256	0,0054973
176	0,1103415
345	0,0030126
414	0,0024132
335	0,0040652
66	0,0168498
234	0,0028363
349	0,0038623
150	0,0021559
28	0,0045750
228	0,0019859
105	0,0020045
277	0,0022262
91	0,0044156
350	0,0068760
321	0,0024766
359	0,0034906
243	0,0020030
34	0,0021792
353	0,0109135
157	0,0031397
327	0,0109972
10	0,0106708
272	0,0100319
415	0,0147968
177	0,0029882
180	0,0072085
346	0,0022339

PTF BIG NEUTRAL

ID	Weight
19	0,0034437
320	0,0060438
416	0,0041971
281	0,0054099
252	0,0081059
326	0,0032071
271	0,0043871
254	0,0028570
149	0,0364707
58	0,0087373
336	0,0027707
166	0,0052237
218	0,0260573
81	0,0079863
40	0,0024805
436	0,0684890
206	0,0029987
357	0,0056016
413	0,0124494
3	0,0170823
443	0,0030239
82	0,0062319
7	0,0057918
143	0,0098737
141	0,0030683
418	0,0112819
262	0,0162503
383	0,1043375
449	0,1043375
49	0,0061094
24	0,0049000
63	0,0172459
378	0,0182221
423	0,0039157
93	0,0034274
283	0,0349898
274	0,0292896
193	0,0044720
4	0,0063168
35	0,0036081
220	0,0035538
17	0,0024493
226	0,0045379
94	0,0034493
431	0,0030970
217	0,0030176
233	0,0039797
410	0,0024489
130	0,0023565
76	0,0029518
104	0,0133047
189	0,0053124
116	0,0033752
319	0,0038568
118	0,0064287
79	0,0138910
132	0,0047795
420	0,0026943
112	0,0033278
45	0,0123390
20	0,0038560
325	0,0027018
37	0,0214007
135	0,0033168
106	0,0073532
174	0,0155360
219	0,0050971
405	0,0027759
44	0,0045314
394	0,0056963
213	0,0180159
90	0,0042154
247	0,0024227
54	0,0036603
360	0,0073610
472	0,0121395
207	0,0026312
36	0,0059372
291	0,0025554
114	0,0037594
115	0,0083280
371	0,0211289
84	0,0194942
352	0,0028116
248	0,0025184
381	0,0147335
406	0,0024425
238	0,0026756
363	0,0023906
16	0,0028712
354	0,0070296
191	0,0030838
142	0,0169799
109	0,0067197
343	0,0056763
86	0,00540046
77	0,00242334
302	0,00648508

PTF BIG HIGH

ID	Weight
246	0,0161059
384	0,0096999
190	0,0073602
187	0,0119402
75	0,0068258
15	0,0102624
411	0,0111756
351	0,0217837
239	0,0247003
295	0,0075430
124	0,0066922
284	0,0081761
241	0,0091212
275	0,0269521
47	0,0186645
95	0,0072200
215	0,0105995
439	0,0075815
88	0,0167228
25	0,0069606
59	0,0961249
469	0,0129505
365	0,0086627
182	0,0307692
427	0,0147908
249	0,0174255
178	0,0127739
235	0,0508609
202	0,0102218
60	0,0403450
39	0,1349247
236	0,0088242
429	0,0066785
294	0,0172416
342	0,0085240
102	0,0432530
11	0,0082954
425	0,0076799
314	0,0650717
322	0,0225175
1	0,0077523
32	0,0160356
460	0,0106136
175	0,0093331
55	0,0112593
194	0,0309664
266	0,0318585
338	0,0104858
366	0,0076724

Below is the composition of the S/L; S/N; S/H; B/L; B/N; B/H portfolios for 2021/2022 with the relative weights calculated as the ratio of the market capitalisation of each company to the total capitalisation of each portfolios:

PTF SMALL LOW

ID	Weight
448	0,01199584
380	0,02118124
22	0,01007628
29	0,03441316
280	0,02893593
370	0,01014549
397	0,02773872
253	0,0161808
169	0,01767995
113	0,02836057
285	0,02345878
433	0,02545865
65	0,0230809
458	0,02863209
240	0,01031114
404	0,01892839
372	0,02054655
451	0,02483843
466	0,0124471
186	0,01681448
386	0,02353858
446	0,01225367
232	0,01736344
385	0,01613199
264	0,01141637
387	0,02966278
119	0,02754114
301	0,01481725
390	0,02824703
265	0,02679925
407	0,02003192
46	0,03244369
454	0,01528539
257	0,01806319
292	0,03279468
259	0,02749611
402	0,01934889
362	0,01108815
419	0,02313063
382	0,03131393
318	0,02273786
31	0,0184961
56	0,01708654
125	0,01251234
230	0,01280679
456	0,03420387
34	0,03216391

PTF SMALL NEUTRAL

ID	Weight
234	0,01602882
40	0,01112615
61	0,01185413
244	0,0064725
347	0,00882549
80	0,00744709
471	0,00748808
373	0,00879916
309	0,00662715
208	0,0066606
133	0,01016763
403	0,01184775
185	0,00974806
188	0,00699793
430	0,01024331
101	0,01077603
137	0,0085111
341	0,01386115
434	0,0086095
87	0,0123858
277	0,01041568
392	0,01598822
151	0,01040935
2	0,0076752
117	0,00944236
268	0,01036685
273	0,0090407
326	0,01478463
170	0,01087853
313	0,01282298
337	0,00571097
211	0,00571133
9	0,01295325
364	0,0070853
198	0,00737729
391	0,00719085
452	0,00872406
330	0,00840157
128	0,00918325
179	0,01288359
103	0,0065431
455	0,00947104
122	0,00639846
388	0,00866698
199	0,01241215
52	0,00864982
424	0,00566601
140	0,00768007
296	0,01029791
358	0,0122512
282	0,01304863
168	0,01301716
53	0,00627608
331	0,00900795
146	0,00698506
107	0,00507566
258	0,00728893
303	0,011395
421	0,00658743
12	0,00635805
307	0,01085971
85	0,01369175
464	0,01146691
76	0,01477951
344	0,00563503
13	0,01086122
339	0,0061262
329	0,01201926
435	0,00409566
165	0,00996966
155	0,01513979
348	0,0083407
299	0,01005353
130	0,01087634
328	0,01412624
223	0,00773956
316	0,00377564
306	0,00852255
120	0,009697
237	0,00492203
123	0,00921565
374	0,0081614
72	0,00973705
148	0,00831233
289	0,00675193
156	0,01424373
375	0,00497415
395	0,00590981
457	0,00624108
465	0,01295814
288	0,01461121
48	0,00892655
399	0,00671511
291	0,01450395
468	0,0119451
467	0,01290865
290	0,01498718
245	0,00546179
89	0,00738645
334	0,00550056
207	0,01451467
332	0,00965526
78	0,01096973
248	0,01456652
428	0,00354365

