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EMPIRICAL ANALYSIS OF THE RELATIONSHIP BETWEEN SUSTAINABILITY AND MACROECONOMICS INDICATORS

MASTER'S DEGREE THESIS

Elif Begüm ALACAOĞULLARI

ADVISORS

Assoc. Prof. Erdem KILIÇ

ISTANBUL, February 2024

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(198106012)

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ABSTRACT

EMPIRICAL ANALYSIS OF THE RELATIONSHIP BETWEEN SUSTAINABILITY AND MACROECONOMICS INDICATORS

This thesis undertakes an empirical investigation into the intricate relationship between sustainability and macroeconomic indicators, focusing on a comparative analysis of 14 countries from Central Asia, Europe and Turkey over the period 2010-2020. The countries studied include Estonia, Switzerland, Germany, Denmark, Bulgaria, Bosnia and Herzegovina, Belarus, Spain, Azerbaijan, Belgium, Austria, and Czechia. One of its aim is to analyze Turkey's sustainability performance among the region. The study explores sustainability through three dimensions: social, economic, and governance, with a specific emphasis on the detailed analysis of social indicators.

Macroeconomic indicators, encompassing GDP growth, inflation, interest rates, foreign trade and government expenditure are examined to understand their correlation with sustainability factors. Data for both sustainability and macroeconomic indicators are sourced from the World Bank and analyzed using a Python program with panel regression analysis.

The findings reveal a meaningful and significant relationship between Environmental, Social, and Governance (ESG) factors and macroeconomic indicators. Notably, the social dimension demonstrates a stronger correlation compared to environmental and governance parameters. The thesis contributes to the ongoing discourse in the literature concerning the necessity for a global definition of sustainability. It highlights the pivotal role of technology and innovation in advancing sustainability objectives and underscores the importance of universal legislation and policies. The research also advocates for a revisitation of macroeconomic policies and theories to align them with sustainability imperatives.

ÖZET

SÜRDÜRÜLEBİLİRLİK VE MAKROEKONOMİ GÖSTERGELERİ ARASINDAKİ İLİŞKİNİN AMPİRİK ANALİZİ

Bu tez, 2010-2020 döneminde Orta Asya ve Avrupa'dan 14 ülkenin karşılaştırmalı analizine odaklanarak sürdürülebilirlik ve makroekonomik göstergeler arasındaki karmaşık ilişkiye dair ampirik bir araştırma yürütmektedir. İncelenen ülkeler arasında Estonya, İsviçre, Almanya, Danimarka, Bulgaristan, Bosna Hersek, Belarus, İspanya, Azerbaycan, Belçika, Avusturya ve Çekya bulunmaktadır. Amaçlarından biri de Türkiye'nin bölgedeki sürdürülebilirlik performansını analiz etmektir. Çalışma, sürdürülebilirliği sosyal, ekonomik ve yönetişim olmak üzere üç boyutta incelemekte ve sosyal göstergelerin detaylı analizine özel bir vurgu yapmaktadır.

GSYH büyümesi, enflasyon, faiz oranları, dış ticareti ve devlet harcamalarını kapsayan makroekonomik göstergeler, sürdürülebilirlik faktörleri ile korelasyonlarını anlamak için incelenmiştir. Hem sürdürülebilirlik hem de makroekonomik göstergeler için veriler Dünya Bankası'ndan temin edilmiş ve panel regresyon analizi ile bir Python programı kullanılarak analiz edilmiştir.

Bulgular, Çevresel, Sosyal ve Yönetişim (ÇSY) faktörleri ile makroekonomik göstergeler arasında anlamlı ve önemli bir ilişki olduğunu ortaya koymaktadır. Özellikle sosyal boyut, çevresel ve yönetişim parametrelerine kıyasla daha güçlü bir korelasyon göstermektedir.

Tez, sürdürülebilirliğin küresel bir tanımının gerekliliğine ilişkin literatürde süregelen söyleme katkıda bulunmaktadır. Sürdürülebilirlik hedeflerinin ilerletilmesinde teknoloji ve inovasyonun önemli rolünü vurgulamakta ve evrensel mevzuat ve politikaların öneminin altını çizmektedir.

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1. INTRODUCTION AND PURPOSE

In the contemporary global landscape, the concept of sustainability has evolved into a pivotal force, influencing diverse facets of our lives encompassing environmental, social, and governance dimensions. With an increasing awareness among individuals, families, corporations, NGOs, and governmental bodies, discussions have emerged on the precise definitions of sustainability and the areas in which these definitions wield influence. The complexity arises when dealing with concepts that remain ambiguous in their definitions and impact domains, necessitating comprehensive problem-solving strategies.

While the concept of sustainability carries historical roots, its significance has surged in the present era, emphasized by the escalating impact of ongoing events. Academic examination reveals a spectrum of interpretations, theories, and subheadings under which sustainability is illustrated. This research is inspired by the desire to explore the intricate interplay between sustainability and macroeconomic data.

This thesis aims to explain the intricate relationship between sustainability and macroeconomic data, driven by the increasing importance of sustainability in the contemporary world. As current developments and our own study indicate a notable connection between sustainability and macro data, particularly in the social dimension, the research delves into the intricate dynamics underlying this association. The investigation reveals that the social parameter significantly influences environmental and administrative impacts within the broader social dimension, prompting a critical evaluation of this relationship from beyond a purely social standpoint.

The primary objective of this study is to observe and analyze the impact of sustainability studies conducted in Asia, Europe, and Turkey at the macroeconomic level. To facilitate the deepening and development of the relationship between sustainability and macroeconomic data, it is essential to establish clear and universal definitions and understand the economic and sustainable impacts comprehensively. The steps taken in

both these conceptual realms should align with universal human values and necessitate comprehensive planning across all countries, ensuring that lax regulations in one region do not compromise its sustainability.

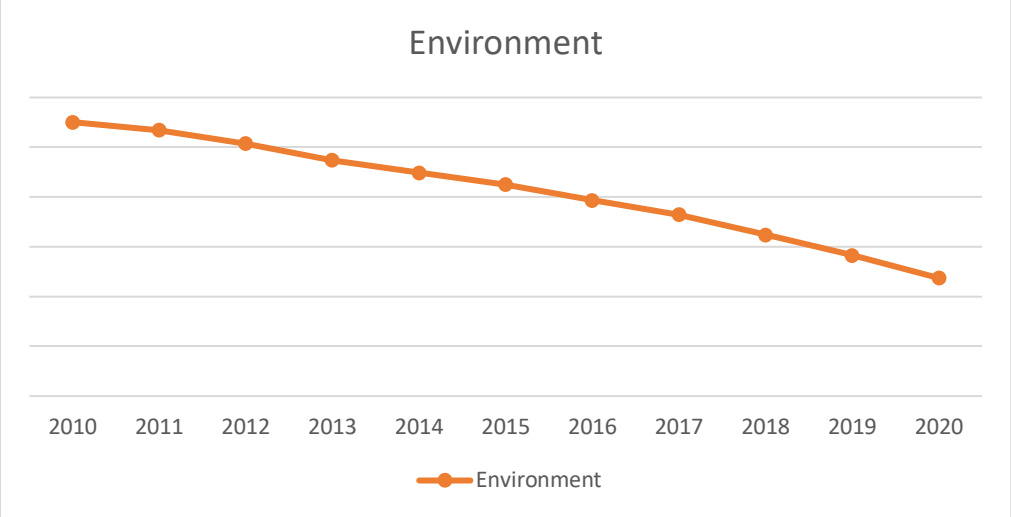
2. DIMENSIONS OF SUSTAINABILITY ENVIRONMENTAL, SOCIAL AND GOVERNANCE

2.1. Environmental Sustainability

2.1.1. Definition of Environmental Sustainability

In the face of a dilemma, society grapples with the sustainability of ongoing economic growth. Whether the growth is low or negative, as depicted in Figure 1 (sourced from world bank), it seems ecologically unsustainable. Moreover, economic growth rates bring about negative social impacts. Consequently, there is an imperative for macroeconomic investigations and tools that can guide the identification of pathways toward socially sustainable growth. The evolving field of ecological macroeconomics emerges as a response to this need, introducing diverse novel approaches to macroeconomic modeling.

Figure 1: Yearly Averages of 14 Countries Environmental Indicators



In the realm of ecological macroeconomics post-growth literature, studies focus on emerging models. Income inequality and work patterns receive brief attention, while alternative business models and cross-scale interactions are not extensively explored. Further research is essential to explore diverse approaches given the expansive definition of "economy." (Hardt, L., & O'Neill, D. W. ,2017)

A fundamental transformation is imperative in response to ecosystem degradation, urging a departure from the perpetual pursuit of economic growth in our system. (Jackson, 2009; Martínez-Alier et al., 2010; Victor, 2008).

