

SSA Paper

2023

Budapest Business University
Faculty of Finance and Accounting

**A TRANSZMISSZIÓS MECHANIZMUS HATÁSA A MAGYAR ESG
RÉSZVÉNYEK HOZAMÁRA ÉS KOCKÁZATÁRA**

**EFFECT OF THE TRANSMISSION MECHANISM ON HUNGARIAN ESG
STOCKS RETURNS AND RISKS**

Kenese László Balázs

Supervisor: Dr. habil. Sági Judit

Date of closing the manuscript: 2023, November, 5

Abstract

Environmental, social and governance (ESG) assessment has received increasing attention over the years as sustainability has gradually become a central issue in society. ESG is one of the "products" that these movements have created and shaped the investment strategies in recent years. Thus, by applying ESG factors, we can define new valuation criteria for company stocks. But the question arises: if macroeconomic factors change, will the demand for ESG stocks decrease or not? Does it have a negative impact on returns or risk? To answer these questions, I have used the Capital Asset Pricing Model (CAPM) and the Fama&French three-factor model developed to evaluate the causal relationship between average return and stock prices such as Book to market ratio (B/M), standard return and size. Furthermore, my research was based on an ESG portfolio that I compiled, which included Hungarian companies that had a high ESG score or were operating in a greener industry. My calculations showed that the ESG portfolio outperformed the BUX index in average return most of the time and also showed lower volatility from 2018 to 2022. My calculations show that high ESG stocks can achieve more reasonable returns with lower risk and volatility when interest rate changes have taken place.

Table of contents

1. Introduction.....	1
1.1. Research background.....	1
1.2. Research problem.....	1
1.3. Research methodology.....	2
1.4. Structure of the research.....	3
2. Literature review.....	4
2.1. ESG investing risks and returns.....	4
2.2. Transmission mechanism effects on the stock market.....	5
3. Research methodology.....	8
3.1. Hypothesis.....	8
3.2. Data.....	8
3.3. The methods.....	10
3.3. Developments of the CAPM and empirical tests.....	11
4. Results.....	13
5. Conclusion.....	19
5.1. Study implication and recommendations.....	19
5.2. Study limitation and suggestions for future research.....	20
Bibliography:.....	21
Appendix.....	24

List of tables

Table 1: Weight of the ESG stocks in the portfolio.....	13
Table 2: Beta calculations for stocks in the United States from 2019 to 2022.....	17
Table 3: Beta, average return, and dispersion calculations for the ESG stocks, portfolio and the market.....	18
Table 4: ESG portfolio beta and return calculation with the three-factor model.....	18

1. Introduction

1.1. Research background

Climate change has become a major worry in the last couple of decades, but fortunately the concept of sustainability is getting more and more attention from the public, since the environment is not treated as it should be treated. Nowadays, we can find plenty of movements about environment protection, human rights, equality, and other as well that highly affected public opinion, the companies' operations, the political parties' decision-making processes at the same time (Spangenberg (2005), Geissdoerfer and his co-authors (2017)). The Environmental, Social and Governance (ESG) evaluation system is one of the products that has been influenced by these movements and shaped the knowledge of modern investing strategies. We can agree that sustainable investing is gradually becoming more and more mainstream in recent years. In Uzsoki (2020) research we can see the tendencies about why this method becomes more and more popular throughout the years. In his research, he determined two main categories in his paper: the private investors and institutional investors. According to Uzsoki, in the private investor category the millennials are in the majority, who play the most significant role in demand generating for sustainable financial goods and services, but the institutional investors also play a crucial part to help sustainable investing grow to historic levels. Among the largest investors, there are plenty of analyst who initiated to be more concerned with "green" investing and they also started to implement these factors in their strategy. Amundi, who is currently one of the largest European asset managers, announced that it will integrate ESG in 100 per cent of its investment. From the European Union point of view, they also perceived how important is to adopt the ESG regulations properly in the local area. According to Alamillios and Mariz (2022) after the implementation of the regulations the European union has influenced global policy in sectors such as trade, antitrust and data protection. Due to the scale of the market and the cost of entry, it has established strict standards in several areas and affected international trade. But of course, there is still a lot that can be done to strengthen regulation collaboration. Formal agreements between the nations that make up the institutions can be useful in achieving the ultimate objective of preventing climate change. Thus, priority areas include further analysis of the urgent need for key actors to work together to achieve standardized regulation and how this can be addressed to prevent green washing, protectionism, and regulatory arbitrage and to promote sustainable growth and prosperity.

In Hungary, the ESG valuation system is gradually attract more and more attention in the corporate sector, due to the fact that the sustainability becomes one of the main concerns in the companies' operation. In the recent years, these changes have shaped the knowledge of the domestic investment strategies and had a huge impact on the stock market as well. The main goal of this paper is to determine how efficient an ESG portfolio is in comparison with the BUX index in an interest changing period. One of the motivations behind this paper is to apply the ESG valuation system in our investment strategy to acquire more return accompanied with minimum risk.

1.2. Research problem

The second key concept in my work is the transmission mechanism. Academic literature has always been paying significant attention to the effect of interest rate changes on capital asset

prices. According to Loayza and Schmidt-Hebbel (2002) the monetary transmission mechanism is the method by which adjustments in monetary policy instruments, for instance: short-term policy interest rates or money supply, effect the economy, especially output and inflation. In addition, the report published by the Bank of England (1999), it also presented that the changes in the official interest rate have an impact on the market value of the securities, such as equities and bond prices. Above all, monetary policymakers have direct control over only certain aspects, such as short-term interest rates, asset prices, and last but not least, the exchange rate. The main objectives of the policymakers are to keep up the price stability, the output stability, financial stability, and other. The feedback of all these will change from time to time because the external environment, policy regime and market sentiment will not remain the same. Moreover, in the field of sustainability, the Central banks also play an imperative role in ESG investing. As Uzsori Sais, they have primarily engaged with ESG risks, especially with climate-related risks that can have an enormous effect on the financial world. Scatigna and her co-authors (2021) published research where they also introduced certain challenges in field of financial sustainability that must be solved by the central banks. Their intention was to create a more environmentally friendly economy, so they integrated ESG principles into the monetary policy in the form of green bonds and green loans. To give an illustration, in Asia, the People's Bank of China (PBoC), the Bank of Japan and the Central Bank of Malaysia have announced instruments to assist commercial banks' lending financial services that support decarbonization sectors, purchase of green bonds or lend green loans.

The effect of the transmission mechanism is one of the key factors in my research, because the main problem that must be answered is the interest rate effect on the Hungarian ESG stocks return and risk in comparison with the market. Studies presented that the ESG stocks can perform particularly surprising results in many fields, but I could not really find any research, that examine the interest rate change effect on the Hungarian ESG equities. It is important to examine this issue, because the ESG might be a safer, reliable, and profitable investment for the households in the economy.

1.3. Research methodology

The third key concept is the Capital Asset Pricing Model (CAPM), which is one of the most known concepts in modern financial literature. This model could not have been created without Sharpe (1964), Lintner (1965) and Mossin (1966) what has taken more and more impact in the field of riskiness and profitability measurement of an asset throughout the years. The classical version of the CAPM calculates the return on individual shares with the usage of risk premium plus the individually computed beta of a stock. On the other hand, plenty of improvements have been made about the CAPM through the years. One of the most well-known developed versions is the five-factor model what is a multi-factor model which was created by Fama and French (1992). Those models that are comprised of different factors are known as APT (Arbitrage Pricing Theory) which observes the return on an individual asset is an independent factor. It is used commonly with the weighted averages of factor portfolios, which are sensitive to a particular type of risk. This version of the model attempts to capture the size, value, profitability, and investment patterns in average stock return outperform a three-factor model. With this in mind, the authors also mention that the main weakness of this model is its inability to reflect the low average returns on small stocks, whose returns behave similarly to those of enterprises that

spent heavily despite their poor profitability. In light of these developments, the empirical tests of the CAPM generally apply observed variables while none of the variables involved in empirical tests as Guermat (2014) mention in his research. He tested the efficiency of the CAPM model in the field of risk and return calculations, also he mentions Kandel and Stambaugh work about the Ordinary Least Squares (OLS) measures of beta-return relation bear no relation to the proximity of an ineffective index to the effective frontier. Moreover, Kandel and Stambaugh's work presented that while OLS evaluations are of little use, Generalized Least Squares (GLS) estimates are functions of known quantities that are precisely linked to a given position in the index. To test easily the CAPM, he achieved that by the usage of the coefficient determination from the OLS and GLS methods as well. The conclusion of this test is come out as the CAPM model is testable even when it holds and when it does not, thanks to the usage of OLS and GLS. In spite of the CAPM having been successfully tested, I also observed that this model received a reasonable number of critics as well (Elbannan (2015), Roll (1977)).