PTF SMALL HIGH

ID	Weight
110	0,01438751
420	0,01950282
75	0,02018891
317	0,00977895
261	0,01081288
247	0,01611296
83	0,00774967
14	0,01456994
195	0,02073
224	0,01206676
305	0,00590355
363	0,01880388
38	0,00924757
227	0,00819753
190	0,01987568
70	0,01161933
352	0,01686391
192	0,01578286
77	0,01911198
286	0,01367179
300	0,00782705
145	0,01123529
96	0,01438632
221	0,0091959
131	0,00789009
279	0,01296636
304	0,01115271
368	0,0094368
444	0,00949433
445	0,00949433
453	0,01552862
8	0,00414848
276	0,00662335
356	0,00833609
287	0,01093441
278	0,01951234
439	0,02017456
205	0,01433928
41	0,01425847
92	0,01647571
57	0,01249045
376	0,0056428
269	0,01815373
437	0,01216766
470	0,01203336
312	0,00688962
43	0,00686669
401	0,00588874
154	0,00965883
159	0,02019705
71	0,01917823
33	0,01584804
69	0,00506897
26	0,00742137
181	0,00784079
68	0,00725013
136	0,00946059
62	0,0116656
152	0,01368407
108	0,01892139
11	0,02143118
196	0,01720478
111	0,00947638
293	0,0062794
121	0,01493116
50	0,00982235
229	0,01090617
270	0,00812298
361	0,01218263
134	0,01417275
203	0,01531545
459	0,00845425
379	0,01320508
164	0,0125581
263	0,0060135
100	0,00685238
412	0,0074581
462	0,01217656
396	0,01249801
98	0,00523791
184	0,01039748
73	0,00600205
355	0,00674627
161	0,00783805

PTF BIG LOW

ID	Weight
267	0,00233572
42	0,00678923
340	0,00243221
400	0,00197519
408	0,00848678
173	0,00263143
127	0,00200585
250	0,00764012
200	0,01101133
163	0,00903448
171	0,0114945
447	0,00249486
214	0,00499542
426	0,00458531
463	0,00214828
129	0,02196343
201	0,00273052
183	0,00263325
310	0,00223857
67	0,00412744
153	0,00276145
138	0,00320384
417	0,00337189
27	0,003153
21	0,00380004
440	0,0022301
172	0,0065264
393	0,02020627
23	0,1393596
167	0,00308808
242	0,00529841
422	0,0608992
438	0,00741225
160	0,01516215
297	0,00764985
442	0,00662519
255	0,00224836
298	0,00416647
6	0,01012686
389	0,00298631
323	0,03276535
398	0,00282251
139	0,00443136
5	0,01683284
158	0,00661664
18	0,00727138
51	0,00296353
367	0,01534756
324	0,00565336
243	0,0030127
441	0,01373569
432	0,00218057
222	0,0086657
157	0,00515942
28	0,00484976
311	0,0019937
150	0,00285165
147	0,00831008
212	0,01347034
126	0,00228701
176	0,11707753
345	0,00297359
231	0,00195767
256	0,00488598
335	0,00464123
414	0,00211526
333	0,01068988
260	0,00998781
409	0,02718483
228	0,00205848
315	0,0970338
105	0,00211425
210	0,00209141
353	0,01287054
272	0,00929364
327	0,01142377
197	0,00236517
66	0,01467572
450	0,0025347
320	0,00517693
350	0,00736533
461	0,01271412
24	0,00708014
64	0,00213121
97	0,0020514
74	0,00199559
271	0,00400627
254	0,00291565
91	0,00385758
423	0,0034759
162	0,00562447
443	0,00308579
336	0,00273575
413	0,0125578

PTF BIG NEUTRAL

ID	Weight
19	0,00390656
81	0,00778951
418	0,00841177
166	0,00655488
346	0,00261407
359	0,00379696
141	0,0035844
383	0,14354367
449	0,14354367
416	0,00353618
436	0,06988348
10	0,01072126
177	0,00312034
218	0,02467316
357	0,00572193
220	0,00490571
3	0,01858805
252	0,00753486
58	0,00827489
180	0,0075868
206	0,00305762
262	0,01963789
143	0,00895284
274	0,03532406
49	0,00622888
149	0,03363735
82	0,0079274
94	0,00420601
63	0,01742824
349	0,00444129
281	0,00417023
369	0,00262299
431	0,00333277
189	0,00541101
79	0,01755988
415	0,01445915
17	0,00254052
325	0,00330272
104	0,01368213
217	0,00330094
193	0,00458338
35	0,00321015
209	0,0029603
410	0,00256077
93	0,00265728
283	0,02896604
233	0,00387521
405	0,00352896
112	0,00457697
118	0,00680284
213	0,0247553
377	0,00271234
321	0,0031093
90	0,00514511
7	0,00423446
472	0,01326231
116	0,0031436
378	0,01711455
319	0,00348059
45	0,01033674
302	0,00929692
132	0,00445317
44	0,00452127
226	0,00507263
84	0,02388834
16	0,00352618
54	0,00302398
394	0,00575539
114	0,00434768
219	0,00448565
360	0,00690889
135	0,00263227
30	0,00263635
354	0,00840324
99	0,00253836
36	0,00527291
4	0,0038704
239	0,0118757
384	0,00375725
295	0,00362159
238	0,00313932
174	0,0103727
37	0,01606757

PTF BIG HIGH

ID	Weight
246	0,01200773
406	0,00559532
115	0,01713911
20	0,01537477
371	0,03769402
95	0,00858658
191	0,00602495
106	0,00961629
187	0,00817081
109	0,01132113
86	0,01051294
142	0,03447577
308	0,00570816
124	0,00616789
215	0,01572831
381	0,02393326
411	0,00863491
15	0,0074113
216	0,00733585
178	0,01376113
284	0,00725243
144	0,00633541
182	0,0291001
365	0,00792949
275	0,02128122
249	0,01376018
342	0,0137128
25	0,00624705
202	0,00933566
88	0,01333317
60	0,03737293
241	0,00697882
225	0,00669211
47	0,01257347
59	0,07731298
469	0,00691446
102	0,04279811
204	0,01400125
429	0,00650788
343	0,00635938
427	0,01406315
351	0,0109808
294	0,01375652
314	0,0601548
236	0,00635782
39	0,11054602
322	0,02115935
32	0,01291251
251	0,00562317
425	0,0059412
1	0,00638153
175	0,00792411
235	0,02902231
194	0,031606
55	0,01020233
460	0,00712842
338	0,00868414
366	0,00675954
266	0,01979716

Table 5 – SG, SN, SV, BG, BN, BV portfolios composed by intersection of ME/ESG for 2018/2019