The need for a clearer definition of the ecological concept in models arises from the challenges posed by comprehensive macroeconomic development. It is crucial to enhance the acceptance of ecological considerations from a macroeconomic perspective. Ecological macroeconomics, a field dealing with complex systems, employs various modeling approaches to comprehend these intricacies. (Scrieciu et al., 2013; Pueyo, 2014; Foxon et al., 2013; Foxon, 2011).

Despite the developmental phase of current models, the exploration of existing models has brought to light numerous promising and innovative approaches to macroeconomic modeling. These approaches, whether from an analytical perspective or through numerical methods, offer essential tools for progressing towards a sustainable post-growth economy.

Examining current models focused on post-growth policies highlights a literature gap in testing critical processes related to these policies. Applying macroeconomic models to the post-growth context broadens their scope but restricts their significance compared to traditional models.

The post-growth perspective brings often-overlooked elements into macroeconomics, revealing model limitations in summarizing various economic features. Models may not fully capture essential aspects, providing diverse scenarios rather than

an optimal vision for a post-growth context. The evaluation of these scenarios extends beyond macroeconomic models.

To encompass the various facets of the post-growth vision, a range of macroeconomic models is indispensable. These models should confront crucial inquiries related to attaining financial stability amidst reduced consumption, deciphering the repercussions of transitioning to less productive sectors on incomes and inequality, and exploring avenues for crucial societal investments during the post-growth transition without contingent reliance on economic growth itself (Hardt, L., & O'Neill, D. W., 2017).

2.1.2. Indicators of Environmental Sustainability

Sustainability, derived from various origins such as ecological carrying capacity, reserves of resources, and critiques of technology, entails fulfilling present needs without endangering the capability of future generations to meet their own requirements.

When assessing the sustainability of an activity or system, it's crucial to address three fundamental questions: 1) Identify the system requiring preservation and delineate its boundaries. 2) Specify the timeframe under consideration. 3) Evaluate the quality of the system necessitating preservation or enhancement (Taylor and Francis, 2012).

The United Nations' Sustainable Development Goals (SDGs) are a contemporary call to action for global sustainable development, envisioning a resilient and sustainable trajectory by 2030 (UN, Transforming our world, 2015). Aligned with Life Cycle Assessment (LCA) and Planetary Boundaries (PB), the SDGs share a foundation in scientific principles, utilizing operational approaches for evaluation. However, there is a scarcity of information on methodologies for SDGs indicators, prompting UNEP to conduct workshops to address this gap (UNEP, 2014). While SCP indicators exist, their integration into the SDGs framework is incomplete. As the SDGs' operational phase progresses, additional guidance and measurement methods are expected for goal realization (UNEP, 2014). Current environmental sustainability indicators in LCA, PB,

and SDGs converge on long-term global preservation, with SDGs uniquely emphasizing the social facet (Dong, Y., & Hauschild, M. Z., 2017).

2.2. Social Sustainability

2.2.1. Definition of Social Sustainability

Understanding social sustainability involves integrating materials, individuals, finances, and ideas, each with its unique challenges. A resilient social infrastructure enhances overall quality of life, contributing to social sustainability in the built environment. The objective is to establish conceptual connections, forming a social sustainability framework (Bebbington and Humphreys Bebbington, 2018).

The interaction between individuals and social infrastructure significantly influences overall life fulfilment and pleasure with chosen lifestyles. Constructing a theoretical model for social sustainability implicates defining these concepts, supplemented by distinct challenges. The model progresses through three phases: outlining social infrastructure, life quality, and social sustainability; determining a robust link between social infrastructure and quality within the wider sustainability framework; and considering socio-economic features and urban life quality. Social sustainability serves as a nexus between its social, economic, and environmental dimensions. Addressing social issues and managing associated risks through socially focused practices are crucial for achieving social sustainability. A all-inclusive attitude is needed, affecting individual and social capacities, encouraging widespread participation, and enhancing whole quality of life and well-being (Grum, B., & Kobal Grum, D., 2020).

The enduring challenge within sustainability research, reflected in the ambiguity and lack of clarity surrounding the notions of social infrastructure and quality of life, frequently directs researchers to investigate the subject within the broader scope of social sustainability (Salas-Zapata and Ortiz-Munoz, 2017). The criteria employed to assess social sustainability are primarily grounded in practical scenarios and current political dynamics rather than being rooted in theoretical foundations (Grieller and Littig, 2004).

The significance attributed to social infrastructure becomes apparent through its in-depth analysis, particularly in the realm of community social development. This can be about peoples communication, social services, education, housing and health (Pogrebskyi, 2016). However, in the midst of various debates, discussions, and efforts, a common consensus emerges: social infrastructure is recognized as the "bonding element that brings communities together" (SGS Economics and Planning, 2020).

Prioritizing resident satisfaction within residential environments is pivotal for gauging the overall quality of life. The attainment of personal objectives in one's living space signifies a heightened sense of satisfaction (Mohit et al., 2010). Residential satisfaction, intricately tied to factors in neighborhood profiles (Adriaanse, 2007). Studies examining housing satisfaction often employ it as a predictive factor for behavior or as a criterion for housing quality (Weidemann and Anderson, 1985; Amérigo and Aragonés, 1997; Parkes et al., 2002; Pinquart and Burmedi, 2004). The development of a housing model entails the evaluation of desired features, systematic organization of variables, and exploration of the impact of both physical and social environments (Adriaanse, 2007). The exploration of meaningful interactions across the consumer/product life cycle sheds light on the substantial role housing plays in an individual's overall quality of life (Grzeskowiak et al., 2006).

The presumption associated with the housing concept across the consumer/product life cycle is that promoting specific qualities enhances overall housing quality (Bardo and Dokmeci, 1992). While humanity is central to the sustainability concept, limited attention has been given to defining the importance of social infrastructure in constructed environments compared to the natural environment (Dempsey et al., 2009). Studies on social sustainability show a gradual integration of the "social" aspect in discussions around sustainable development. The proposed conceptual framework for social sustainability emphasizes the distinctive features of each concept and highlights the interconnected nature of socially-focused practices with significant social dimensions. The significance of the physical dimensions of human spaces in achieving social sustainability extends to reducing environmental risks and improving the quality of life and well-being. Sustainable human spaces necessitate addressing the

qualitative aspects of spaces that tackle social issues, presenting challenges within a broader sustainability framework (Eizenberg and Jabareen, 2017).

Research on social sustainability frequently aims to offer policymakers valuable insights and raises questions about its tangible impact on policy construction within the social sciences. Such studies often respond to concerns stemming from specific policies or a general call for extraordinary action. There is a frequent aspiration for the concept of social sustainability to function as a tool for supervising policies and guiding decision-makers. Positive reactions to similar questions can only be obtained when we have a complete analyze of the mutual advantages between social infrastructure and the quality of life (Jacobsen and Delaney, 2014).

2.2.2. Indicators of Social Sustainability

The current financial and economic crisis negatively affected the EU due to the gathering of macroeconomic insecurities in member states' economies (Buti, 2011). Popa (2012) explored the theoretical and practical aspects of how social considerations effect macroeconomic meters. Employing an econometric model, Popa's research considered the path and worth of social factors on the economic growth of EU countries from 2005 to 2009. The study used per capita real GDP as the dependent variable, considering variables of some social sustainability dimensions. The findings validated the hypothesis of a solid connection between a country's human improvement and its economic growth. Popa suggests that, for a more comprehensive analysis, additional economic, political, and legal factors should be considered within the precise background of each country under investigation, beyond the projected parameters (Popa, 2012).

The impact of social infrastructure on economic growth and inequality in South Africa from 1994 to 2013. The study exposes that education costs meaningfully encourage economic growth, although health expenses have an unimportant and adverse influence. Surprisingly, the association between education costs and inequality is statistically insignificant but has a meaningful negative effect. (More & Aye, 2017; Gnade et al., 2017) Furthermore, a study in Jordan and some Arab countries finds a significant

correlation between economic growth and fluctuating unemployment rates. The findings suggest that a 1% increase in economic growth corresponds to a 0.16% reduction in the unemployment rate (Abdul-Khaliq et al., 2014).