This paper uses beta calculation, standard deviation and Fama and French (1992) multifactor model to calculate the volatility and return of the ESG stocks when macroeconomic factors are changing in the Hungarian economy. The applications of these models will present how safe and profitable an ESG investing strategy can be in comparison with the Hungarian market, when interest rate changes have taken place.

1.4. Structure of the research

This research mostly follows the structure of the introduction, where the main objective is to clarify the key concepts. The second chapter introduces the empirical research that has been done at international and domestic levels. In the literature review, the ESG companies and stocks profitability has been determined and valued by academic evidence. In this same chapter, the effect of monetary policy on the stock market has been discussed, which proved that interest rate changes can influence equity prices through the asset price channel. In the third chapter the used data and methods are presented, where I determined which research was used in the portfolio construction part, what type of data and database has been implemented in this paper and last but not least, what type of calculation and valuation was applied in this paper to define empirical results. Moreover, in this chapter I also introduce my hypothesis, which I shall give objective answers to in the next part. In the fourth chapter the Hungarian ESG stocks and portfolio performance is presented in contrast with the domestic market when interest rate changes have taken place in the economy. Furthermore, I also compare my results to those research that have been introduced in the literature review chapter, to see the differences between markets, economies, and other factors that affect the equity prices through the years. In the conclusion part, I summarize the main empirical result and provide additional directions of this research.

2. Literature review

If we are talking about environmental, social and governance (ESG) investing and monetary policy we can perceive that these are exceedingly wide topics to write research about. With this in mind, the first step in my paper is to examine the ESG equities returns and risk, and the second step is to define the transmission mechanism effect on the stock markets. Firstly, I review the empirical evidence from the different topics in a separated way, and after in the result chapter I draw down the connection between the subjects.

2.1. ESG investing risks and returns

The ESG investing started to become more and more mainstream among the private and institutional investors as well, but the question still arises: how is this possible and why is this strategy getting an extensive amount of attention? Nowadays companies are more concerned about sustainable and environmentally friendly governance, and it has a huge impact on these firms' operation, profitability and stocks' return as well. In Mendiratta and his co-authors (2021) research they find that those companies who are acquired more ESG scores are typically more competitive and more likely to generate extraordinary returns. From Systematic-risk point of view: those companies who obtained high ESG ratings are usually have lower exposure to systematic risk factors. That means the cost of capital is lower, so it will result in higher estimation in the discounted-cash-flow model. Furthermore, the high ESG rated enterprises demonstrated superior return on return on equity (ROE), thus they were able to build higher and more stable earnings than in contrast with low ESG rated companies. Similarly, Stempler's (2021) conclusion includes that those firms that earn higher ESG scores usually treat the shareholders better and functions on a more reliable level, and even it makes the company more persistent against unexpected shocks. But what happens if this shock comes in the form of monetary policy issue? According to Patozi (2023) green firms are significantly less impacted by transmission mechanism than their less environmentally friendly competitors. Patozi illustrated that this variation in response cannot be attributable to changes in business characteristics. Instead, the author showed that it is motivated by investors' preferences for long-term investing. First, the evidence from stock price, credit risk and investment data demonstrate that greener companies are significantly less susceptible to monetary policy shocks than their less sustainable peers. Second, statistics on institutional investor stock holdings imply that the reduced sensitivity of green business to monetary policy shocks is due to investor preferences for sustainable investing.

Considering these factors about sustainable investing, Gibson, and his co-authors (2020) studied the relations between ESG rating disagreement and stock returns. This paper was one of the first research that systematically tested whether the second moment of ESG ratings has consequences for stock returns. They noticed that the returns on the stocks connected to ESG rating disagreement on a positive way. This positive relation was primarily driven by the disagreement about the environmental importance. From portfolio performance point of view, Luo (2022) investigated ESG portfolio performance of UK securities from 2003 to 2020, where he finds out that lower ESG firms earn higher earnings than high ESG enterprises. They also tried to find out the returns and riskiness by splitting up ESG one by one. The *ENV* (environmental) and *SOC* (social) premiums have been shown to be stronger than the overall ESG premium. However, it

turned out the GOV (governance) premium is rather insignificant. In the other hand Di Luo stated that stocks with higher liquidity have higher ESG scores than stocks that has low liquidity. Prol (2022) wrote down the same results as well, but his research mostly covered the New York Stock Exchange. Their calculations show us that sustainable optimized portfolios have lower performance than less sustainable ones. Portfolios what were constructed with high ESG firms, had smaller returns and smaller volatility as well. In the case of Khan (2019) paper, the author presented a little twist in his research about ESG stock performances. Khan developed a new corporate governance method and ESG metrics to predict future stock returns. Khan constructed a governance score what contains the top-down and the bottom-up governance components to justify his stock return predictions. It is highlighted that good corporate governance could be essential what leads to suitable capital allocation and growth potentials in capital. It was found that the stock returns were quite predictable in case of usage of new governance and ESG metrics. The earnings on the stocks were monotonically increasing across governance and ESG quartiles. Those companies who had sustainable governance of their stock returns outperformed the global universe by 40pps cumulatively. In contrast with Templer's (2021) results, the ESG stocks perform better results than the market. In Hungary the ESG indices outperformed their benchmarks and were less effected by external shocks (for example the Covid-19 pandemic) and were less sensitive at the same time. With the usage of the Smart Beta strategy accompanied by high ESG rated firms, it is clear to see that those organizations who operates on an environmentally friendly way gained less loses then those companies who lack of sustainable governance. Another key thing to mention is Manescu (2010), Kumar and his Co-authors (2016) who also examined the ESG factors and risk-adjusted performance in case of a new quantitative model. In Ashwin Kumar research they applied the ESG risk-premium model, what is designed for to create the connection between ESG performance and volatility of stock returns. But in the case of Manescu (2010) paper, the author applied the well-known three- and four-factor model, modified with the momentum factor what was identified by Jegadeesh and Titman (1993). In accordance with their results, it presents that ESG companies provide lower volatility in their stock performances than their peers from a similar industry. Among all industries, ESG factors have stronger impact on material, energy, banking, and technology industries. Notwithstanding the ESG has a strong effect on the shares, they also highlight that each industry can be affected differently by the ESG framework. Coupled with the information above, their verdict includes that the ESG stocks performed lower risk and higher return at the same time. Interestingly, their model provided evidence for stock behavior, and it demonstrated that ESG factors bring lower volatility and therefore lower risk, and consequently higher risk-adjusted returns.

2.2. Transmission mechanism effects on the stock market

The effects of transmission mechanisms on the capital markets and on the role of the banks are still one of the most notable subjects in the academic debate. The application of recent developments in information economics to the study of financial markets has reshaped the whole topic through the years. Mishkin (2001) and Csontó and Siklós (2006) surveyed the transmission mechanism of monetary policy beyond the usual interest rate channel by focusing on how monetary policy influences the economy through other asset prices. Mishkin also mentions Tobin's q-theory in his paper, which is built on the theory of market value of the firms divided by the replacement cost of capital.

$$r \downarrow \longrightarrow P_s \uparrow \longrightarrow q \uparrow \longrightarrow I \uparrow \longrightarrow Y \uparrow (1)$$

In this case, the r represents the interest rate, the P_s represents the price of the stock, the q is the q value which is equals with market value over the replacement of the capital value, I stands for the investments and Y is the output. If the calculated q value is relatively high, it means that the economic entities are able to get hold of new funds more easily. If the companies plan to finance their new investments not only by issuing bonds but also shares of the companies, and the share prices are increasing at the same time, it will cause cheaper opportunities to fund investments in the firms. Also, the greater the money supply in the economy, the lower the interest rate which consequence less enquiry in bond purchases and will be more demand in the field of stock purchasing. In contrast with Modigliani (1986) he also determined how the transmission mechanism effects on the stock prices as

$$r \downarrow \longrightarrow P_s \uparrow \longrightarrow Wealth \uparrow \longrightarrow Consumption \uparrow \longrightarrow Y \uparrow (2)$$

According to Modigliani's life-cycle hypothesis a consumer's income for his whole life has an impact on how much that person consumes, since wealth is one of the factors of lifetime income. Moreover, Mishkin (2001) proved that decreasing interest rates will lead to higher stock prices. The households who acquired shares in the las years, this change will increase their wealth and will boost the demand for durable consumer goods. Monetary expansion will result in more investments in form of equities as Csontó and Siklós (2006) conclusion indicated that. The purchase of durable productions, housing and other investments by households what involves a more reasonable amount of capital will be more and more frequent due to the changes in their financial situation. Another key thing to mention is that the Hungarian transmission mechanism in comparison with the euro zone, the interest rate channel has been found to play the most significant role in the euro zone while in Hungary the exchange rate channel has the most prominent role.