SG	MKT CAP	WEIGHT
382	11.500.347.300	0,01075
471	4.809.758.458	0,00449
343	16.290.619.204	0,01522
434	15.943.197.288	0,01490
374	7.502.147.285	0,00701
390	16.781.969.765	0,01568
467	10.454.611.378	0,00977
468	4.064.697.972	0,00380
455	2.802.336.945	0,00262
389	10.643.552.531	0,00995
332	7.315.760.526	0,00684
117	14.091.825.393	0,01317
400	19.593.662.776	0,01831
463	11.906.311.103	0,01113
362	2.572.973.463	0,00240
404	4.686.006.994	0,00438
419	3.088.326.093	0,00289
451	7.013.567.670	0,00655
26	10.442.851.351	0,00976
232	11.816.188.031	0,01104
386	4.930.395.000	0,00461
292	8.577.908.628	0,00802
373	7.250.849.580	0,00678
179	11.288.347.858	0,01055
437	9.386.608.350	0,00877
345	16.751.128.913	0,01565
125	10.076.118.451	0,00942
185	8.719.138.369	0,00815
223	4.410.156.703	0,00412
197	10.095.325.406	0,00943
17	15.714.251.304	0,01468
470	7.516.291.061	0,00702
457	8.807.623.767	0,00823
440	18.414.407.833	0,01721
159	13.804.715.666	0,01290
424	8.258.789.689	0,00772
50	9.636.870.139	0,00901
397	10.320.094.254	0,00964
229	10.753.593.164	0,01005
454	1.605.879.932	0,00150
466	9.567.859.718	0,00894
97	11.229.156.921	0,01049
140	13.532.470.131	0,01265
380	10.396.583.517	0,00972
293	7.829.621.341	0,00732
412	12.410.437.407	0,01160
77	15.904.749.667	0,01486
83	8.280.997.126	0,00774
105	14.949.811.345	0,01397
464	10.829.730.199	0,01012
318	7.214.137.616	0,00674
276	10.783.251.577	0,01008
240	5.467.271.320	0,00511
330	10.679.092.089	0,00998
433	502.931.946	0,00047
245	8.032.094.024	0,00751
244	7.256.905.437	0,00678
309	11.562.744.407	0,01081
188	7.133.098.085	0,00667
74	13.330.442.282	0,01246
100	8.851.508.044	0,00827
38	9.026.202.800	0,00843
137	9.685.368.868	0,00905
221	7.299.586.019	0,00682
168	10.778.323.987	0,01007
452	5.586.839.181	0,00522
388	12.034.204.831	0,01125
402	13.572.578.073	0,01268
72	12.693.271.257	0,01186
346	11.944.068.973	0,01116
273	10.917.128.558	0,01020
450	15.892.532.110	0,01485
304	14.148.632.855	0,01322
435	9.226.210.799	0,00862
268	8.021.628.441	0,00750
41	6.946.495.181	0,00649
428	8.174.631.311	0,00764
51	12.228.034.280	0,01143
254	13.303.093.220	0,01243
98	4.806.107.140	0,00449
363	19.578.023.546	0,01830
14	15.935.414.512	0,01489
305	8.677.812.000	0,00811
398	11.998.278.267	0,01121
248	17.950.470.970	0,01677
421	10.976.713.344	0,01026
113	11.619.788.989	0,01086
280	17.926.543.357	0,01675
417	11.999.173.538	0,01121
259	5.624.862.176	0,00526
303	8.315.451.834	0,00777
211	6.474.117.375	0,00605
56	15.170.750.943	0,01418
287	6.787.199.957	0,00634
263	8.313.106.236	0,00777
22	9.963.020.603	0,00931
385	7.943.692.095	0,00742
208	12.512.337.223	0,01169
407	17.281.186.567	0,01615
340	18.345.609.541	0,01714
348	10.400.441.180	0,00972
432	6.273.843.074	0,00586
52	8.200.556.297	0,00766
133	10.157.765.278	0,00949

SN	MKT CAP	WEIGHT
396	16.369.064.002	0,01405
431	16.221.988.957	0,01392
257	5.559.053.327	0,00477
282	13.046.324.221	0,01119
300	6.895.748.869	0,00592
370	10.755.326.815	0,00923
128	11.151.591.033	0,00957
62	12.599.153.121	0,01081
316	10.195.694.735	0,00875
48	14.067.404.804	0,01207
224	13.429.032.651	0,01152
192	18.506.437.975	0,01588
326	12.285.850.947	0,01054
444	9.104.785.554	0,00781
445	9.104.785.554	0,00781
198	16.413.499.637	0,01408
43	7.235.394.154	0,00621
453	16.861.446.010	0,01447
225	19.147.901.354	0,01643
12	8.147.944.289	0,00699
301	8.799.044.616	0,00755
161	10.960.058.388	0,00940
80	14.773.083.094	0,01268
361	12.502.251.406	0,01073
150	15.981.564.670	0,01371
107	8.718.805.282	0,00748
364	11.332.057.556	0,00972
138	16.041.183.387	0,01376
313	16.235.415.947	0,01393
339	7.886.744.491	0,00677
31	7.702.471.330	0,00661
101	11.751.658.275	0,01008
64	19.449.884.390	0,01669
237	11.877.944.026	0,01019
310	14.164.966.936	0,01215
358	11.861.007.639	0,01018
391	10.041.736.468	0,00862
195	15.832.669.710	0,01359
337	12.128.389.973	0,01041
458	5.730.284.246	0,00492
459	13.633.202.595	0,01170
61	16.192.263.273	0,01389
111	16.027.841.474	0,01375
446	7.576.894.869	0,00650
186	17.757.485.747	0,01524
347	5.373.332.042	0,00461
379	13.833.183.811	0,01187
146	7.929.171.445	0,00680
317	9.973.430.474	0,00856
110	19.204.772.893	0,01648
119	15.773.295.970	0,01353
2	9.576.821.546	0,00822
372	16.210.400.514	0,01391
264	8.542.360.000	0,00733
8	7.502.798.611	0,00644
331	9.947.856.868	0,00854
73	11.145.824.609	0,00956
344	13.443.965.234	0,01154
369	13.373.974.611	0,01148
328	10.553.228.000	0,00906
261	11.091.192.110	0,00952
165	12.796.653.349	0,01098
87	10.382.303.220	0,00891
96	15.590.910.445	0,01338
148	10.855.663.574	0,00931
181	8.678.308.607	0,00745
258	11.885.458.378	0,01020
169	8.932.771.666	0,00766
103	9.783.548.171	0,00839
177	19.658.944.341	0,01687
414	17.950.180.175	0,01540
108	15.426.635.515	0,01324
376	5.550.103.946	0,00476
184	14.128.302.853	0,01212
341	6.949.539.689	0,00596
170	19.748.888.486	0,01695
329	8.597.678.850	0,00738
392	14.544.623.815	0,01248
65	17.515.954.160	0,01503
289	6.819.190.349	0,00585
270	11.920.496.062	0,01023
355	6.885.762.849	0,00591
285	14.289.430.078	0,01226
334	9.288.104.904	0,00797
410	16.392.952.531	0,01407
299	11.330.724.183	0,00972
134	12.477.465.644	0,01071
311	7.262.030.148	0,00623
136	11.259.581.183	0,00966
312	9.429.271.658	0,00809
306	17.393.181.894	0,01492
9	8.185.287.557	0,00702
308	12.391.365.499	0,01063
228	14.784.839.225	0,01269
401	4.452.903.756	0,00382
145	16.346.949.049	0,01403