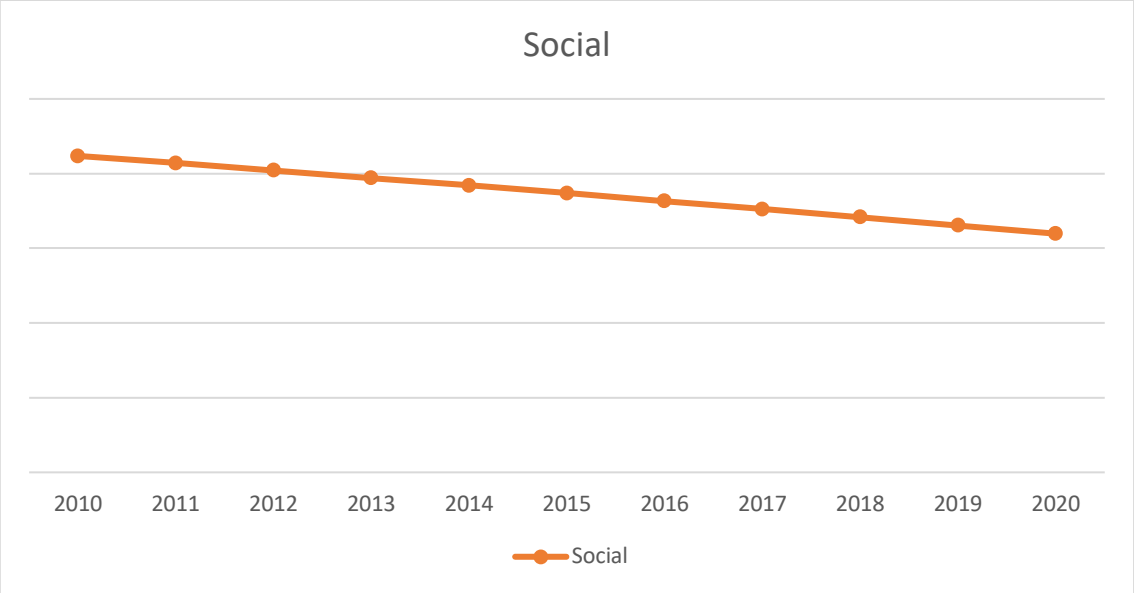
The demographic composition of a nation's population significantly influences its economic progress and competitiveness, reflecting the economic activities of individuals at different life stages. It emphasizes the importance of countries tailoring their population policies to the unique life stages of their populations. There are three main hypotheses: 1) population growth restrains economic development (pessimistic theory); 2) population fluctuations can spur economic growth (optimistic theory); 3) population changes do not significantly influence economic growth (neutral theory) (David et al., 2001).

Additionally, the educational achievement of a population is a key determinant influencing a nation's economic advancement (Lutz et al., 2008). Odit, in 2010, the identify education as a contributing factor to the impressive GDP growth of Mauritius from 1990 to 2006. Education is known as a genuine mechanism for boosting labor productivity. Positive relationships exist among economic growth and the average years of secondary and higher education for adult males. Similarly, the educational achievements of females at these levels are positively linked with economic growth (Barro, 2000).

The recent worldwide financial and economic downturn has expedited disparities in the socio-economic progress of nations. Two primary adverse outcomes of the crisis were persistent and heightened unemployment rates and an escalation of social inequality, potentially accounting for the trend shown in Figure 2 1 (sourced from world bank) below. Noteworthy factors for future development include security, culture, science, education, and health. The proposal emphasizes the creation of an indicator reflecting the country's human capital level to establish a robust monitoring system and

implement measures ensuring the stability of forthcoming macroeconomic policies (Palienko, M., & Lyulyov, O., 2018).

Figure 2: Yearly Averages of 14 Countries Social Indicators



2.3. Governance Sustainability

2.3.1. Definition of Governance Sustainability

In recent times, there has been a rising trend among various companies to establish obligation to focusing social and environmental effects within their investment practices. A key emphasis is on aligning with the United Nations Sustainable Development Goals (UN-SDGs) and the Paris Agreement on climate change. A noteworthy standard in this area is the United Nations-supported Principles for Responsible Investment (UNPRI), which serves as a pioneering standard for ESG considerations (Mazars, 2021).

The financial industry has experienced a notable uptick in the embrace of ESG principles, seen through the proliferation of products like ESG investment funds and pension funds. Additionally, there is a discernible trend of funds undergoing rebranding to align with ESG standards (Fink, 2019). ESG, encapsulating environmental, social, and governance criteria, is acknowledged as a pivotal framework for responsible and

sustainable investment practices (Hao Liang/Luc Renneboog, 2020). Beyond influencing portfolio decisions, ESG considerations extend to choices in lending and insurance, aspiring to bring about a positive and enduring impact, often referred to as the 'gradual impact' (Palmiter, 2021).

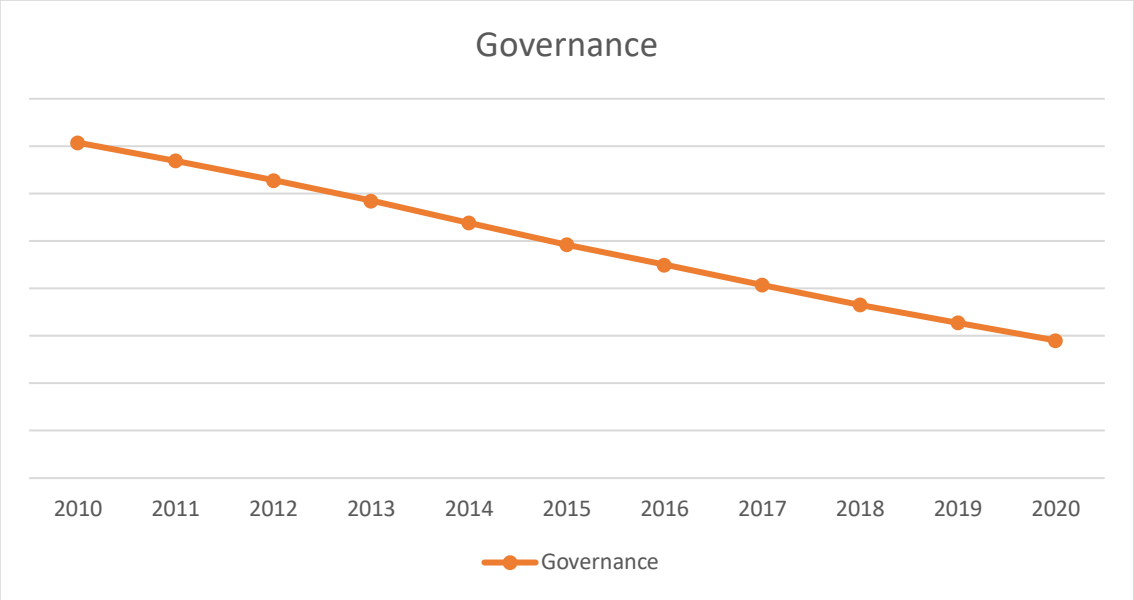
This global shift among investors, propelled by ESG, is reshaping the financial landscape (Hale, 2018). The Principles for Responsible Investment, endorsed by the United Nations, promotes for the mixture of ESG criteria into asset management, highlighting active ownership and the disclosure of pertinent ESG information (Freshfields, 2005). ESG underscores the integral assembly between environmental and social sustainability and corporate governance, underlining the crucial role of governance in achieving sustainability (Pollman, 2021).

Originally spurred by market forces and UN inspiration, the sustainable investment movement has proficient a surge in momentum, driven in part by regulatory pressures. A key driver of this shift is the European Union, which introduced the trajectory with the 2018 Action Plan on Financing Sustainable Growth. Legal interventions have played a pivotal role in promoting ESG activism and enhancing shareholder engagement. The multidimensional nature of ESG objectives significantly influences numerous aspects of the corporate governance system, surrounding decision-making progressions, ownership policies, product governance strategies, internal controls, and disclosures. This highlights the systemic relationship between ESG and corporate governance, spreading beyond environmental respects (Câmara, 2021; Directive (EU), 2017; Mele, 2010)

2.3.2. Indicators of Governance Sustainability

The improvement in ESG (Environmental, Social, and Governance) advantages is happening in a crucial era considered by significant changes in the worldwide corporate governance setting. Growing hesitations about climate change have become a global central fact, and the change toward a net-zero economy emerges foreseeable. Major nations are dynamically converting their voiced promises into solid movements (Cullen, 2019).

Figure 3: Yearly Averages of 14 Countries Governance Indicators



The current situation underscores the importance of a more active role for the private sector and increased transparency in tackling climate change. This allows companies to play a vital part in both mitigating and adapting to environmental crises, as illustrated in Figure 3 (sourced from world bank) below.