From another point of view: Hondroyannis and Papapetrou (2001) used VAR analysis which measures variables in the economy, as well as the returns of the stock market. Also, they applied the Johansen maximum likelihood approach to test for cointegration among the variables. This method is simply based on the error-correction representation of the VAR formula with Gaussian errors. Furthermore, the empirical interpretation was based on six variables: exchange rate, treasury bill rate, real oil prices, industrial production, stock rate of return and stock rate of return, and it has been carried out using monthly data from 1984:1 to 1999:9. In accordance with Hondroyannis and Papapetrou (2021) macroeconomic actions heavily influenced the financial derivatives on the market. For instance: from industrial production point of view, the changes of real stock returns by macroeconomic factors did hold back the growth of the manufacturing capabilities, because when it represented higher returns in real stocks, it does not represent higher production levels at the same time. Their result suggested that the domestic real stock return variable is determined by the macroeconomic variables. Peiró (2015) also analyses the how dependent the stock prices apart from the macroeconomic variables, but his paper is mainly focused on the biggest European economies: United Kingdom, France and Germany. Peiró used the APT model in his calculations, what roots in the explanation of financial returns through various unknown factors. According to him, while the effect of the rising interest rate on the stock returns occurs simultaneously within the same year, but in case of stock returns affected by

variations in the industrial production, that will appear only in the following year. The results show that the changes of the future production positively affect the stock prices while when interest rates modification takes place, it will cause negative movements on the share prices. Moreover, the conclusion is the European markets acted similarly to the US markets and throughout the years the relative importance of these factors will change. In other words, real economy factors like the level of production are going to play a more significant role (affecting the intrinsic value of the issuing companies) than financial factors like the interest rate. Alam and Uddin (2009) also studied the relationship between interest rate and stock prices, but their research included developing countries as well, which means it shows how emerging markets can be affected by the macroeconomic changes. The authors made a market efficiency test what made visible that there are serial dependences of return of all Stock Exchanges. For all the 15 countries what was the base of their calculations, they find that none of those markets follows the random walk model. After that they used Panel Data analysis on interest rate and share price during changes as well, but the results were quite versatile. Apart from the fact that they reviewed developed and developing countries, certain individual regions had mix outcomes. According to Alam and Uddin (2009) in Malaysia they did not find any relationship between interest rate and share price, but importantly, they found that if there are any changes in the interest rate, it will have a negative effect on the share price changes. In contrast with Japan, it is found that there is a positive correlation between interest rate and share prices, but any changes in the interest rate, it will result a negative relationship with the change of the share prices. In case of Bangladesh, Colombia, Italy, and South Africa, the results suggest that there is a negative relationship for both changes of interest rate with changes of share price interest rates with share price.

What's more, in Australia, Canada, Chile, Germany, Jamaica, Mexico, Spain and Venezuela there is an enormous negative effect on the relationship between interest rates and share price, but surprisingly there is no correlation between change of interest rate and change of share price. In conclusion, Alam and Uddin's research also show us that all the countries (except the Philippine one) had a significant negative relationship for both changes of interest rate with changes of share price interest rates with share price.

3. Research methodology

3.1. Hypothesis

Based on the presented empirical research and results on the transmission mechanism effect on the stock market and the ESG stock returns and risks through the years, my hypotheses about the transmission mechanism effect on the ESG stock portfolio's risk and returns compared to the whole market is that the high ESG stock portfolio will act less sensitive in comparison with the market. The reason why I decided to define this hypothesis is that the high ESG companies are more sustainable and treat their stockholder's way better, thus they are more reliable for a conservative investment strategy. Moreover, those companies that have great ESG scores are less sensitive to interest rate changes than their less environmentally friendly peers.

3.2. Data

In Hungary the environmental, social and governance framework is a relatively new thing. This is the reason why we did not find decent information about ESG reports in case of Hungarian companies for a long time. But it has been changed in the latest years. The government gradually implemented those acts that the European Union made obligatory for the firms that are registered in the EU zone. The domestic companies aligned to these changes and started to issue ESG reports as well. In 2023 the first fully detailed list was published by HVG accompanied with Planet Fanatics' Network and it was about the top 25 domestic companies who acquired high ESG scores according to their calculations. Their analysis was based on the 100 largest Hungarian companies by revenue and the seven largest banks by total revenue based on the available figures for 2021. The Planet Fanatics' Network made a simplified two rounds ESG-based screening where they used published information by the companies only. In the first round they analyzed one hundred seven firms examined by environmental, social and governance factors. In case of environmental aspects, they also made research about which firm has an environmental management system what has been accepted by the SBT. Furthermore, they tried to find reports that show direct and indirect emission data. Moreover, they looked at carbon emissions related to the revenues and their changes between 2019-2021. In case of social and governance factors, they tried to find out whether it has a human right policies, health and safety management system, diversity objectives, and so on. They also analyzed gender equality and how companies train their employees, the extent of the gender pay gap and awareness of social problems. In addition, they looked at the proportion of disabled workers with disability as well. The last aspect was the Governance factor where they searched for sustainability reports, audit examinations by a third party and prepared in accordance with international standards, goals and code of ethics, and so on. As most of the companies included in the analysis are Hungarian subsidiaries of a multinational company, it was also considered if the parent company has such objectives and documents. Same things happen if the parent company in the Hungarian top 100 firms has the above, but the member company who is also in the top 100 does not publish it. Following these steps, the second round has been started where they analyzed those companies out of 107 that issued sustainability reports by themselves or their parent company. The assessment in this round was mainly focused on performance and results. But in case of an international parent company not reporting data on its Hungarian subsidiary it could not be included in the calculation of performance as this would not reveal the specific performance of the Hungarian subsidiary concerned.

In case of share prices, I used all the information in my research from the Budapest Stock Exchange official database from 2018 to 2023 for the Hungarian market. I calculated with monthly data from 2018 because at that time the European Commission initially determined the Action plan on “Financial Sustainable Growth” as Faccia and his co-authors (2021) mention in their work. It was one of the first steps towards the ESG framework by the European Union what is included companies must publishing their ESG information for the public. The data I obtained conclude opening, closing, maximum and minimum prices. I used only those Hungarian stocks’ data from the Budapest Stock Exchange official database that corresponds to the research that has been done by the HVG and the Planet Fanatics’ Network, plus I added additional stocks that issued by a company which operate in a more environmentally friendly industry (for example: sustainable energy). I concluded those firms in my calculations that are registered at Budapest Stock Exchange and can be purchased in Hungarian forints. Furthermore, I gathered data of the Hungarian BUX index as well to compare that to the high ESG stocks on the Hungarian market. The Bux index is the official stock index of the Budapest Stock Exchange what is playing a key role in my essay as well as the ESG investing whereas my intension is to examine the possible correlations or discrepancies. In this case I also used monthly data to my calculations along with the individual stocks.

Decisions about interest rates have an enormous effect on economic activities and inflation through several channels, which are known collectively as the ‘transmission mechanism’. In my research I also included the interest rate changes from 2018 to 2022 and the yields of the 10-year government bond what I acquired from the Hungarian Central Bank. I used data starting with the year 2018, because from 2016 to 2020 the interest rate did not change in this period. It resulted that my calculations represented the return and risk differences between the ESG stocks for the whole Hungarian market when interest rate change has taken place and when interest rate change did not take place at. This is the reason why it is an essential part of my calculations as it provides two different results for two different periods. Moreover, I used the 10-year government bond yield as risk free rate in my calculation, as the academic literature mostly uses these types of bond yields. Government bond yields frequently represents investments without risk as a state is less likely to go bankrupt.

For further comparison purposes, I will apply Damodaran’s Beta calculations to measure the differences between industries. I get these data from the creator’s official database, what will be the base of my comparison later. Damodaran performed plenty of empirical estimation for beta, regression, D/E (debt per equity ratio), standard deviation, and so on, what is used by plenty of researchers in the academic environment. Furthermore, these estimations were categorized by industries, and it is mainly focused on the companies that can be found in the United States. Damodaran also noted that if you are searching beta for a certain company, the unlevered beta corrected for cash is your best bet. Although even a sector beta can change over time, Damodaran included the average of that certain sector betas throughout time in the last column for obvious reasons, this value is less likely to fluctuate over time.