SV	MKT CAP	WEIGHT
70	14.721.568.648	0,03091
6	17.809.436.589	0,03739
69	17.252.520.036	0,03623
230	6.948.371.830	0,01459
92	18.496.302.165	0,03884
68	11.107.057.189	0,02332
448	14.789.270.777	0,03105
307	16.199.822.435	0,03401
368	13.948.741.389	0,02929
253	14.695.601.658	0,03086
265	10.157.282.773	0,02133
154	6.173.382.618	0,01296
156	12.749.724.000	0,02677
456	10.698.393.322	0,02246
152	15.068.254.340	0,03164
121	15.945.762.705	0,03348
123	13.336.477.217	0,02800
430	11.990.654.856	0,02518
89	10.219.120.743	0,02146
34	15.596.011.698	0,03275
227	9.942.922.634	0,02088
395	7.847.427.196	0,01648
13	11.998.252.008	0,02519
183	18.812.245.935	0,03950
356	7.539.746.568	0,01583
375	11.481.228.950	0,02411
131	12.370.181.008	0,02597
144	14.315.763.206	0,03006
288	16.377.512.590	0,03439
112	14.939.537.076	0,03137
203	12.318.514.055	0,02587
40	15.734.368.739	0,03304
122	10.263.551.690	0,02155
187	18.456.676.900	0,03875
377	13.648.847.292	0,02866
53	12.308.432.051	0,02584

BG	MKT CAP	WEIGHT
418	64.219.074.381	0,03043
367	116.859.980.473	0,05538
438	31.924.365.000	0,01513
109	29.283.617.402	0,01388
359	27.216.862.535	0,01290
39	502.599.567.547	0,23817
413	91.276.640.101	0,04325
465	22.595.930.694	0,01071
365	23.773.015.200	0,01127
210	23.561.278.633	0,01117
320	45.065.203.514	0,02136
201	27.217.192.629	0,01290
324	79.799.005.518	0,03782
231	23.095.873.235	0,01094
381	53.966.280.129	0,02557
216	22.419.173.945	0,01062
384	21.994.653.647	0,01042
164	20.089.397.028	0,00952
281	42.348.521.980	0,02007
54	32.166.856.016	0,01524
220	35.293.116.421	0,01672
286	23.164.327.942	0,01098
205	20.403.263.790	0,00967
236	31.719.715.779	0,01503
351	33.583.921.883	0,01591
416	30.242.213.438	0,01433
352	21.156.422.977	0,01003
239	56.084.304.826	0,02658
200	172.933.292.400	0,08195
460	53.130.774.759	0,02518
95	50.573.344.206	0,02397
350	54.692.790.435	0,02592
139	42.035.930.895	0,01992
422	57.152.667.520	0,02708
443	23.239.369.494	0,01101
294	59.526.837.955	0,02821
349	43.839.810.000	0,02077

BN	MKT CAP	WEIGHT
166	40.170.720.656	0,00546
234	33.994.112.459	0,00462
199	22.192.951.684	0,00301
21	35.009.100.411	0,00475
338	40.519.578.627	0,00550
93	30.447.897.779	0,00414
442	41.097.768.446	0,00558
290	26.692.451.784	0,00363
406	19.815.196.414	0,00269
85	23.009.315.529	0,00312
4	35.535.271.937	0,00483
469	121.344.929.910	0,01648
249	73.855.445.987	0,01003
226	39.711.718.935	0,00539
219	35.181.122.948	0,00478
278	31.810.388.903	0,00432
436	376.724.818.057	0,05116
252	58.653.857.081	0,00797
217	22.217.241.719	0,00302
49	52.463.837.029	0,00713
425	33.943.941.254	0,00461
371	154.109.023.874	0,02093
29	20.369.543.772	0,00277
321	27.026.559.476	0,00367
209	20.721.727.321	0,00281
233	27.566.391.208	0,00374
178	61.191.608.681	0,00831
75	24.180.056.509	0,00328
269	21.783.829.568	0,00296
461	99.088.215.710	0,01346
277	34.382.069.138	0,00467
32	33.383.247.483	0,00453
387	40.784.000.118	0,00554
46	25.254.582.587	0,00343
429	40.767.266.569	0,00554
399	22.813.445.217	0,00310
1	34.683.886.958	0,00471
79	72.277.086.733	0,00982
158	52.372.782.353	0,00711
378	116.257.050.000	0,01579
291	21.853.136.278	0,00297
173	22.455.066.340	0,00305
297	69.680.774.732	0,00946
420	31.904.973.500	0,00433
15	36.865.196.772	0,00501
394	42.906.759.405	0,00583
411	35.616.821.373	0,00484
235	207.714.120.000	0,02821
250	76.682.844.000	0,01041
78	20.066.330.147	0,00273
405	30.639.977.008	0,00416
114	46.557.702.984	0,00632
28	59.091.664.541	0,00803
157	28.658.697.314	0,00389
207	19.966.727.099	0,00271
383	723.465.248.599	0,09825
449	723.465.248.599	0,09825
84	173.918.149.176	0,02362
242	36.838.210.687	0,00500
426	42.830.774.225	0,00582
71	23.815.486.614	0,00323
99	24.384.434.678	0,00331
88	61.521.333.255	0,00836
82	42.782.578.559	0,00581
47	72.317.317.687	0,00982
354	67.927.173.410	0,00923
190	20.610.252.952	0,00280
19	24.413.524.721	0,00332
357	28.342.474.327	0,00385
218	196.289.635.097	0,02666
298	26.831.664.000	0,00364
327	102.237.190.153	0,01388
439	39.725.946.404	0,00540
246	45.188.791.001	0,00614
155	22.392.646.992	0,00304
91	42.565.444.212	0,00578
215	71.779.931.717	0,00975
243	51.913.188.369	0,00705
175	46.541.756.690	0,00632
196	46.343.492.074	0,00629
16	34.863.996.203	0,00473
10	97.806.890.592	0,01328
23	1.090.307.495.240	0,14808
333	83.800.328.165	0,01138
202	43.612.139.545	0,00592
130	21.948.464.108	0,00298
272	101.846.498.011	0,01383
94	48.127.891.896	0,00654
462	22.442.636.316	0,00305
322	62.138.213.267	0,00844
153	39.457.526.255	0,00536
360	58.197.031.662	0,00790
247	26.136.010.396	0,00355