At the same time, institutional investors are agreeing a more firm stance on ESG issues. In the last decade, there has been a significant reforming of ownership in publicly transacted shares on a global scale, with large institutional shareholders holding important blocks. Urging corporations to take on a more central role in relating with investors. Some explanations suggest that these organized investors, handling diverse portfolios, place themselves as "worldwide owners" (Alexander, 2020). Countries indicate that highlighting the justification of systemic risks such as climate change is crucial. In reaction, major asset directors and banks are providing broad assistance for ESG issues. This shift has been facilitated in several regions by governance guidelines that clarify the responsibilities of institutional investors, inspiring them to take on more active roles in corporate management and promoting increased commitment with invested companies. (Ringe, 2021)

The United Kingdom has actively fueled this trend by adopting a governance structure that incorporates ESG contemplations. These guidelines mandate signatories to systematically incorporate administration and investment practices, giving important notice to environmental and social subjects, and satisfying their tasks related to authority and climate change. Additionally, there is an growing push to weave environmental and social considerations into the primary mutual purpose, a shift that follows wide discussions on corporate social responsibility (Davies, 2020).

The widened notion of business resolution doesn't conflict with profit-making; instead, it means that beneficial commercial should associate with a more widespread collection of points beyond financial profits. (Tallarita, 2021). The Davos Manifesto declares that a company's determination is to 'include all shareholders in the procedure' and provide to generating common and sustainable worth. A company assists not only its shareholders but all stakeholders, containing staffs, clients, dealers, resident people, and society at huge (Mayer, 2020).

The COVID-19 pandemic has led to a reevaluation of corporate values by both boards and investors, increasing the importance on social and environmental significances within the ESG context. This shift in company purpose, stress a more widespread range of interests such as climate, social, and governance objectives, holds significance (Carney, 2021). This trajectory presents exploration chances for both investment units and the corporations they invest in. Financial organizations are expected to align their ESG strategy externally, while shareholder force assumes that ESG choices at authorized companies associate with their mutual purposes.

3. SUSTAINABILITY AND MACROECONOMICS

Ecological economics emphasizes that the economic system extends beyond traditional views of meso- or macroeconomics, affecting organizations, management, and difficulty at numerous levels. This viewpoint directs notice to small-scale subsystems due to the core belief that Earth's supplies are restricted. The current worldwide economic development poses a challenge to the planet's limited margins, inquiring the sustainability of continuous growth. Accomplishing sustainable growth contains reconsidering old-fashioned macroeconomic notions and focusing social trials. While neoclassical macroeconomics relies on limits and price indications, alternative standpoints call for a all-inclusive transition, requiring a intense rethinking of the prevalent growth paradigm. This entails considering broader effects of economic costs and joining communal organizations (Rezai, A., & Stagl, S., 2016).

As ecological economists shifted their focus to construction as a critical link between the economy and the ecosystem, it became apparent that restrictions on material output incorporate not just resources but also the planet's environmental measurements. In this context, Daly introduced the concept of ecological macroeconomics, describing it as "material trades exceeding the border among systems" and creating a "subsystem of the environment macroeconomics - applicants." Daly outlined the conflict between growth limits and other policy objectives, proposing collective solutions for achieving social and ecological sustainability (Daly, 1991, p. 35).

Within ecological economics, the macroeconomic emphasis prompts uncertainty about the usefulness of innovation and technology in succeeding sustainability. Disparate neoclassical environmental economists supporting for pricing devices, ecological economists, associated with Post-Keynesian theorists, recognize doubts and endorse the Precautionary Principle. They highlight the possible weaknesses of innovations and grading struggles, underlining the requirement to realize subjects of scale. Ecological macroeconomics is meticulously tied to growth theory, outspreading into monetary,

distributional, and welfare economics. Ecological economists have investigated connections with the (Post-) Keynesian growth toolkit early on.

Conventional methodologies to route sustainable evolutions inadequately grasp macroeconomic relationships and struggle to harden modern social manufacture associations, as noted by Røpke (2016). The perception of job sharing, presented by Røpke, is not only seen as a way to break from current institutions but also as a pathway to figure a society that is both reasonable and more maintainable. Discussions on condensed working hours in economic circles argue that while job sharing may deficiency in having strong consensus in global, it highlights the fundamental function played by official and political dynamics (Zwickletal, 2016).

In modern capitalist settings, social communications are mainly formed through market exchanges, and the purposes of ecological macroeconomics highlight this initial aspect. While the interest of improved equality is crucial, it must be assumed within the ecological limitations important for satisfying living circumstances. A thorough knowledge of market associations is crucial for facilitating effective trades, and people within the Ecological Economics Community are discovering wider investigations into social revolution that question the basics of ecological macroeconomics (Røpke, 2016).

3.1. Factors Affecting Macroeconomy

Re-establishment of equilibrium within a year is expected through modifications in interest rates, foreign capital, and market dynamics, inflows. This research donates precious comprehensions into the multifaceted collaboration of macroeconomic variables and the dynamics of the stock market (Olokoyo, F. O., Ibhagui, O. W., & Babajide, A., 2020).

Sustainable competitiveness occurs from incorporating economic usefulness with social and ecological reflections, confirming current client needs are met without cooperating future originations. It's a dynamic cause for a nation's development, intending

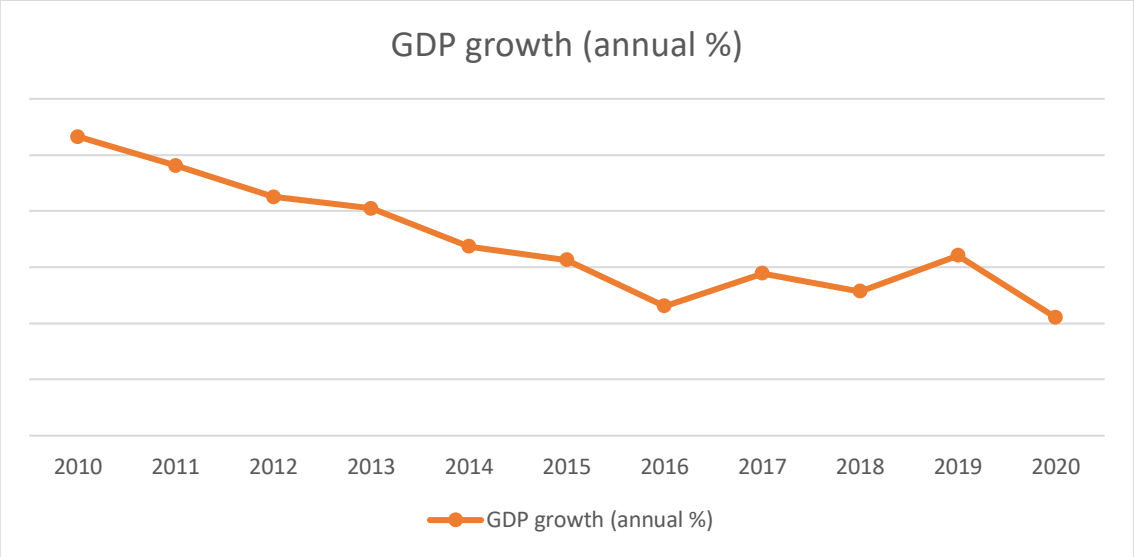
to tolerate real competition and develop efficiency. Scientific research highlights the influence of output, particularly in nationally manufactured goods, on competitiveness, emphasizing efficiency as vital. The study supporters for strategic improvement and motivational organizations to boost competitiveness. To achieve improved competitiveness and sustainable development, basics include presenting customer-centric stuffs, providing all-inclusive worth, justifying charges, and gaining a competitive benefit. Features affecting competitiveness, such as salary and occupation levels, capital deployment, and worker motivation signs, are crucial concerns (Okunevičiūtė Neverauskienė, L., Danilevičienė, I., & Tvaronavičienė, M., 2020).

3.1.1. Growth

Noticeable a enjoyable equilibrium among economic growth and sustainability stances a modern trial. Although recognizing the need of economic growth for progress, there is a growing consciousness of its environmental and social consequences. Sustainable growth includes gathering current desires exclusive of compromising the ability of upcoming generations to do the similar. This requires implementing practices that decrease resource exhaustion, improve environmental influence, and highlight social welfare. This change needs a reconsideration of achievement metrics, the acceptance of

modern technologies, and the application of comprehensive policies for the long-term international well-being, as depicted in Figure 4 (sourced from world bank) below.

Figure 4: Yearly Averages of 14 Countries GDP Growth Rates



In the field of environmental economics, considerable support has been gathered for the Environmental Kuznets Curve (EKC) theory, representing a separate change in economic actions connected to energy strength and intake of raw materials (Cleveland and Ruth, 1998; Herman et al., 1990). Nonetheless, a central space occurs in examining whether these patterns happen from the nonlinear features essential in macroeconomic basics, particularly once considering the immediate dynamics of supply and demand in physical flows (Cleveland and Ruth, 1998).