For the Fama and French’s (1992) models I used Kenneth R. French data library what is include all the estimations what is required for the calculations. At the Tuck School of Business at Dartmouth University, Kenneth R. French teaches finance. He assembled a sizable collection of economic data that is accessible for download on the internet. The database provides historical information of the Unmeted Stated, European Union, Asia, and other areas monthly Fama/French

3 factors and 5 factors, in addition to 2x3 multivariate portfolio sorts used to create the factors for each July data. In my empirical calculations the European market factors was used because Hungary is also part of the euro-zone. I also decided to use these performed calculations for a four-year period from 2018 to 2022.

3.3. The methods

In the calculation stage, I used the beta, standard deviation and the Capital Asset Pricing Model (CAPM) to show the risk and return differences in the case of ESG stock returns and the market in periods where the central bank changes the interest rate several times. We know that the CAPM is an equilibrium model where the expected return on a security is given by the covariance with the market portfolio. This model is structured as follows:

$$E(R_i) = (R_f) + \beta_i (E(R_m) - R_f) \quad (3)$$

The CAPM formula comprised of the R_i what is the expected return on asset I , R_m is the expected return on the market portfolio, β_i is

$$\sum_{i=1}^x x_{ip} \frac{\text{cov}(R_i, R_m)}{\text{var}(R_m)} = \sum_{i=1}^x x_{ip} \beta_i \quad (4)$$

equals the beta of asset I , and R_f is the risk-free rate of interest. In the case of beta, Blume (1975) observed that estimated beta coefficients were largely constant over time, at least in the circumstances of a portfolio containing many different securities. However, a portfolio that had an extraordinarily low or high estimated beta in one period often had a less significant beta as projected in the following period. With these factors Blume analyzed the effectiveness of the classic beta model and according to his research, the companies of high-level risk -either high or low- tend to have less unusual risk characteristics over time. In this case, there are only two logical assumptions. First, it's possible that ongoing projects' risks will gradually become less severe. This justification might make sense for high-risk businesses, but it doesn't appear to apply to small businesses. Second, compared to ongoing projects, new projects that companies engage on may have less extreme risk attributes.

Moreover, to obtain the most accurate results possible I also used the standard deviation to measure the depression of a stock, what is one of the most common measures of risk and uncertainty (Lee (2015)). This function is defined on the positive real line. The original standard deviation is calculating as

$$\sigma_0 = \sqrt{\frac{\sum_{i=1}^n (x_i - \bar{x})^2}{n-1}} \quad (5)$$

The formula contains the x_i what is represents each individual data point in the database, $\bar{x}$ is the mean and n is the total number of data points. Furthermore, a function that requires the standard normal moment of order $n - 1$ about a well-defined point can be used to estimate the coefficient of variation from a normal population with sample size n . The standard deviation comprised of the observed values discrepancy from the mean, which means that these values illustrate the variations of the data. As Lee highlights in his research, a statistical model which performs normal distribution is obtained by examining the mean and the standard deviation of a certain data.

3.3. Developments of the CAPM and empirical tests

Fama and French (1992) developed this formula to another level, and they created their own Three-factor model what was designed to measure the relationship between average return and size and correlation between average return and price ratios like B/M .

$$R_i - R_{ft} = a_i + b_i(R_{Mt} - R_{ft}) + s_i SMB_t + h_i HML_t + e_{it} \quad (6)$$

In this formula, the R_i stands for the return on security or portfolio i for period t , R_{ft} is the risk-free return, R_{Mt} is the return on the value weight market portfolio, SMB (small minus big) is the return on a diversified portfolio of small stocks minus the return and HML (High minus low) is the discrepancy between the returns on diversified portfolios of high and low B/M (book to market ratio) stocks, and e_{it} is a zero-mean residual.

In case of three-factor model, Fama and French (1992) mentions Novy-Marx, Titman, Wei, and Xie results that says that (5) is an insufficient model for expect returns as its three factors miss much of the variation in average returns correlated to profitability and investment. They added the profitability and investment factors to the Three-factor model,

$$R_{it} - R_{ft} = a_i + b_i(R_{Mt} - R_{ft}) + s_i SMB_t + h_i HML_t + r_i RMW_i + c_i CMA_t + e_{it} \quad (7)$$

In this case, we can perceive that RMW has been added to the equation, and it is representing the difference between the returns on diversified portfolios of stocks with huge and weak profitability at the same time. Moreover, CMA is the discrepancy between the returns on diversified portfolios of the share of low and high investment firms. According to the research, if all variation in expected returns is captured by the exposures to the five components, b_i ; s_i ; h_i ; r_i ; and c_i , the intercept a_i in (7) is zero for all securities and portfolios i .

Fama and French (1992) they also observed that the five-factor model can be dropped because in this case the given HML is redundant for describing mean returns. If we want to evaluate properly the exposures of LHS (left-hand sized) portfolios to the size B/M (book to market equity ratio). It is represented in the paper of Fama and French, the four-factor model that drops HML captures average returns as well as the five-factor model. A difference on the five-factor model meets these objectives.

$$R_{it} - R_{ft} = a_i + b_i(R_{Mt} - R_{ft}) + s_i SMB_t + h_i HML_t + r_i RMW_i + c_i CMA_t + e_{it} \quad (8)$$

The residual and the intercept (8) remain the same as in the five-factor regression (7), thus the two regressions will be comparable for measure how effective the model performance. Likewise, the HML slope part of the (8) equation is still the same in case of HML slope in (7) formula, so that means the (8) model produce the similar evaluation of the value tilt of the LHS portfolio.

What's more, research by Guermat (2014) tested the efficiency of the CAPM model in the field of risk and return calculations. The author mentions Kandel and Stambaugh work about the Ordinary Least Squares (OLS) measures of beta-return relation, and the results showed that there is no relation to the proximity of an ineffective index to the effective frontier. Furthermore, Kandel and Stambaugh's work presented that in the meantime OLS evaluations are of little use, Generalized Least Squares (GLS) estimates are functions of known quantities that are exactly related to that certain position of the index. To test easily the CAPM, he achieved that by the usage of the coefficient determination from the OLS and GLS methods as well.

Lastly, the verdict of this test and examination is the CAPM is testable even when the CAPM holds and when it does not (thanks to the usage of OLS and GLS). The only possibility when both expected return vector for N individual assets can attain their maximum value is when we use an effective index and there are no omitted variables.

Fama and MacBeth (1973) also tested the relationship between average risk and return but focusing on the New York exchange rate. The test was based on the "two-parameter" portfolio model and models of market equilibrium derived from the same model. The capital market is considered to be flawless in the sense that investors are price takers without taking into account the transaction or information costs. The distribution of one-period percentage returns on all assets and portfolios is expected to be normal or to correspond to some other systematic stable class member with two parameters. Furthermore, investors are required to be risk averse and to choose portfolios based on the greatest predicted benefit. Given that the market portfolio is efficient, their research cannot refuse the notion that average returns on New York Stock Exchange common stocks reflect risk-averse investors' attempts to hold efficient portfolios. Especially, in the case of average there seems to be a positive tradeoff between risk and return, with the risk estimated from the portfolio viewpoint.

4. Results

In this chapter I will provide the analysis and the results of my calculations what will include the construction of the ESG portfolio, the performance of the stocks and the effect of the interest rate change. Firstly, I will present the proportions of stocks in my portfolio as the table (1) shows below. The weight of the shares was determined by the scores the companies obtained for a certain period, or whether the firm is operating in a more sustainable industry. According to the HVG research, Magyar Telekom telecommunication company acquired the most ESG points among the domestic companies. The Richter Gedeon, E-On and OTP also gained nearly 80-85 points, what was enough to get into the top ten most sustainable firms in the county. The last company in my portfolio is MBH (Magyar Bank Holding) which recently changed its name from MKB (Magyar Kereskedelmi Bank). They received a solid 57,1 points, what is not unpleasant, but still below the best results in contrast with the other firms from the same research. With this in mind, this is the reason why I added less weight for the MBH in the portfolio construction process. Finally, I also added PannEnergy to the portfolio because they have a significant role in the area of alternative energy sources. Since PanEnergy did not make it into the HVG research best ESG firms' table, I weighed the portfolio accordingly.