BV	MKT CAP	WEIGHT
160	122.584.771.349	0,01141
409	333.967.503.146	0,03108
213	253.170.000.000	0,02356
366	33.680.150.000	0,00313
284	68.039.754.516	0,00633
171	136.890.533.093	0,01274
124	26.073.478.845	0,00243
262	90.092.568.528	0,00838
222	105.820.068.139	0,00985
319	36.756.698.011	0,00342
403	34.212.373.180	0,00318
20	32.402.187.636	0,00302
256	60.300.802.627	0,00561
37	232.301.888.978	0,02162
255	35.578.296.470	0,00331
325	23.398.291.670	0,00218
335	32.020.076.533	0,00298
66	201.545.933.070	0,01876
189	40.091.445.503	0,00373
283	278.411.071.454	0,02591
275	91.933.149.722	0,00856
315	734.416.210.197	0,06835
18	124.047.470.229	0,01154
191	25.317.328.011	0,00236
167	37.033.105.368	0,00345
182	68.204.136.670	0,00635
24	31.809.573.260	0,00296
90	29.757.244.000	0,00277
447	21.293.725.641	0,00198
129	208.251.032.005	0,01938
141	22.411.223.063	0,00209
423	24.087.335.248	0,00224
126	22.487.198.718	0,00209
314	238.251.216.157	0,02217
104	83.076.444.572	0,00773
116	31.622.135.864	0,00294
393	194.836.659.976	0,01813
58	73.134.215.718	0,00681
206	24.523.426.069	0,00228
323	97.691.500.000	0,00909
472	85.986.554.947	0,00800
57	41.577.560.704	0,00387
174	117.109.934.923	0,01090
25	22.969.600.044	0,00214
76	21.457.412.533	0,00200
30	24.108.696.572	0,00224
106	40.201.451.139	0,00374
45	84.841.692.273	0,00790
143	101.448.134.648	0,00944
151	19.866.960.494	0,00185
127	38.199.341.383	0,00356
102	288.703.310.922	0,02687
55	35.803.694.911	0,00333
296	20.376.320.019	0,00190
44	48.903.519.601	0,00455
353	108.331.277.717	0,01008
5	122.467.820.589	0,01140
267	28.706.783.662	0,00267
7	36.629.470.457	0,00341
163	77.975.154.950	0,00726
238	49.897.352.810	0,00464
441	138.673.703.186	0,01291
274	239.661.959.904	0,02230
135	60.630.142.487	0,00564
42	183.143.031.503	0,01704
118	80.915.906.731	0,00753
193	42.519.466.979	0,00396
86	46.911.589.235	0,00437
33	23.648.529.508	0,00220
115	65.844.730.550	0,00613
415	198.694.768.365	0,01849
204	53.945.141.568	0,00502
279	20.885.446.117	0,00194
3	127.035.568.205	0,01182
302	36.966.001.600	0,00344
27	32.238.100.659	0,00300
149	341.335.336.115	0,03177
342	30.430.960.895	0,00283
120	23.285.309.883	0,00217
11	28.461.264.770	0,00265
194	216.909.811.261	0,02019
35	35.025.520.488	0,00326
212	155.780.644.480	0,01450
408	103.780.015.631	0,00966
132	38.837.140.195	0,00361
241	29.607.299.418	0,00276
260	89.316.702.689	0,00831
59	324.626.594.975	0,03021
36	69.834.092.814	0,00650
162	74.474.022.146	0,00693
266	127.137.642.485	0,01183
251	23.963.239.883	0,00223
147	52.405.590.716	0,00488
142	213.367.000.000	0,01986
336	20.653.078.950	0,00192
214	92.559.704.617	0,00861
63	200.201.707.770	0,01863
180	109.860.632.511	0,01022
60	207.873.143.604	0,01935
81	37.138.897.526	0,00346
427	47.211.451.524	0,00439
172	42.637.946.000	0,00397
295	32.372.276.335	0,00301
271	37.940.621.933	0,00353
67	51.622.881.579	0,00480
176	757.640.105.771	0,07051

Executive Summary

"Sustainable finance" refers to finance that considers environmental, social and corporate governance factors, the so-called ESG factors, in investment decision making, directing capital toward longer-term sustainable activities and projects. Sustainable finance is thus the application of the concept of sustainable development to financial activity.

Environmental type factors include issues such as those of climate change mitigation and the transition to climate neutrality, i.e., to a zero-emissions economy, as well as issues related to the preservation of biodiversity, pollution prevention, and the circular economy[67]. Social factors refer to issues related to inequality and inclusion, labor relations, investment in training and community welfare as well as respect for human rights. Finally, the corporate governance of public and private institutions plays a key role in ensuring that social and environmental considerations enter into their decision-making processes, for example through diversity policies in the composition of boards of directors, the presence of independent directors, or the way in which executives are compensated.

Making a financial investment that takes ESG factors into account therefore means investing in companies that make sustainable business choices that are consistent with the principles of the United Nations Global Compact relating to human rights, labor standards, environmental protection and anti-corruption, the goals of the United Nations 2030 Agenda for Sustainable Development and the Paris Agreement[68] on climate change.

The topic of sustainability is at the centre of the economic debate thanks to a widespread awareness of environmental issues and social inequalities, which has made it possible to integrate the notion of sustainability with the creation of socially shared value, shifting interest from shareholders to corporate stakeholders. The transition to sustainable business models requires significant financial resources, with mitigation only possible through technological innovation. Investments are also important with regard to emerging economies that must be supported in their growth path by providing them with the financial means for development to take place in a sustainable manner. Social inequalities also require the input of private capital in the development of coherent policies. Sustainable finance, unlike traditional finance, seeks to hold together financial economic return and

[67] European Commission, *Overview of sustainable finance*, finance.ec.europa.eu

[68] It is an international treaty signed by 195 states within the framework of COP21, the 21st annual session of the Conference of the Parties to the United Nations Framework Convention on Climate Change (United Nations Framework Convention on Climate Change - UNFCCC), held in Paris in December 2015. The signatory states pledged to limit the rise in global temperatures below 2°C compared to pre-industrial levels and to do their utmost to limit the increase to 1.5°C.

the generation of a positive socio-environmental impact. Practically, sustainable finance bets on the absence of a trade-off between being sustainable and being socio-environmentally compatible. The definition of sustainable finance identifies all investment strategies that, directly or indirectly, aim to achieve a socially shared return along with the expected economic return from the investment.