Several research activities retain the Environmental Kuznets Curve (EKC) assumption, demonstrating a relationship approaching an overturned U-shape among economic output per capita and environmental quality signs. This display is demonstrated by improved occupation openness connected with economic configurations. The perceived occurrence, characterized by important commercial openness, technological backgrounds, and the transmission of labor adaptation and natural resource use from established to developing economies, is induced by precise environmental regulations, guidelines, and technological improvements (Stern, 2004).

Examination into the decrease of CO2 emissions, especially in wealthy societies, relies meaningfully on investigation, progress, and technological improvement (Du et al., 2019). The combination of renewable energies is also key in this determination (Akram et al., 2020) (Kaya, 1995). Additional feature tied to the Environmental Kuznets Curve (EKC) hypothesis is the unexplored realm of physical consumption. According to this hypothesis, material consumption associates with economic growth until attaining a specific threshold, after which it weakens with further economic growth (Bernardini and Galli, 1993).

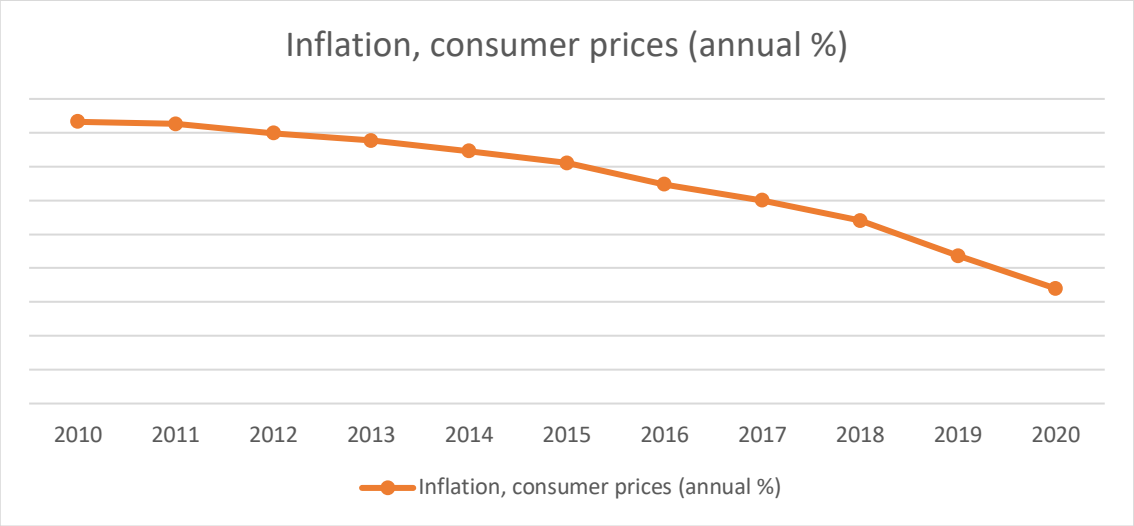
3.1.2. Inflation

Addressing inflation is vital for ensuring a nation's sustainable economic growth, reflecting the overall health of the country's economy within the broader context of sustainable development. Key macroeconomic indicators, such as unemployment and inflation rates, play a pivotal role in evaluating sustainable development.

Demand-driven inflation is a significant factor in the dynamics of contemporary advanced economies, arising from economic expansion and serving as both a consequence and a challenge. Efficiently managing inflation requires a proactive approach to guide economic growth, as rapid economic expansion can lead to escalating

inflation and subsequent economic crises. Below, you'll find the inflation rates for recent years (sourced from world bank).

Figure 5: Yearly Averages of 14 Countries Inflation Rates



Achieving sustainable economic growth imposes a nuanced approach to managing expansion—encouraging it during slow-moving periods and limiting it during excessive growth. The key is controlling investments to avoid financial saturation in fundamental markets, underlining the significance of forming investment strategies.

A reexamination of the understanding of inflation and its underlying factors is essential, with the saturation phenomenon playing a pivotal role in describing price and financial bubbles, manipulating demand-induced inflation. Financially saturated markets often yield higher profitability due to the saturation paradox, where demand exceeds supply.

In an economic landscape characterized by total financial saturation, the conventional applicability of economic equilibrium theory diminishes. The saturation phenomenon reveals three distinct financial saturation bubbles: price, financial, and inflation. Overcoming stagnation requires organizing solvent and optimistic stockholders expressing positive prospects.

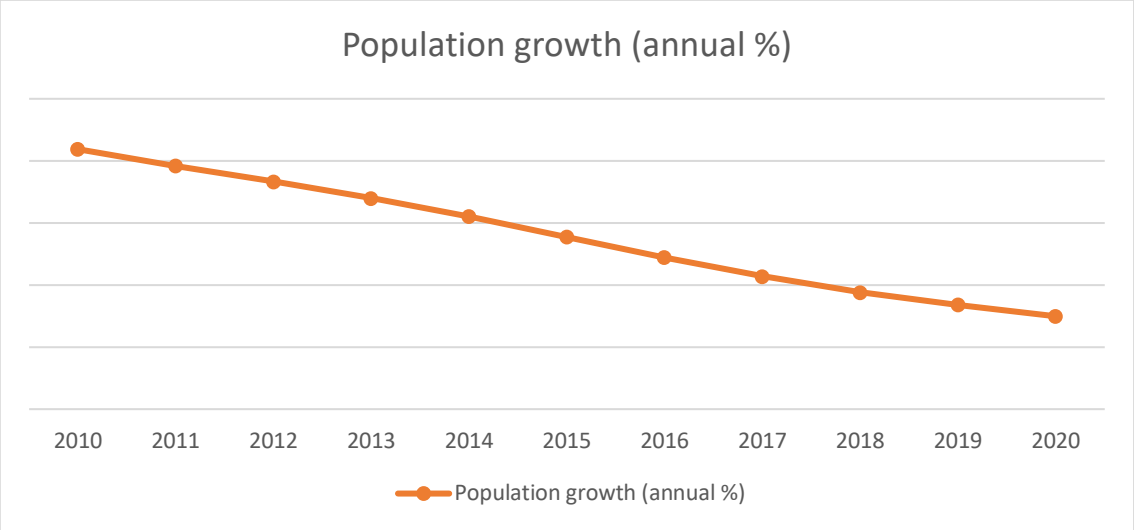
Thus, regulating economic growth becomes crucial for sustaining economic conditions. Outstanding a balance involves encouraging growth during sluggish periods and reigning it in during excess. Controlling financial resources is essential to prevent economic overheating by limiting market saturation (Girdzijauskas et al., 2022).

3.1.3. Population

Effectively managing population size and attaining macroeconomic stability can alleviate adverse impacts on environmental degradation during economic development in the developing world. Highly populated countries with elevated growth rates often exhibit modest environmental sustainability. (World Economic Forum, 2015).

Population control is important for successful macroeconomic permanence policies in developing countries, fostering higher income growth and enhanced environmental standards throughout the conversion process. Empirical evidence suggests an inverted U-shaped relationship between environmental degradation and economic conditions in developing nations. Increasing political awareness about the significance of population control and macroeconomic stability policies allows these countries to address tasks in upholding natural resources and the environment (Hanif, I., & Gago-de-Santos, P., 2017).The Figure 6 (sourced from world bank) is showing the last years population rates. The decrease may be because of having certain awareness and control.

Figure 6: Yearly Averages of 14 Countries Population Growth Rates



Consistent findings indicate that a higher mandatory retirement age brings long-term benefits, improving PAYG pension budgets, government transfers to the elderly, and lifetime consumption. However, possible drawbacks include adverse effects on capital accumulation and overall output over an extended period. The positive impact arises from increased labor supply and a shortened retirement duration, while negative shifts in employment may lead to wage reductions.

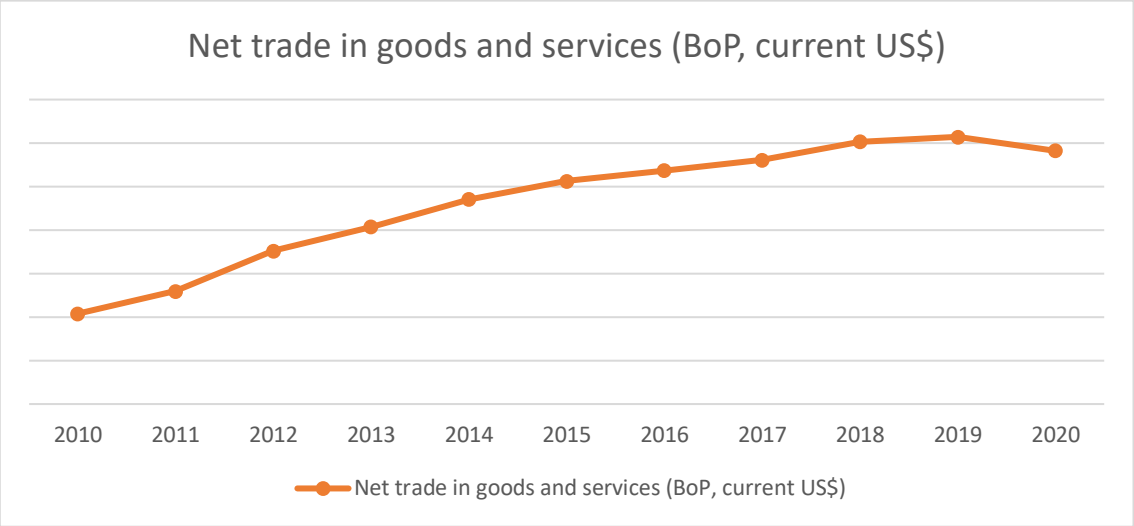
While a higher retirement age proves advantageous, it may have negative effects on capital accumulation and output in the long term. The analysis acknowledges limitations, notably the exclusion of considerations related to human capital. Extending the retirement age encourages longer work-life planning, fostering human capital accumulation, which could alter the study's outcomes. Addressing these limitations in future research is crucial (Mattayaphutron, S., Tam, B., & Jariyapan, P., 2021).