Industry		
Magyar Telekom	Telecommunications	20%
Richter	Pharmaceutical industry	17%
E-on	Energy industry	15%
OTP	Financial services	14%
MOL	Energy industry	13%
MBH	Financial services	11%
PannEnergy	Energy industry	10%

Table 1: Weight of the ESG stocks in the portfolio.

This table represents the proportion of the stocks in constructed the portfolio. Source: Own edit (based on the HVG and Planet Fanatics' (2023) Network research).

Interestingly, all the ESG stocks return were quite versatile in the 2018 period, most of the shares closed with negative average returns that placed a negative effect on the BUX index as well. From standard deviation point of view, the PannEnergy had the biggest degree of dispersion compared to its mean among the ESG stocks, as the table(3) shows. In contrast with, the MBH had the smallest standard deviation for this period and had a surprisingly small beta in comparison with the other equities. It is clear that the whole market was fluctuating in this period, but what is the case from an average return point of view in the 2018 period? Interestingly, the ESG portfolio not just outperformed the BUX index, but the dispersion and the beta came out in better numbers as well. As the table(3) shows, the average return was higher by 0,085 percent with less than 3 percent standard deviation, meaning that the portfolio was able to earn a slightly

higher average return with less risk at the same time. From the risk to return point of view, the expected return was almost 5 percent for the ESG portfolio. With the implementation of the Fama-French Three-factor Model, it is visible that the market risk factor exposure is relatively low while the small minus big coefficient is relatively higher, but since the portfolio mostly contains small cap stocks the results are not so surprising. The average returns on Mkt-Rf and SMB were negative for the 2018 period, while the HML factor, what is based on the value stocks over the growth stocks, earned 0,15 percent yield on average, as the table (4) shows. With the usage of these coefficients, it is clear that the return that we assumed is less in the case of the Three-factor Model than the expected for this period. But as I highlight in the past chapters, during the calculation process some of the factors exceeded certain threshold values, due to the fact that Hungary is an emerging market, which means the result can be less accurate in comparison with stocks from developed countries.

In 2019, the whole stock market was quite volatile again, and it was the only period when the BUX index performed better results than the ESG portfolio, just as Prol (2022) presented that in his work, with the difference that the author used the New York Stock Exchange as a basis. Magyar Telekom and MOL were the only stocks, that gained minus average returns with relatively low volatility. Stocks from the banking and energy industry performed the most average return from the portfolio, what includes OTP, E-On and MBH. Only the OTP were able to gain a higher average return than the BUX index for this period. In comparison with the MBH, their average return was beyond the OTP, but in case of volatility, the MBH had significantly less standard deviation, that means they were able to perform slightly less returns than the BUX index with the smallest risk among the ESG stocks. In contrast, the ESG portfolio underperformed the BUX index in average return, but interestingly, it was also far less volatile simultaneously. In the case of BUX index, there was approximately 0,4 percent more standard deviation than the ESG portfolio, meaning that the index provided significant amount of average return with more risks at the same time. In comparison Damodaran's Beta calculations, we can see how volatile shares have been relative to their home country's stock market indices. But I should also highlight that, the Hungarian stock market contains more shares that comprised of lower amount of capitalization in comparison with the exchanges in the United States. Due to the fact that Hungary is an emerging market, the results can be more versatile in the field of profitability, riskiness, and so on. With this in mind, we can observe that the US stocks are more stable in comparison with the standard & poor's S&P 500 index, than the Hungarian stocks compared to the BUX index, as the table (2) shows below. The bank industry has a slightly greater beta and relatively high standard deviation according to Damodaran's calculations. In case of Hungarian stocks, the relative dispersion reached high levels, especially in the bank industry. For instance: the OTP stocks had a significant amount of risk with a negative average return for the 2019 period, but at the same time, the MBH was more stable and earned higher yields than the OTP's shares as the table (3) presents. Furthermore, in the United States the telecommunication sector has been relatively less volatile than the S&P 500 index, as well as in Hungary, where these companies were able to obtain less beta but higher overall dispersion. Another notable thing to mention is the gas and oil sector in the United States, which was one of the least risky assets to invest in, while average stock returns in Hungary have been more uncertain. Considering the Fama-French Three-Factor Model, I observed that the market risk factor has a positive value, which means in case of risk-free investment, you should have been earned positive yield. As the table (4) represents, while in contrast with the SMB and the HML, these factors obtained negative returns for the same period. In the case of beta coefficients, the ESG portfolio covariance

obtained considerably low values in comparison with the SMB and HML factors, especially in contrast with the results in the last year. After the implementation of the coefficients, it is evident that the Three-factor Model yields provide lower return than what I calculated in 2019.

In 2020 the ESG portfolio continues to provide better results than the BUX index (as the table (3) shows below), although the interest rate changed two times in a row this year. With this in mind, the results of Prol (2022) show interesting differences compared to my calculations. As Prol presented lower average returns for high ESG portfolios on the New York Stock Exchange, in Hungary the results are more promising for such financial instruments, even when macroeconomic factors change. The Hungarian central bank changed the interest rates on several occasions, which had a major impact on the profitability and volatility of shares. In addition, it should be mentioned that the COVID-19 crisis had a huge negative effect on the world economy (Oleg 2020, Stephan 2020). One is able to forecast broadly the new socio-economic reality, but its specific features are yet unclear. Without a question, it makes sense to begin thinking about the social and economic landscape right away in order to kickstart the policy-making process that will mitigate the worst effects of the crisis as soon as possible. We can now declare with confidence that the world will once again emerge from its current crisis in an entirely different shape. But the question arises as to how this crisis has affected capital markets? In case of Hungarian market, the crisis also put a huge impact on the shares on various ways. As the crisis gradually grew, the Hungarian central bank also altered the interest rate to keep the inflation and other factor more controllable levels. In March and April there were huge falls in equity returns, especially in case of the OTP stock where it decreased more than 30 percent in only one month. After the events that occurred in the last periods, the central bank settled a lower interest rate on the 24th of June, that impacted positively the stock market. As interest rate drops, throughout the asset price channel the stock prices are increasing as well as the q factor, what was introduced by Tobin (1956). When the rate reached the 0,75 percent, surprisingly, the Hungarian ESG stocks in banking industry earned an astonishing amount of return in just one month. In contrast, the returns were relatively high, but this was not the case for the whole year. In July, the central bank continued to hold back the interest rate by 0,60 percent and it had a versatile effect on the market. In the next couple months, all the ESG stocks ended up in negative returns, except some stock from the pharmacy and banking industry. In the case of the ESG portfolio, it manages to fluctuate less, which means that the exposur for interest rate changes is not remarkable. As I mentioned in my hypothesis, I highlighted that the ESG stocks and portfolio will fluctuate less than the BUX index and earn higher returns or at least high losses will not take place. Interestingly, a decrease in the interest rate had a higher impact on the ESG portfolio than the BUX index. It is also interesting to see, if the macroeconomic factors present positive changes, the ESG portfolio also perform better results in comparison with the Hungarian market. From June to August, the Bux index acquired a negative return, but the ESG portfolio gained a positive average return for this period. For the whole year, the ESG portfolio earned more return accompanied by smaller volatility while the BUX index closed with a negative average return. In light of Damodaran's calculations, the telecommunication, oil and gas distributor, healthcare and banking stocks in the United States obtained relatively low betas, meaning that these equities were less volatile than the total market as the table (2) shows below. Furthermore, it is surprising that the renewable energy stocks also performed suitable results in the field of beta calculation. From Hungarian perspective, the domestic renewable energy stocks also performed similarly in this period in contrast with the results from the United States. Taking into account the Fama-French Three-factor Model, I recognized that, the risk-free premium ($Mkt-R_f$) and the SMB gained positive

return for this period, while in case of HML, it acquired losses in average in 2020. From beta calculations point of view, the small minus big coefficient is acquired a negative value as well as the high minus low factor, while the market risk factor coefficient is approximately 0,15. Surprisingly, the Three-factor Model will deliver more return than what I anticipated when the coefficients are implemented, which means the ESG portfolio should have been obtain more return in contrast with the performance and value of the portfolio.