Since the adoption of the 2030 Agenda and the signing of the Paris Agreement in 2015, the integration of the SDGs[69] - and, more generally, of environmental and social - into investment targets and strategies is an increasingly common practice.

This trend is driven by a growing awareness among governments and investors of the financial relevance of sustainability issues and the central role of capital markets in supporting inclusive, low-impact economic growth.

In addition, savers are increasingly interested in aligning their financial choices with their own values or with environmental and social issues they consider important.

The interest of governments, regulators, financial operators and savers has focused predominantly on environmental issues, partly as a result of the attention generated by international conventions such as the Paris Agreement. For financial operators, environmental issues can be more easily integrated into investment strategies than social ones: factors such as CO2 emissions are easier to measure and express in quantitative terms; consequently, the performance of different companies is also more comparable.

The regulatory and policy interventions proposed by the European Commission also focus on directing investments towards projects aligned with the EU's environmental and climate objectives.

Nevertheless, actors, strategies and products of finance for sustainable development consider the environmental and social dimensions as deeply interconnected: in fact, phenomena such as climate change produce effects both environmental (e.g. increased frequency and intensity of extreme weather phenomena, droughts, floods, etc.) and social (e.g. climate migrants, increased poverty and social tensions generated by famine and shortage of primary resources).

With this in mind, the action of finance for sustainable development is innervated by the concept of the "Just Transition", according to which the transition to an economy with no impact on the environment requires support for the areas, sectors and actors that are most exposed and vulnerable to change (e.g. fossil fuel companies).

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[69] Sustainable Development Goals: in September 2015, more than 150 international leaders met at the United Nations to contribute to global development, promote human well-being and protect the environment. The community of states endorsed the 2030 Agenda for Sustainable Development, the core elements of which are the 17 Sustainable Development Goals (SDGs) and 169 sub-goals, which aim to end poverty, fight inequality and achieve social and economic development. They also take up aspects of fundamental importance for sustainable development such as tackling climate change and building peaceful societies by the year 2030. https://sdgs.un.org/goals

The role of the financial sector is crucial; the quantitative and qualitative characteristics of economic development depend crucially on the process of transforming savings into investment, and the latter depends crucially on the process of financial intermediation between savers and investors exercised by the financial system. If banks manage to incorporate sustainability risks (i.e., environmental and social risks) into their lending criteria, new investments will be more compatible with sustainable development in terms of both production processes and products and services.
Similarly, if asset management gives more weight to environmental and social ethical criteria, the market share of ethical funds feeding Socially Responsible Savings will increase. In other words, the financial system has a responsibility to channel savings towards socially responsible uses that are fully compatible with the goal of sustainable development.

The private financial sector plays an important role in the discussion on corporate social responsibility (or CSR, an acronym for Corporate Social Responsibility), both in terms of the social and environmental impact of the financing and credit offered and the ways in which financial companies raise, place and leverage capital and how they then hedge risk. The private financial sector plays a key role in the functioning of the business world, acting as an intermediary in the flow of capital between the corporate world, governments, individuals and organisations of various kinds.
The increasing attention paid in recent years to the role played by financial institutions in large projects involving a potential risk of violating environmental, social and human rights standards has brought to the fore the direct responsibility of these companies in ensuring and promoting more "ethical" behaviour, in different areas, and by different actors such as commercial and investment banks, asset management institutions, reinsurance, credit insurance and insurance groups, investment funds and pension funds.

While the role of finance is crucial in spreading the culture of sustainability, it may be useful to mention the topic of measuring sustainability ratings. Socially responsible and sustainability-conscious investors use the analyses of agencies that provide sustainability ratings. Sustainability ratings that focus on indices and indicators other than purely economic performance are becoming more widespread in various sectoral contexts, and ESG rating agencies are increasingly measuring the sustainability performance of corporate companies.
An investment is defined as "sustainable" on the basis of indicators, ESG ratings, which express a synthetic judgement on the level of environmental (Environmental), social (Social) and corporate governance (Governance) sustainability of issuers (companies, states, supranational organisations), securities and/or collective investment instruments.

Different approaches have been used in the literature to study agency ratings, what matters, however, is whether the agencies stimulate the adoption of "sustainable business models" that contribute to sustainable business organisations.
In several cases, it is claimed that the ratings still do not include all the indicators necessary to adequately stimulate a sustainability approach among companies. In this context, a further open topic is the integration of SDGs goals into reporting.[70]

It is widely believed that the integration of environmental, social and governance factors contains valuable information for long-term strategies but also in short-term considerations, e.g. to intercept share price fluctuations due to future ESG rating changes, or the opportunity for active managers to exploit information asymmetries to conduct transactions based on ESG controversy forecasts.

Understanding how the market views sustainability performance is an important step for companies of all sizes.
Although the main non-financial rating agencies focus their analyses on large companies, ESG issues are becoming increasingly important in investment decisions and - with a view to financing truly sustainable projects - even small and medium-sized companies involved in the various value chains have to take on board certain extra-financial criteria.
Therefore, the sustainability rating is an additional consideration that should be part of corporate policies alongside the financial rating.
Furthermore, it is an opportunity for small and medium-sized enterprises to prove their commitment to social impact issues also with a view to attracting the interest of so-called "responsible" investors.
The sustainability (or ESG) rating is commonly understood as a synthetic judgement that attests to the consistency of an issuer, a security or a fund with regard to environmental, social and governance aspects, accompanying the financial rating with the aim of increasing the scope of information available to investors.

Connected to the ESG issue, is the topic of greenwashing, to which attention must be paid. Greenwashing - which can affect a company's products, objectives and/or policies - damages investors, consumers, competitors and, more generally, market credibility. In particular, the risks to

[70] The United Nations Global Compact provides a practical guide to achieving this integration (UN-GlobalCompact, Integrating SDGs in Corporate Reporting: a practical guide, 2018). Also available from the same source is a matrix that cross-references SDGs and financial instruments for sustainability produced by the financial industry (UN-GlobalCompact & KPMG, SDG Industry Matrix, 2016).

which both companies that engage in greenwashing and the financial operators that support them are exposed fall into three main categories: reputational, legal and financial.
It is therefore essential to prevent and counteract the phenomenon, making use of resources such as: European and Italian regulations in force; ESG data; and sustainability certifications. Finally, companies and investors can avoid incurring greenwashing by following some general recommendations regarding: identification of sustainability goals and their achievement; methodologies for measuring KPIs; ways of retrieving ESG data; verification of disclosed data and progress; dialogue with stakeholders; and accurate and transparent communication.
Regarding the financial sector, the commitment of both asset owners and asset managers is essential to prevent and counteract greenwashing.