3.1.4. Foreign Trade

Uneven distribution of pollution and resource-intensive industries globally, resulting in substantial and escalating adverse environmental impacts. The situation

worsens as emissions reduction often entails shifting industries to low-cost producers, inflicting environmental consequences on producers in less developed regions. Our scenarios posit that achieving global sustainability and equality demands extensive coordination, possibly entailing a noteworthy decrease in the growth rate ("degrowth") in developed countries. Current research may overly optimistic about the efficacy of "green" investments in ensuring sustainability. Figure 7 illustrates the upswing in global trade, prompting an in-depth analysis to discern its impact on the current economy's distribution and whether it contributes to unequal sustainability outcomes.

Figure 7: Yearly Averages of 14 Countries Net Trade Rates



"Ecologically Unequal Exchange" (EUE), underlining the unequal sharing of pollution and resource-intensive productions globally, primary to significant and rising opposing environmental effects. The situation is combined as emissions decrease often involves moving industries to low-cost manufacturers, imposing environmental consequences on producers in less developed regions. Our scenarios propose that achieving global sustainability and equality requires wide coordination, possibly linking a important reduction in the growth rate ("degrowth") in developed regions. Current research may be overly positive about the usefulness of "green" investments in ensuring sustainability. Figure 7 depicts the surge in global trade, prompting a thorough analysis

to discern its impact on the current economy's distribution and whether it contributes to unequal sustainability outcomes (Althouse, J., Guarini, G., & Porcile, J. G., 2020).

Degrowth emerges as a potential and perhaps necessary alternative or supplement to "green growth" policies, aim to foster growth, preventing adverse income shocks in environmentally vulnerable countries, also play a pivotal role. The proposed scenarios aimed to include two key measurements of environmental fairness: the true of future generations to inhabit a steady and strong planet and the right to advance their existing solid well-being. Outstanding a balance between pollution boundaries and improving global equality stances a significant challenge, both in reallocating means among countries and within countries (Laurent, 2014; Roberts and Parklar, 2009).

Geopolitical shifts resulting from the irregular allocation of emissions render the model unfeasible for illustrating long-term trends in growth or shrinkage. Variations arising from the delocalization of production or complex environmental harms shaping production possibilities deepen with the concentration of climate change. For instance, many nations deeply reliant on the environment may find successful growth impossible with a important presence of greenhouse gases in the upper atmosphere, leading to irreparable damage. (Althouse, J., Guarini, G., & Porcile, J. G., 2020).

The significant decline in global trade, termed "global sustainability through displacement," has wide-ranging effects mutually centrally and peripherally. This deterioration, hypothetically, could spot a substantial footstep toward global sustainability, particularly when merged with local progress strengths communities and holding to principles like environmental independence and egalitarian accountability (Fischer, 2017). Strategies with possibly noteworthy impacts, such as decreasing institutional revenues, releasing international patents, and supporting knowledge distribution, meet resistance. In a world progressively limited and unstable, a vital change about ecological macroeconomics is central to recognize alternative pathways for well-being, moving beyond the traditional importance on GDP growth for sustainability and reassurance (Bonds and Downey, 2012; Hickel, 2019).

3.1.5. Government Expenditure

In macroeconomics, government expenditure plays a crucial role in shaping the economic landscape by strategically allocating funds to fuel growth and address societal needs. Investments in infrastructure, education, and healthcare not only drive immediate economic activity but also lay the foundation for sustained development. During economic downturns, increased government spending acts as a vital measure to stabilize demand and employment. Effective fiscal management is essential for maintaining a balanced budget, avoiding inflationary pressures, and ensuring optimal resource allocation. Government expenditure emerges as a vital tool for policymakers to mold economic outcomes, enhance social well-being, and navigate macroeconomic complexities.

Public spending in the social services sector, mainly for the development of human capital, plays a positive role in fostering economic growth, distinguishing it from less impactful agricultural expenditures. Investments in education and infrastructure are not only pivotal but also exert a significant influence on overall economic growth. The strength of these investments lies in their positive externalities, developing the efficiency of both human and physical capital, as highlighted in modern growth literature. Our study focuses the necessary nature of directed public spending in education and economic infrastructure. This standpoint underlines the need to increase public investments in these sectors, identifying their potential for more substantial growth compared to a singular sector-focused approach. (Ebong, F., Ogwumike, F., Udongwo, U., & Ayodele, O., 2016).

3.2. The Role Of Sustainability In Macroeconomics In Central Asia And Europe

Air pollution considerably influences communal well-being, primary to increased death, illness, and reduced lifetime expectation. This study examines the reasons affecting manufacturing emissions and their effects on lifespan probability and humanity proportions in matured regions, including Europe, Central Asia, Australia, Canada, and

the United States. Whereas higher income ranks link with improved life expectation and reduced death frequencies, air pollution appears as a contributing influence to high mortality rates irrespective of income levels. The research highlights the role of economic improvement and augmented energy consumption in clarifying the harmfulness of environmental air pollution. It determines an opposite U-shaped relationship between rapid urbanization and ambient air pollution, highlighting the necessity for sustainable urban settlement planning, thoughtful land use, capacity improvement, and the establishment of sustainable energy and transportation systems (Sarkodie, S. A., Strezov, V., Jiang, Y., & Evans, T., 2019).

Central Asia, strategically placed for China's Belt and Road Initiative, struggles with ecological challenges, encouraging Turkey to play a essential role in sustainable improvement. This study focuses on Turkmenistan, Kyrgyzstan, Kazakhstan, Tajikistan, and Uzbekistan, employing an Ecological Emergency Footprint (EEF) model to measure ecological confidence, deliberating socio-economic factors and environmental conditions. The evaluation, addressing a gap in quantitative ecological security assessments, forecasts upcoming fluctuations in emergency ecological circumstances and capability. The outcomes highlight the linear form of the Environmental Kuznets Curve (EKC) in Central Asia's primary steps, with GDP, ecological footprint, energy intake, and climate transformation modification positively affecting carbon dioxide emissions. The study focusses government policies' role in the income-environmental degradation relationship and suggests a favorable route toward decreasing CO2 emissions with enterprises for energy effectiveness and obedience to the Paris Climate Agreement (Caporin, M., Cooray, A., Kuziboev, B., & Yusubov, I. ,2023)

3.3. Sustainability And Macroeconomics In Turkey

Turkey's environmental degradation is mainly driven by internal issues, supporting for common efforts between environmental representatives and tourism specialists to adopt sustainable economic development, green job construction, and environmental preservation. In the face of occasional tourism surges and risks linked to industrial production, the study advocates continuing investments in renewable energy

and consumption to ensure a well-adjusted attitude to economic, environmental, and social properties in the era of globalization. Such measures provide to environmental excellence and sustainability for both existing and upcoming generations (Saint Akadiri, S., Alola, A. A., & Akadiri, A. C., 2019).

It is notified that globalization may have opposing outcomes on environmental property, challenging suppositions of its characteristic configuration with progressive goals. The present body of literature lacks a clear agreement on the environmental consequences of globalization, displaying varying influences on a country's improvement. Globalization in trade might improve negative consequences through modifications in trade policies, while financial globalization could result in reorganized investments and increased openness in capital accounts. Political globalization boosts international partnership on environmental policies, demonstrated by enterprises like the Kyoto Protocol. However, relational globalization, as seen in features like telephone subscriptions and travel freedom, may generate negative effects. Over the past two decades, cultural and natural heritage tourism, along with sustainable tourism, has made a substantial influence to global tourism growth, containing in Turkey (Bilgili, F., Ulucak, R., Koçak, E., & İlkay, S. Ç., 2020).