In the following year, the central bank increased the interest rate several times in only one year, but overall, the ESG portfolio still outperformed the Bux index again. Before the first interest rate change have been settled, the Hungarian market performed well, the BUX Index was able to acquire a solid return for this period. However, following the first interest rate hike, almost all equities produced negative returns in June, which rather held back the BUX index as well. Surprisingly, the OTP and MOL financial derivatives performed well and gained a significant amount of average return in a single month. In the case of MOL stocks, the changes in the oil prices had an impact on the firm's profitability and on his shares at the same time (Kotán, László, Sali (2007)). The nations that acquire significant financial advantages from oil exports are most impacted by the short-term fluctuations in oil prices, but on the other hand, the major importing country's capital markets are the main cause of this volatility. In addition, OTP shares also posted a significant return, as the company published a huge profit for the third quarter, despite the Hungarian central bank raising interest rates on several occasions during this period. But if we make the whole year the main field of analysis, most of the ESG stocks earned more average return in comparison with the BUX index, as the table (3) shows below. From a riskiness perspective, I must highlight that the ESG stocks were more volatile than the market for the same period. The average dispersion for the ESG securities was more than 5 percent, but in the case of the PannEnergy stocks, the volatility was significantly higher than the mean. Interestingly, PannEnergy acquired a -1 beta, what means that most of the time the volatility of this security in completely opposite to the BUX index. According to Aswath Damodaran's beta calculations: telecommunication, renewable energy, Oil distribution and banking stock were acquired less beta, than the total market, which means, these equities were less volatile in case of macroeconomic and other external factor effects. In case of the Hungarian market, the situation is almost the same. Industries that have been mentioned in Aswath Damodaran's table acted almost similarly in the domestic stock exchange in comparison with BUX index as the table (2) shows below. With these in mind, we can observe that the ESG portfolio has presented more reasonable numbers than the BUX index, in a period in which the Hungarian central bank has been raising interest rates frequently. In comparison with the ESG stocks and with the BUX index, we can see the ESG portfolio was less volatile and gained a higher amount of average return. For this period, the ESG portfolio was more stable, more profitable, and interestingly, it was remarkably less sensitive for the interest rate change in contrast with the Hungarian market. Using the Fama-French Three-factor Model, it is observable that the market risk factor, the small minus big and the high minus low factors earned positive average return for this period, as well as ESG portfolio. As the table (4) shows below, the Mkt-Rf and the HML acquired negative beta, but the small minus big have gained positive values at the same time, meaning that the portfolio has low coherence with the factor's volatility. When the coefficients are applied, the Three-factor Model presents a negative return in contrast with the calculated average return for 2021.

In 2022, the Hungarian central bank increased the interest rate in several times in a year, what still negatively impacted the domestic stock market. Moreover, we can't ignore the fact that the

escalating war between Russia and Ukraine has severely damaged the world economy (Mbah and Wasum (2022) Liadze and his co-authors (2022)). Inflation has risen gradually over the year as oil, gas and other prices have risen, and central banks have responded by raising interest rates. These factors put a huge pressure on the stock market, especially on the emerging ones (Boungou and Yatié (2022)), and most of the equities ended up in significant losses for this very period. In case of the Hungarian market, there were a considerable number of losses for 2022, but as the results shows, most of the ESG stocks still outperformed the BUX index, even though the central bank changed the interest rate several times. By contrast, the ESG Portfolio had better results for the year with reasonably less overall risk. After the first interest rate changes period, the ESG portfolio acquired less average negative return than the Bux index. Interestingly, besides the lower losses the ESG portfolio obtained significantly less dispersion for the same period by almost 4 percent, meaning that the performance had been less affected by the interest rate changes. In contrast with the interest rate changing period from June to September the average return was negative as well, but overall the BUX index obtained higher losses than the ESG portfolio for this period as the byle (3) shows below. But surprisingly, in terms of risk, ESG portfolio volatility was significantly lower again, which means despite the less amount of return, you can get a much more stable investment. In view of Aswath Damodaran's beta calculations, the Hungarian results are quite similar. For instance: banking and telecommunication stocks are acquired way less beta as the table (2) shows below, meaning that their fluctuation were significantly different than the Hungarian market. With this in mind, the calculated return where the Three-factor Model was applied was quite surprising, as it provided more loss on the ESG portfolio than the actual numbers. In 2022, the Mkt-RF and the SMB factor acquired negative average return in case of emerging markets, while the HML obtained higher yields for the same period. Furthermore, the market factor exposure is still relatively low, but in the case of the small minus big and high minus low factor the coefficients are gained minus values. According to the results, the ESG portfolio should have been less profitable, meaning that it gained less losses for the same period than I expected.

<i>INDUSTRY NAME</i>	<i>2019</i>	<i>2020</i>	<i>2021</i>	<i>2022</i>
BANK (MONEY CENTER)	0,43	0,56	0,59	1,03
DRUGS (PHARMACEUTICAL)	1,38	1,29	0,84	1,01
GREEN & RENEWABLE ENERGY	0,80	0,59	0,68	1,10
HEALTHCARE PRODUCTS	1,04	0,98	0,8	0,91
OIL/GAS (PRODUCTION)	1,07	1,08	0,81	1,13
OIL/GAS DISTRIBUTION	0,62	0,62	0,6	0,86
TELECOM. SERVICES	0,74	0,67	0,42	0,51
TOTAL MARKET	0,80	0,83	0,75	0,91

Table 2: Beta calculations for stocks in the United States from 2019 to 2022.

This table represents the US stocks' Beta from different industries. Source: Own edit (based on Aswath Damodaran (2022) beta calculations)

Finally, the cumulated results for the 4-year period are good representations of what I expected in my hypothesis. From 2018 to 2022, just like other countries the Hungarian economy was influenced by plenty of positive and negative externalities, which had a strong impact on the macroeconomic factors as well. As time went by, the market was highly bound by these variables, but the question still arises: Did the ESG portfolio outperform the BUX index in case of average return and risk in a period where several interest rate changes have taken place? As the

aggregated results are presented, the ESG portfolio outperformed the BUX index in average return, with almost a 2 percent dispersion difference.

		Magyar Telekom	Richter	Eon	OTP	MOL	MBH	Pann-Energy	Bux	ESG Portfolio
2018	Return:	-0,18%	-1,38%	-0,55%	1,30%	0,61%	-0,04%	2,13%	0,03%	0,12%
	SD:	0,0549	0,0621	0,0546	0,0587	0,0669	0,0178	0,0838	0,0403	0,0284
	β :	-0,4687	0,0877	-0,116	-0,478	-0,732	0,0075	-0,2027	1	-0,2778
2019	Return:	-0,20%	0,52%	1,07%	1,95%	-0,65%	1,29%	0,94%	1,41%	0,63%
	SD:	0,0342	0,0620	0,0421	0,0491	0,0312	0,0147	0,0518	0,0286	0,0241
	β :	0,1206	-0,0414	0,5944	0,3923	-0,199	0,0184	-0,0871	1	0,1286
2020	Return:	-0,80%	1,79%	0,72%	-0,64%	-2,36%	1,25%	0,15%	-0,37%	0,01%
	SD:	0,0628	0,0600	0,0558	0,1234	0,1218	0,0644	0,0465	0,0894	0,0576
	β :	0,1734	-0,0138	0,0730	0,1943	0,1849	0,2582	0,0754	1	0,1304
2021	Return:	0,63%	1,71%	2,81%	3,49%	1,67%	0,22%	2,61%	1,63%	1,83%
	SD:	0,0225	0,0551	0,0652	0,0579	0,0587	0,0174	0,0930	0,0341	0,0217
	β :	0,0099	-0,4501	-0,242	0,3932	-0,091	0,0284	-1,0185	1	-0,1663
2022	Return:	-1,62%	0,25%	-1,13%	-3,09%	1,70%	-0,44%	2,28%	-0,86%	-0,48%
	SD:	0,0690	0,0866	0,0878	0,1316	0,0867	0,0449	0,0684	0,0830	0,0583
	β :	-0,4067	0,1158	0,1916	-0,287	-0,268	0,1099	-0,0503	1	-0,1009

Table 3: Beta, average return, and dispersion calculations for the ESG stocks, portfolio and the market.

This table represents the ESG stocks, ESG portfolio and the BUX index performance from 2018 to 2022. Return represents the average return, SD is the standard deviation and β is the beta.

Source: Own edit and calculation

With the usage of the Three-Factor model, all the factors which were applied in the calculation process earned positive average returns from 2018 to 2022 in the emerging markets. The ESG portfolio beta was relatively low in comparison with the Mkt-Rf and the SMB factors, while in case of HML, the portfolio gained negative value for this period. After the implementation, the calculated expected return for the ESG portfolio, interestingly, gained negative value, while the actual average return minus the risk-free rate was 0,33 percent for this period.