However, there is a lack of internationally agreed standards for assessing sustainability. Consequently, pending a regulation establishing uniform criteria on the data and methodologies used for the construction of ESG ratings, different concepts and measures are currently used to define "sustainable" an economic activity. ESG scores are used extensively in finance for the selection of financial instruments, the construction of investment portfolios and the creation of market indices that are referred to as "sustainable" or "ESG".
The objective of sustainable finance is to teach investors and creditors ethics in their financial choices, incentivising them to share in the circular economy and protect the last remaining resources as much as possible. It is with this perspective that rating takes over, in order to disclose reliable and certain data that can guide these financial agents towards more responsible choices. Thus, multiple aspects make this ambition complex to implement, not least in terms of obtaining ESG ratings, the timeframe for which is exaggeratedly long.
Investors, aware of the economic and temporal difficulties of sustainable transition, are demanding an increasingly accurate and, above all, clear valuation based on consistent corporate reporting. Considering these requirements and the competitiveness inherent in this emerging sector, it is necessary to ensure the veracity of the ratings themselves, sometimes accentuated for opportunistic purposes.

A study by the ESG European Institute found that more than 600 ESG ratings could be counted globally in 2018. Of them all, the most globally recognized are those of MSCI ESG Ratings; Sustainalytics; and Refinitiv.

There are several ways to calculate an ESG rating. The rating can look at the degree to which a company (a nation, a fund) is aligned and compliant with international sustainability strategies and guidelines set by institutions such as the EU, UN and OECD. Or it can measure how much of a company's economic value is at risk due to ESG factors or, more technically, the extent of ESG risks not managed by a company, assigning lower scores the lower the unmanaged risk (thus better ESG ratings), as in the case of the Sustainalytics rating. Or again, as in the case of the rating proposed by MSCI, not only the ESG risks faced by a company and its sector of reference can be observed, thus rated, but also the opportunities. So the rating tries to give a quantification of the exposure to key risks and opportunities and how well the company is managing them in general and relative to competitors. In particular, it refers to material ESG risks and opportunities that are driven by large-scale trends, such as climate change, resource scarcity, demographic changes, as well as the nature of the company's operations.
A risk is considered relevant to an industry when its member companies are likely to incur substantial costs in relation to it (e.g., a regulatory ban on a chemical input that requires reformulation of a product). Conversely, an opportunity is relevant to an industry when companies are likely to capitalize on it to profit from it (e.g., being able to take advantage of a green and innovative technology).

It is precisely in recognition of ESG that these issues are also gaining importance in the financial markets that Refinitiv is committed to providing "transparent, accurate and comparable" information on environment, social and corporate governance for use by the financial industry
Making detailed analysis on ESG possible in Refinitiv is the data platform that provides a set of third-party data organized to be usable with ease through a cloud platform, enabling rapid development of specific applications with all the most advanced analysis capabilities.
The data is mostly derived from public sources and information released by the companies themselves and consists of more than four hundred ESG metrics, manually processed within a standardised process to ensure uniformity of assessments.
Although the database is updated on an ongoing basis and the scoring on a weekly basis, the data undergoes the most significant changes on an annual basis, coinciding with the publication of ESG reporting. In fact, more frequent updating of the data is only done in extraordinary cases, such as, for example, significant changes in the type of ESG reporting standard or corporate structure during the year.
The main sources of data are annual reports, company websites, market and stock exchange perceptions, news and, above all, corporate social responsibility reporting.

The scores are constructed through the analysis of over 630 key performance indicators (KPIs) to make the assessment as uniform as possible.

In general, the factors that determine the quality of an ESG rating are the quality and transparency of the methodology, the focus on relevant and substantive issues, the credibility of the data sources, the experience and expertise of the research team, the participation of the rated company and stakeholders in the rating process, and finally the common use of the rating.

Given the increasing importance of ESG ratings, the need arises to understand how to implement this ESG variable in economic models. Therefore, it is important to make an overview of multifactor models in order to proceed with ESG risk factor implementation.
The CAPM turns out to be one of the most popular models in the financial markets literature. This model, assuming a linear relationship between the profitability and riskiness of financial securities, stems from the need to show that not all the risk of a security is rewarded by the market in the form of higher returns, but only that part that cannot be eliminated through diversification.
Since its inception, the CAPM has been the subject of numerous empirical tests, the results of which have not always agreed with each other, thus raising the doubt that the model does not provide a complete picture of the expected risk-return relationship.
Therefore, alternative models have emerged which, in some cases, are extensions of the CAPM, such as three-factor model.
This model is named after Eugene Fama and Kenneth French, who proposed it in 1992 as a viable alternative to the CAPM model.
The three-factor model allows the expected return on a security or portfolio to be estimated as the sum of three different components:

- the market risk premium, the same as already analyzed in the CAPM model;
- the average size of investment companies, measured as the difference between the expected return of a portfolio composed of small-cap stocks and the expected return of a portfolio of large-cap stocks (in the equation: SMB, small minus big);
- the degree of over-undervaluation of investment companies, measured by the BE/ME ratio; it is calculated as the difference between the expected return of a portfolio composed of securities with high BE/ME (value securities) and the expected return of a portfolio of securities with low BE/ME (growth securities) (HML, high minus low).

Carhart proposed extending the previous three-factor model to include not only market, size and value but also the momentum factor, the so-called momentum factor. First presented by Jegadeesh and Titman and more commonly known as the Monthly Momentum Factor (MOM) is the tendency of a security to replicate, in the period following observation, the performance of the previous 3-12 months. And so, therefore, that stocks with positive performance will tend to prolong their outperformance, while stocks with negative performance will tend to continue downward.
Criticisms about the limitation of three factors for investigating returns led Fama and French to expand their "three factor model" with two more factors: profitability and investiment. This led to the creation of the "five factor model".

Given these implementations to Fama and French's 3-factor model, it was thought to proceed with the implementation of a fourth factor different from those presented so far, the ESG risk factor. Initially, the basic 3-factor model will be constructed and then proceed with the actual construction of the ESG risk factor and subsequent analysis of the results obtained.

The Fama-French Three Factor model will be developed using the companies listed in the S&P 500 in the period between 2018 and 2022. The index chosen for the construction of the model is the S&P 500 because it contains 503 stocks of as many New York-listed companies (NYSE and Nasdaq), representing about 80 per cent of the market capitalisation, which are selected by a special committee. Data collection was largely based on a secondary source, Refinitiv Eikon Datastream, which is a renowned tool for accessing stock market data. In addition, Refinitiv Eikon produces its own ESG scores that will form the basis of the independent variables created for the factor analysis. The data used in this thesis contain the accounting information of a total of 472 companies, obtained for the years 2018 to 2022.
This information includes the daily closing prices of each of the 472 companies from 01/07/2018 to 30/06/2022, the annual market capitalisation from 2018 to 2022 for all 472 companies taken into account as well as the annual book equity from 2018 to 2022 understood as book value of assets minus total liabilities. The daily closing price observation amounts to 734061 over a 4-year period; daily closing prices are needed to calculate the daily return on shares of the 472 companies in our sample for the period from 2018 to 2022.
Fama and French's model expands the CAPM by adding two additive factors; the size factor is considered through the SMB variable, measured in terms of market capitalisation (ME), while value expectations are quantified through the HML variable, determined as a function of the BE/ME ratio.