Cultural and nature tourism thrive in Turkey, motivated by its varied inheritance. However, this article highlights a immediate rise in Turkey's ecological footprint due to economic and social globalization and population growth. Increased demand from globalization influences GDP growth, trade development, and overall economic progress, compelling strategies for environmental mitigation, scale effect control, and sustainable growth. Raising consciousness, improving production, and enhancing human capital can lower resource demand. The relationship between physical and natural capital proposes that growing capital stock deals an alternative to decrease resource depletion and the ecological footprint. Politicians should prioritize these strategies for a balanced approach to economic growth and environmental sustainability (Bulut, 2021).

3.4. Legislation Regulating Macroeconomics For Sustainability

Since the 1970s, the influence of chief environmental guidelines on commercial competitiveness has been a issue of widespread discussion. In a global background of growing trade and capital incorporation, fears have appeared about the latent change in environmental pollution allocation due to changing policy strictness. This turn might include displacing pollution-intensive manufacture to areas with less severe principles, touching industrial construction and worldwide commerce dynamics. This concern is mainly related for countries prominent climate change action, as their emission decrease struggles may drawback pollution-intensive businesses internationally (Dechezleprêtre, A., & Sato, M., 2017).

In environmental economics, there are two contrasting viewpoints on the impact of unequal strategies on competing firms in the similar market: the pollution haven suggestion and the Porter theory. The pollution haven proposition, rooted in trade theory, proposes that severer environmental policies might increase obedience costs, potentially leading to the appearance of pollution havens over time. This supposition expects that territories with lower costs for emission decline influence pollution-intensive production, resulting in policy-induced pollution leakage. This trial is particularly relatable for global pollutants like carbon dioxide, as it involves the economic influences on local firms, mutual with emission decrease efforts, may be moderately offset by an upsurge in emissions in other regions (Levinson and Taylor, 2008). Tougher environmental guidelines can advance the competitiveness of regulated firms by driving productivity amendments and encouraging revolution in new technologies, chief to cost decreases that balance or surpass regulatory expenses (Porter and van der Linde, 1995b). Environmental policies' effect on firms is usually uncertain. Leading in determined policies may have short-term problems, particularly in pollution-intensive sectors. Nevertheless, these outcomes are minor compared to other trade and investment factors. Environmental guidelines drive innovation in cleaner technologies, yet the rewards don't fully balance costs. The Porter hypothesis needs substantial evidence, and consequences on industry replacement are relatively negligeable. Additional investigation is essential for

understanding and monitoring competitiveness effects precisely (Abate, T. G., Nielsen, R., & Tveterås, R., 2016).

3.4.1. Legislation Regulating Macroeconomics for Sustainability in Central Asia And Europe

China's recent Environmental Protection Law has induced companies in high-polluting industries, leading to an expansion in green innovation initiatives. Analyzing application information from listed high-polluting businesses, the analysis discovers a important increase in environmental patent suggestions ensuing the law's application. Publicly-owned initiatives, particularly in cities less reliant on secondary industries, demonstrate a more obvious reaction. Businesses with higher attention display a greater preference to pursue green invention patents, predominantly in competitive sectors. This research holds vital suggestions, signifying that while the law encourages innovation in clean technology, its influence varies based on ownership, city economic dependance on secondary industries, and industry concentration (Liu, Y., Wang, A., & Wu, Y., 2021).

China has obligated to covering carbon emissions by 2030 and underlines the importance of continuous encouragement for unpolluted technology as a longstanding objective. Front-runners in high-pollution trades are advocated to prioritize eco-friendly applies under the new law, intending for a competitive edge and safeguarding future profitability. Companies present diverse replies to the Environmental Protection Law, constructing separate investment opportunities. In the situation of severe regulations, firms embracing environmentally friendly practices can gain a intelligent improvement in innovation. Stakeholders seeking above-average revenues can leverage these opportunities by purposefully restructuring their portfolios (Murshed, M., Rahman, M. A., Alam, M. S., Ahmad, P., & Dagar, V., 2021).

3.4.2. Legislation Regulating Macroeconomics for Sustainability in Turkey

Turkey's openness to climate change needs crucial action, containing significant emission decreases and determined, self-sufficiently supportable energy goals (Climate Transparency 2020). Successful regulations, including financial measures, are crucial for achieving these objectives and diminishing environmental effect while supportive to economic progress (Gani, 2012).

Turkey goals for sustainable improvement by concentrating economic, social, and environmental challenges, dynamically contributing to global climate transformation improvement efforts. The 12th National Development Plan (2024-2028) and the 2053 long-term policy combine weather targets with economic growth, underlining sustainable methods and efficiency. The government has introduced a all-inclusive policy bundle throughout regions to achieve the determined net-zero target. The Nationally Determined Contributions (NDC) support with long-term development and sustainable progress urgencies, mirroring a general attitude to climate action. The 2030 target is a result of these strategies, accompanying the predominant net-zero objective (UNFCCC, 2022).

Turkey's resilient economy positions it to comprise fintech for sustainable finance, concentrating on better-quality financial inclusivity through enterprises like contactless expenditures and microfinance. The study underlines Turkey's strategic proposals, expecting faster approval of forward-looking fintech solutions. Partnership with sectors is critical for addressing climate-related financial risks and determining a national carbon transaction mechanism. Restructured proposals in sustainable supporting through fintech provide improved financial inclusivity and support responsible consumption tendencies.(Bayram, O., Talay, I., & Feridun, M. (2022).

Turkey's banking system dynamically encourages renewable energy and sustainability developments, stressing obedience with future international procedures like the Carbon Border Adjustment Mechanism. Many Turkish banks have established technology companies, development centers, and commercial venture capital funds. Anticipated developments, such as the upcoming sandbox environment in Istanbul

Finance Center, have the possibility to accelerate fintech solutions through partnership among banking, fintech sectors, and supervisory organizations. This situations Turkey as a standard for others, encouraging the implementation of policies and the formation of a startup environment to power fintech sector progress. (Odugbesan, J. A., Rjoub, H., Ifediora, C. U., & Iloka, C. B. ,2021).

4. METHODOLOGY

The increasing prominence of sustainability in the academic literature has led scholars and experts to define and explore these concepts through dedicated studies. However, this research distinguishes itself by aiming to observe the main impact of a multiple studies and practices on a macro level.

Research is covered under one model which is encompassing a diverse array of countries and ESG (Environmental, Social, and Governance) parameters which are the dependent variables. The examination delves into each of these parameters individually, scrutinizing their impact on a macro level through key economic concepts such as growth, inflation, international trade, population growth and government spending are taken as the independent variables.

This research specifically focuses on the effects of ESG data sourced from the World Bank, emphasizing its influence on macroeconomic data within Asian and European countries, as well as Turkey. The intention is to contribute a broader perspective to the existing body of knowledge by analyzing the interplay between sustainability factors and macroeconomic indicators across varied geographical and contextual settings.

4.1. Method

This study employs the balanced panel data analysis method to comprehensively investigate the relationships between macroeconomic variables and Environmental, Social, and Governance (ESG) dimensions across various countries and regions. Utilizing this approach allows for a thorough examination of macroeconomic trends over time and across diverse entities.

The methodology is influenced by the work of Jin and Kim (2018), particularly their study on "Coal Consumption and Economic Growth: Cointegration and Causality Evidence from Panel OECD and Non-OECD Countries." This research serves as a

valuable reference, guiding the analytical framework and methodology applied in this study.

The central analytical tool is the panel regression model, chosen for its ability to address complexities associated with studying the impact of ESG dimensions on macroeconomic variables. This model provides several advantages:

The panel regression model, chosen as the central analytical tool, is adept at handling the intricacies of examining the impact of ESG dimensions on macroeconomic variables. Its multifaceted benefits include incorporating data from diverse entities to account for cross-sectional variations, crucial in light of the heterogeneous nature of ESG dimensions. The inclusion of time-series data captures the dynamic interplay between macroeconomic variables and ESG dimensions over time, offering insights into evolving relationships. Utilizing both cross-sectional and time-series data enhances the statistical power of the analysis, ensuring more robust and reliable conclusions. The model effectively addresses unobserved heterogeneity by considering individual or country-specific characteristics that remain constant over time, enabling a precise isolation of the impact of ESG dimensions. To tackle endogeneity concerns stemming from bidirectional relationships, the study employs instrumental variable techniques and dynamic panel models, ensuring a more accurate and causal interpretation of results. The efficient use of data, considering both temporal and cross-sectional dimensions, proves advantageous, particularly in the comprehensive study of ESG dimensions requiring an extended timeframe.

Panel regression model serves as a robust and flexible framework for examining the intricate interactions between macroeconomic variables and ESG dimensions. The methodology ensures a comprehensive exploration of diverse dimensions, enhances statistical validity, and contributes to a nuanced understanding of relationships within the chosen context.