COEFFICIENTS					
PERIOD	2018	2019	2020	2021	2022
MKT-RF	0,20208	-0,02204	0,14417	-0,20443	0,28516
SMB	0,98434	0,31576	-0,12468	0,40570	-0,08084
HML	0,40675	0,00996	-0,03687	-0,38210	-0,46172
RETURN	-0,1050%	0,0657%	0,3015%	-0,3203%	-0,9987%

Table 4: ESG portfolio beta and return calculation with the three-factor model.

This table shows the market risk factor exposure of the ESG portfolio, and the calculated average return for 2018-2022 period. Source: Own edit and calculation.

5. Conclusion

In the latest years the ESG valuation system is gradually getting more and more attention from society and has become one of the main topics in the academic debate. One of the main ideas behind this system is to measure how efficient is a certain company the field of sustainability, human rights, equality, and so on. This idea heavily influenced the investment strategies in the latest years and gained an enormous amount of attention as well, not by chance. Most of the empirical research proved that ESG stocks can be more reliable investments in terms of risk and return, but what happens when internal factors, external factors, hazards, and others put pressure on whole economies and on the capital markets in case of Hungary?

One of the main topics in the financial literature is the interest rate change effects on the stock market and how the equities prices can be influenced by the macroeconomic factors. Since the central bank's goal is to keep the price, output, and others stable, the institutions mainly operate with interest rate changes against the external and internal factors to prevent the potential damages on the economy. The monetary transmission mechanism is the method by which inflation and output will be affected by the changes in the money supply, and short-term policy interest rates. This includes the asset price channel, what show how the equities were affected by the interest rate changes. In the case of stock returns and risks, the effects of these factors can be measured and evaluated, allowing us to determine how profitable a certain financial derivative might be.

In my paper I applied the beta and standard deviation method to measure risk in comparison with the market. Furthermore, I also implemented the three-factor model by Fama and French (1992) to calculate the expected return for a certain period, which I then compared with the average return of the ESG stocks and portfolio. With this in mind, I applied those factors by Fama and French that have been created in particularly for the emerging markets around the world, such as the Hungarian market.

In conclusion, along with the empirical results and research, my paper also proved that a portfolio what is includes only Hungarian high ESG stocks, is able to outperform the market and the BUX index as well. As the calculations presented, an ESG investment strategy can be a better option to realize better returns with less risk than the well-known BUX index. In light of the results, it is also have been proved that the ESG stocks are less sensitive to interest rate changes, meaning that these green equities' return and risk were more resistant against the macroeconomic variables. It is also surprising, that in a period where several crises have affected the world economy negatively, such as the COVID-19, Russian-Ukrainian war, an ESG portfolio have outperformed the domestic market, nevertheless.

5.1. Study implication and recommendations

As the households always seek for the highest possible return with the lowest possible risk, the ESG investing strategy can be a good solution for the families to increase their wealth. As Briglevics and Hegedűs (2023) presented in their research, the Hungarian households' portfolio contains more inflation tracking government bond than stocks, meaning that they are risk-averse. But in the light of my results the question still arises: how can we increase the households' interests in ESG equities to prevent wealth erosion? Policy maker should provide certain incentives for those investors, who seek to increase the number of ESG equities in their portfolio. For example, policy makers might introduce tax allowances in case of ESG equities, which in

practice would mean that the social contribution tax on dividends and exchange gains could be lower for ESG shares. Furthermore, when an investor holds a certain ESG share for a longer period of time, the tax allowance could increase gradually depending on the number of the years.

5.2. Study limitation and suggestions for future research

I must highlight that the applied three-factor model what was used in the calculation process, has weaknesses in terms of accuracy. As Fama and French mentioned in their work, this model can be less precise in case of small stocks with low average return, whose yields behave similarly to those of firms that spend enormous amounts of money despite their poor profitability. However, this is a good opportunity as well to develop more accurate factors for the Hungarian markets, in order to calculate in the most precise way possible. For future research, I also recommend testing the returns and risk of ESG equities in as many ways as possible to get better picture, and with the applications of other stock valuation methods, we will be able to broaden the discussion in case of sustainable investing.

Overall, it turned out that ESG investment strategy can be more reliable and stable, even in case of external or internal factors. Despite this, the ESG framework can be a good base of research, as it spreads around the world and draws attention to sustainable solutions in the field of finance. In Hungary, the ESG valuation system is somewhat a new thing, but as the trends shows, the green financing is paving the way for modern sustainable solutions for modern problems.

Bibliography:

- András, K. G. L. V. S. (2007). Mennyire fontos az olaj, avagy hatások és visszahatások az olaj és a tőkepiac között1.
- Alam, M. M., & Uddin, G. (2009). Relationship between interest rate and stock price: empirical evidence from developed and developing countries. *International Journal of Business and Management* (ISSN 1833-3850), 4(3), 43-51.
- Ashwin Kumar, N. C., Smith, C., Badis, L., Wang, N., Ambrosy, P., & Tavares, R. (2016). ESG factors and risk-adjusted performance: A new quantitative model. *Journal of Sustainable Finance & Investment*, 6(4), 292–300. doi:10.1080/20430795.2016.1234909
- Blume, M. E. (1975). Betas and their regression tendencies. *The Journal of Finance*, 30(3), 785-795.
- Bougou, W., & Yatié, A. (2022). The impact of the Ukraine–russia war on world stock market returns. *Economics Letters*, 215, 110516. doi:10.1016/j.econlet.2022.110516
- Briglevics, T., & Hegedűs, A. (2023). A lakossági portfólió változása inflációs környezetben az MNB felmérésének tükrében. *HITELINTÉZETI SZEMLE*, 22(2), 145-157.
- Buklemishev, O. V. (2020). Coronavirus crisis and its effects on the economy. *Population and Economics*, 4(2), 13–17. doi:10.3897/popecon.4.e53295
- Csontó, B., & Siklós, D. (2006). Hogyan hat a monetáris Politika a befektetői döntésekre? *Competitio*, 5(2), 99–112. doi:10.21845/comp/2006/2/6
- Elbannan, M. A. (2014). The Capital Asset Pricing Model: An overview of the theory. *International Journal of Economics and Finance*, 7(1). doi:10.5539/ijef.v7n1p216
- ENGLAND, B. O. (1999). Quarterly Bulletin. August/1999, Bank of England, London.
- Faccia, A., Manni, F., & Capitanio, F. (2021). Mandatory ESG reporting and XBRL taxonomies combination: ESG ratings and income statement, a sustainable value-added disclosure. *Sustainability*, 13(16), 8876. doi:10.3390/su13168876
- FAMA, E. F., & FRENCH, K. R. (1992). The cross-section of expected stock returns. *The Journal of Finance*, 47(2), 427–465. doi:10.1111/j.1540-6261.1992.tb04398.x
- Fama, E. F., & MacBeth, J. D. (1973). Risk, return, and equilibrium: Empirical tests. *Journal of Political Economy*, 81(3), 607–636. doi:10.1086/260061
- Geissdoerfer, M., Savaget, P., Bocken, N. M. P., & Hultink, E. J. (2017). The circular economy – a new sustainability paradigm? *Journal of Cleaner Production*, 143, 757–768. doi:10.1016/j.jclepro.2016.12.048

Gibson, R., & Krueger, P. (2017). The sustainability footprint of institutional investors. *SSRN Electronic Journal*. doi:10.2139/ssrn.2918926

Guermat, C. (2014). Yes, the CAPM is testable. *Journal of Banking & Finance*, 46, 31–42. doi:10.1016/j.jbankfin.2014.05.001

Hondroyiannis, G., & Papapetrou, E. (2001). Macroeconomic influences on the stock market. *Journal of economics and finance*, 25(1), 33-49.

JEGADEESH, N., & TITMAN, S. (1993). Returns to buying winners and selling losers: Implications for Stock Market Efficiency. *The Journal of Finance*, 48(1), 65–91. doi:10.1111/j.1540-6261.1993.tb04702.x

Khan, M. (2019). Corporate governance, ESG, and stock returns around the world. *Financial Analysts Journal*, 75(4), 103–123. doi:10.1080/0015198x.2019.1654299

Liadze, I., Macchiarelli, C., Mortimer-Lee, P., & Sanchez Juanino, P. (2022). Economic costs of the russia-ukraine war. *The World Economy*, 46(4), 874–886. doi:10.1111/twec.13336

Lintner, J. (1965). The valuation of risk assets and the selection of risky investments in stock portfolios and Capital Budgets. *The Review of Economics and Statistics*, 47(1), 13. doi:10.2307/1924119

Lee, D. K., In, J., & Lee, S. (2015). Standard deviation and standard error of the mean. *Korean journal of anesthesiology*, 68(3), 220-223.