The process for creating the SMB and HML factors starts with sorting the companies that compose the S&P 500 index from first to 472nd, eliminating from the sample those with missing data.
The ME data have to be reordered from smallest to largest based on the market equity of each company in the S&P 500 index and the median (i.e., the 50th percentile) is calculated to divide the data into the "SMALL" and "BIG" groups.
The next step is to also reorder the data obtained for the BE/ME of each company from smallest to largest.

The companies divided on the basis of BE/ME, resulting in three divisions:

- companies with a BE/ME below the 30th percentile will be placed in the "GROWTH" group;
- companies with a BE/ME between the 30th percentile and the 70th percentile will be placed in the "NEUTRAL" group;
- companies with a BE/ME above the 70th percentile will be placed in the "VALUE" group.

Following these steps, it is possible to proceed with the creation of the six portfolios by intersecting the companies:

- the first portfolio will consist of those companies present in both the SMALL group (small-ME) and the GROWTH group (low-BE/ME);
- the second portfolio will be composed of those companies present in both the SMALL group (small-ME) and the NEUTRAL group (medium-BE/ME);
- the third portfolio will consist of those companies present in both the SMALL group (small-ME) and the VALUE group (high-BE/ME);
- the fourth portfolio will consist of those companies present in both the BIG group (big-ME) and the GROWTH group (low-BE/ME);
- the fifth portfolio will be composed of those companies present in both BIG group (big-ME) and the NEUTRAL group (medium-BE/ME);
- the sixth portfolio will consist of those companies present in both BIG group (big-ME) and the VALUE group (high-BE/ME).

After finding the composition of the different portfolios for each year, the next step is to use the daily returns of each company that makes up the entire S&P 500 index from 2018 to 2022.
With the help of Excel software, it is possible to calculate the weights of each company contained in the different portfolios, obtaining a vector necessary for the next step, which will consist of multiplying this vector with a sub-matrix of daily returns in order to calculate the portfolio return (a

sub-matrix is created for each year from July of year t to June of t+1 from the initial matrix of daily returns).

After determining the returns of the S/L, S/N, S/H, B/L, B/N, B/H portfolios, the variables SMB and HML are determined as:

- SMB equals the difference between the average return of the three small portfolios with the average return of the three big ones.
- HML is equal to the difference between the average return of the two value portfolios and the average return of the two growth portfolios.

The Fama-French model is not able to measure the responsibility effect (decreasing return when moving from the portfolio composed of the best companies given the ESG rating, to the portfolio composed of the worst companies given the ESG rating), because it does not take into account the (systematic) risk linked to the CSR levels of the companies. This model therefore does not capture the higher/lower exposure to stakeholder risk of companies with a low/high ESG level.
To take this into consideration, it is necessary to create the ESG Risk Factor. The creation of the ESG Risk Factor stems from empirical evidence related to the exposure of companies to stakeholder risk given the different levels of engagement of ESG criteria.

For the construction of the ESG Risk Factor, the same procedure is adopted as for the Fama-French HML risk factors; indeed, the process begins with the categorization of companies into groups based on their ESG scores and market capitalization. The intersection between the ESG groups and company size leads to the creation of six ESG portfolios, named S/G, S/N, S/V, B/G, B/N, and B/V. Similar to SMB and HML, the returns of these six ESG portfolios are calculated over a specific period.

Once the ESG risk factor has been accurately calculated, the next step involves regression analysis. These analyses can be performed on specific portfolios or on each of the individual companies within the S&P 500 index, allowing for a comprehensive assessment of the impact of the ESG factor on their financial performance.

In this context, portfolios can be created based on specific criteria, such as company size, ESG scores, or other relevant characteristics. An alternative is to perform regressions on each of the individual companies comprising the S&P 500 index individually. This approach provides a comprehensive

picture of the effect of the ESG factor on a wide variety of companies, allowing for an evaluation of how each of them responds to ESG considerations. In the thesis, both criteria will be utilized for the analysis.

The main objective of this study is to assess whether the inclusion of an ESG risk factor in a 3-factor Fama-French model provides significant additional information to the model itself. In other words, the aim is to determine whether the ESG factor adds extra predictive value in explaining the performance of financial assets, beyond the three traditional Fama-French factors (market risk premium, size factor, and value factor). Through this process, we evaluate whether the inclusion of the ESG factor in the second model enhances its ability to explain asset performance, as measured by an increase in the R-squared value. The goal is to ascertain whether the ESG factor constructed in this manner is a significant risk factor contributing to the explanation of asset returns within the Fama-French model framework.

The conducted analyses indicate an improvement in the coefficient of determination (r^2) across various portfolio and asset categories when considering the risk factor. Small enhancements were observed in portfolios constructed based on both the 25% Top ESG and 25% Bottom ESG, as well as those based on the 10% Top ESG and 10% Bottom ESG. A more pronounced increase in model effectiveness was particularly evident when examining the individual behavior of assets included within the S&P500 index.

Specifically, when evaluating the coefficient of determination (r^2) in regressions that included the ESG factor compared to regressions excluding it, an increase in r^2 was observed. This increase was noted in many cases, indicating that ESG plays a significant role in explaining variations in financial performance.

Furthermore, the p-value associated with the ESG beta coefficient was found to be significant in many of the regressions conducted on specific assets. This suggests that the ESG risk factor is statistically relevant and influences asset performance.

Despite the positive results obtained in the analyses of portfolios and specific assets, it is important to highlight that the average increase in the coefficient of determination (r^2) for the entire S&P 500 index was relatively modest, standing at 2.33%. This data raises some considerations.

Firstly, the limited increase in r^2 when applying the ESG risk factor to the entire index suggests that the current implementation may not fully capture the overall impact of ESG on the stock market. This could be due to various reasons, including the diversity of sectors represented in the S&P 500 or the specific methodology used to calculate ESG scores for companies.

Furthermore, the S&P 500 index is known to be composed of a wide spectrum of companies, some of which may be less influenced by the ESG factor compared to others. This could partially explain the modest increase in r^2. It is possible that some companies are already inherently aligned with ESG standards, while others may be in a transitional phase or less sensitive to such considerations.

As a result, it may be necessary to explore further refine the approach to incorporating the ESG factor into financial analysis models. This could involve the creation of more precise ESG metrics or the identification of specific subcategories of companies within the S&P 500 that are particularly influenced by ESG.