Loayza, N., & Schmidt-Hebbel, K. (2002). Monetary policy functions and transmission mechanisms: an overview. *Series on Central Banking, Analysis, and Economic Policies*, no. 4.

López Prol, J., & Kim, K. (2022). Risk-return performance of optimized ESG equity portfolios in the NYSE. *Finance Research Letters*, 50, 103312. doi:10.1016/j.frl.2022.103312

Luo, D. (2022). ESG, liquidity, and stock returns. *Journal of International Financial Markets, Institutions and Money*, 78, 101526. doi:10.1016/j.intfin.2022.101526

Mănescu, C. (2010). *Economic implications of corporate social responsibility and responsible investments*. Göteborg, Västra Götalands län: Department of Economics, School of Economics and Commercial Law, University of Gothenburg.

Mbah, R. E., & Wasum, D. (2022). Russian-ukraine 2022 war: A review of the economic impact of Russian-Ukraine Crisis on the USA, UK, Canada, and Europe. *Advances in Social Sciences Research Journal*, 9(3), 144–153. doi:10.14738/assrj.93.12005

Mendiratta, R., Varsani, H. D., & Giese, G. (2021). How ESG affected corporate credit risk and performance. *The Journal of Impact and ESG Investing*, 2(2), 101–116. doi:10.3905/jesg.2021.1.031

- Mishkin, F. (2001). *The Transmission Mechanism and the Role of Asset Prices in Monetary Policy*. doi:10.3386/w8617
- Modigliani, F. (1986). Life cycle, individual thrift, and the wealth of nations. *Science*, 234(4777), 704–712. doi:10.1126/science.234.4777.704
- Mossin, J. (1966). Equilibrium in a capital asset market. *Econometrica: Journal of the econometric society*, 768–783.
- Patozi, A. (2023). Green Transmission: Monetary policy in the age of ESG. *SSRN Electronic Journal*. doi:10.2139/ssrn.4327122
- Peiró, A. (2016). Stock prices and macroeconomic factors: Some European evidence. *International Review of Economics & Finance*, 41, 287–294. doi:10.1016/j.iref.2015.08.004
- PLANET FANATICS' NETWORK, & HVG. (n.d.). ESG-lista Top 25 ESG-lista Top 25 .
- Redondo Alamillos, R., & de Mariz, F. (2022). How can european regulation on ESG impact business globally? *Journal of Risk and Financial Management*, 15(7), 291. doi:10.3390/jrfm15070291
- Roll, R. (1977). A critique of the asset pricing theory's tests part I: On past and potential testability of the theory. *Journal of Financial Economics*, 4(2), 129–176. doi:10.1016/0304-405x(77)90009-5
- Scatigna, M., Xia, F. D., Zabai, A., & Zulaica, O. (2021). Achievements and challenges in ESG markets. *BIS Quarterly Review*, December.
- Sharpe, W. F. (1964). Capital asset prices: A theory of market equilibrium under conditions of risk*. *The Journal of Finance*, 19(3), 425–442. doi:10.1111/j.1540-6261.1964.tb02865.x
- Spangenberg, J. H. (2005). Economic Sustainability of the economy: Concepts and indicators. *International Journal of Sustainable Development*, 8(1/2), 47. doi:10.1504/ijds.2005.007374
- Stempler, B. (2021). ESG Investing: The Use of ESG Ratings in a Smart Beta Strategy. *Financial and Economic Review*, 20(2), 91–116.
- Tobin, J. (1956). The interest-elasticity of transactions demand for cash. *The Review of Economics and Statistics*, 38(3), 241. doi:10.2307/1925776
- Uzsoki, D. (2020). Drivers of Sustainable Investing. In *Sustainable Investing: Shaping the future of finance* (pp. 8–16). International Institute for Sustainable Development (IISD). <http://www.jstor.org/stable/resrep22000.5>

Zemtsov, S. (2020). New Technologies, potential unemployment and ‘nescience economy’ during and after the 2020 economic crisis. *Regional Science Policy & Practice*, 12(4), 723–743. doi:10.1111/rsp3.12286

Appendix

Industry		
Magyar Telekom	Telecommunications	20%
Richter	Pharmaceutical industry	17%
E-on	Energy industry	15%
OTP	Financial services	14%
MOL	Energy industry	13%
MBH	Financial services	11%
PanEnergy	Energy industry	20%

Table 1: Weight of the ESG stocks in the portfolio.

This table represents the proportion of the stocks in constructed the portfolio Source: Own edit (based on the HVG and Planet Fanatics' (2023) Network research)

INDUSTRY NAME	2019	2020	2021	2022
BANK (MONEY CENTER)	0,43	0,56	0,59	1,03
DRUGS (PHARMACEUTICAL)	1,38	1,29	0,84	1,01
GREEN & RENEWABLE ENERGY	0,80	0,59	0,68	1,10
HEALTHCARE PRODUCTS	1,04	0,98	0,8	0,91
OIL/GAS (PRODUCTION)	1,07	1,08	0,81	1,13
OIL/GAS DISTRIBUTION	0,62	0,62	0,6	0,86
TELECOM. SERVICES	0,74	0,67	0,42	0,51
TOTAL MARKET	0,80	0,83	0,75	0,91

Tabel 2: Beta calculations for stocks in the United States from 2019 to 2022.

This table represents the US stocks' Beta from different industries. Source: Own edit (based on Aswath Damodaran (2022) beta calculations)

		Magyar Telekom	Richter	Eon	OTP	MOL	MBH	Pann-Energy	Bux	ESG Portfolio
2018	Return:	-0,18%	-1,38%	-0,55%	1,30%	0,61%	-0,04%	2,13%	0,03%	0,12%
	SD:	0,0549	0,0621	0,0546	0,0587	0,0669	0,0178	0,0838	0,0403	0,0284
	β :	-0,4687	0,0877	-0,116	-0,478	-0,732	0,0075	-0,2027	1	-0,2778
2019	Return:	-0,20%	0,52%	1,07%	1,95%	-0,65%	1,29%	0,94%	1,41%	0,63%
	SD:	0,0342	0,0620	0,0421	0,0491	0,0312	0,0147	0,0518	0,0286	0,0241
	β :	0,1206	-0,0414	0,5944	0,3923	-0,199	0,0184	-0,0871	1	0,1286
2020	Return:	-0,80%	1,79%	0,72%	-0,64%	-2,36%	1,25%	0,15%	-0,37%	0,01%
	SD:	0,0628	0,0600	0,0558	0,1234	0,1218	0,0644	0,0465	0,0894	0,0576
	β :	0,1734	-0,0138	0,0730	0,1943	0,1849	0,2582	0,0754	1	0,1304
2021	Return:	0,63%	1,71%	2,81%	3,49%	1,67%	0,22%	2,61%	1,63%	1,83%
	SD:	0,0225	0,0551	0,0652	0,0579	0,0587	0,0174	0,0930	0,0341	0,0217
	β :	0,0099	-0,4501	-0,242	0,3932	-0,091	0,0284	-1,0185	1	-0,1663
2022	Return:	-1,62%	0,25%	-1,13%	-3,09%	1,70%	-0,44%	2,28%	-0,86%	-0,48%
	SD:	0,0690	0,0866	0,0878	0,1316	0,0867	0,0449	0,0684	0,0830	0,0583
	β :	-0,4067	0,1158	0,1916	-0,287	-0,268	0,1099	-0,0503	1	-0,1009

Table 3: Beta, average return, and dispersion calculations for the ESG stocks, portfolio and the market.

This table represents the ESG stocks, ESG portfolio and the BUX index performance from 2018 to 2022. Return represents the average return, SD is the standard deviation and β is the beta.

Source: Own edit and calculation

COEFFICIENTS					
PERIOD	2018	2019	2020	2021	2022
MKT-RF	0,20208	-0,02204	0,14417	-0,20443	0,28516
SMB	0,98434	0,31576	-0,12468	0,40570	-0,08084
HML	0,40675	0,00996	-0,03687	-0,38210	-0,46172
RETURN	-0,1050%	0,0657%	0,3015%	-0,3203%	-0,9987%

Table 4: Beta, average return, and dispersion calculations for the ESG stocks, portfolio and the market. *This table shows the market risk factor exposure of the ESG portfolio, and the calculated return for 2018 -2022 period.*Source: Own edit and calculation.