The study is founded upon the utilization of balanced panel data analysis, a methodological approach that offers distinct advantages in research. By employing

balanced panel data, researchers aim to maintain equilibrium in the dataset over time, ensuring consistent observations across all units (e.g., countries, firms) and periods under examination. This balanced structure facilitates hard statistical analysis by minimizing the potential for biases arising from missing or unevenly distributed data.

One of the primary benefits of using balanced panel data is its ability to enhance the accuracy and reliability of estimations. By preserving consistency in sample size and composition across different time periods, researchers can mitigate the risk of false correlations and confounding variables, thereby producing more robust and trustworthy results.

Furthermore, balanced panel data analysis enables researchers to exploit the longitudinal dimension of the dataset, allowing for the investigation of temporal trends and dynamic relationships over time. This longitudinal perspective is particularly valuable when studying phenomena characterized by evolving patterns or gradual shifts in behavior, such as environmental policies, social dynamics, or corporate governance practices.

Additionally, the balanced panel data approach offers greater flexibility in modeling complex relationships and capturing heterogeneity across units. By incorporating fixed effects or random effects models, researchers can account for unobserved heterogeneity at the individual or group level, thereby improving the accuracy of estimates and reducing bias in parameter estimates.

Despite its strengths, it's important to acknowledge that balanced panel data analysis is not without limitations. Maintaining balance over time may require stringent criteria for inclusion or exclusion of observations, potentially limiting the generalizability of findings. Moreover, the assumption of stationarity characteristic in balanced panel data analysis may not always hold true, particularly in dynamic or rapidly changing environments.

4.2. Panel Regression Model Framework

The panel data models is applied to examine whether the factors outlined in Section 4.3 influence economic performance. In the context of statistical properties of the data, the most appropriate models for data analysis is chosen. The first implemented model is a pooled data specification according to equation (1).

$$y_{i,t} = \beta x_{i,t} + \alpha_i z_i + \epsilon_{i,t} \quad (1)$$

where, $y_{i,t}$ is the dependent variable observed for individual i at time t, $x_{i,t}$ represents the time-varying vector of k (the number of independent variables) regressor vector, β indicates the k×1 parameter matrix, $z_i \alpha_i$ is the unobserved time-invariant heterogeneity or individual effect, z_i represents a constant term along with individual and group-specific variables, such as institutional factors for different countries, and $\epsilon_{i,t}$ is the error term. A pooled regression occurs, if z_i is solely a constant term for all countries. As a results, OLS (Ordinary Least Squares) yields consistent and efficient estimates for the common α intercept, paired with the slope vector β.

Alternatively, a fixed-effects model is applied, as shown in equations (2) - (4).

$$y_{i,t} = \beta x_{i,t} + c_i + \epsilon_{i,t} \quad (2)$$

where, $c_i = z_i \ \alpha$ with $E[c_i \ | X_i] = h(X_i)$

$$y_{i,t} = \beta x_{i,t} + h(x_i) + \epsilon_{i,t} + [c_i - h(X_i)] \quad (3)$$

$$y_{i,t} = \beta x_{i,t} + a_i + \epsilon_{i,t} + u_i \quad (4)$$

Where, a_i is the unobservable, time-invariant individual effect, which represents the macroeconomic factors specific of countries. The term $\epsilon_{i,t}$ is the error term, while u_i,

represents the group-specific effect. The variable a_i is not directly observed. The fixed-effects model enables the inclusion of a_i with the $x_{i,t}$ regressor matrix. The notion of fixed effects implies that variations between countries can be accounted for in the constant term. Consequently, heterogeneity among groups is represented through differences in this constant term. Each a_i needs to be estimated.

The last model which is applied is a random effect model as in equation (5).

$$y_{i,t} = \beta x_{i,t} + (u_i + a) + \epsilon_{i,t} \quad (5)$$

Contrary to the fixed-effects model, the random-effects model assumes that the unobservable α is unrelated to $x_{i,t}$ for all t=1,...,T. However, the assumption of strict exogeneity regarding the unique error term $u_{i,t}$ which indicates a group-specific random effect, remains necessary. The models underwent testing for serial correlation and heteroskedasticity. To differentiate between fixed and random effects, the Hausman test was applied. If fixed effects are rejected, the analysis proceeds to test random effects using the Breusch-Pagan Lagrange multiplier (LM), focusing on whether there are variations in variances among country groups. In the absence of such variations, a linear regression employs an OLS-equivalent pooled model.

5. DATA

The dataset of the research both for macroeconomic variables and ESG values are obtained from WORLDBANK, variables that are used in the study is below:

- Subdimension of Environmental Sustainability indicators
- Subdimension of Social Sustainability indicators
- Subdimension of Governance Sustainability indicators
- GDP Growth
- Inflation
- Foreign Trade
- Population Growth
- Government Expenditure

In the World Bank's compilation of ESG data, a structured approach is employed to ensure consistency and reliability. These data are segmented into distinct categories based on various thematic areas. Typically, data are collected on an annual basis, with information sourced from electronic repositories, websites, institutional databases, national accounts data, policies, and relevant indicators.

The aggregation of data is primarily accomplished through weighted averages, summation, or median calculations. Additionally, certain datasets, particularly those pertaining to variables subject to daily fluctuations such as temperature or exchange rates, are accumulated on a daily basis. For the purposes of this study, these datasets are combined and their averages are computed across key environmental, social, and governance indicators.

Table 1: Environmental Sustainability Indicators Used in Analysis

Indicator Code	Indicator
AG.LND.FRLS.XD	Forest Cover Loss
AG.LND.FRST.ZS	Forest area (% of land area)
EG.ELC.ACCS.RU.ZS	Access to electricity, rural (% of rural population)
EN.CLC.CDDY.XD	Cooling Degree Days
EN.CLC.HDDY.XD	Heating Degree Days
EN.CLC.HEAT.XD	Heat Index 35
EN.CLC.LTMP.XD	Land Surface Temperature
EN.POP.DNST	Population density (people per sq. km of land area)
NV.AGR.TOTL.ZS	Agriculture, forestry, and fishing, value added (% of GDP)
NY.ADJ.DFOR.GN.ZS	Adjusted savings: net forest depletion (% of GNI)
NY.ADJ.DRES.GN.ZS	Adjusted savings: natural resources depletion (% of GNI)

Table 2: Social Sustainability Indicators Used in Analysis

Indicator Code	Indicator Name
EG.CFT.ACCS.ZS	Access to clean fuels and technologies for cooking (% of population)
SH.DYN.MORT	Mortality rate, under-5 (per 1,000 live births)
SH.STA.SMSS.ZS	People using safely managed sanitation services (% of population)
SL.UEM.TOTL.ZS	Unemployment, total (% of total labor force) (modeled ILO estimate)
SP.DYN.LE00.IN	Life expectancy at birth, total (years)
SP.DYN.TFRT.IN	Fertility rate, total (births per woman)
SP.POP.65UP.TO.ZS	Population ages 65 and above (% of total population)

Table 3: Governance Sustainability Indicators Used in Analysis

Indicator Code	Indicator
CC.EST	Control of Corruption: Estimate
GE.EST	Government Effectiveness: Estimate
IP.PAT.RESD	Patent applications, residents
IT.NET.USER.ZS	Individuals using the Internet (% of population)
NY.GDP.MKTP.CD	GDP (current US$)
NY.GDP.MKTP.KD.ZG	GDP growth (annual %)
NY.GDP.PCAP.CD	GDP per capita (current US$)
FP.CPI.TOTL.ZG	Inflation, consumer prices (annual %)
PV.EST	Political Stability and Absence of Violence/Terrorism: Estimate
RL.EST	Rule of Law: Estimate
RQ.EST	Regulatory Quality: Estimate
SE.ENR.PRSC.FM.ZS	School enrollment, primary and secondary (gross), gender parity index (GPI)
SG.GEN.PARL.ZS	Proportion of seats held by women in national parliaments (%)
SL.TLF.CACT.FM.ZS	Ratio of female to male labor force participation rate (%) (modeled ILO estimate)
VA.EST	Voice and Accountability: Estimate

The selection process involved identifying countries within the European Union (EU) and Central Asia, which are key trade partners and possess significant global linkages within Turkey's regional context. Furthermore, income level was a pertinent criterion, with a focus on regions characterized by high and upper-middle income groups. This filtration process resulted in a final selection of 14 countries for inclusion in the analysis.

Table 4: Countries Used in the Study from EU and Central Asia Regions

Country Code	Region	Table Name
EST	Europe & Central Asia	Estonia
CHE	Europe & Central Asia	Switzerland
DEU	Europe & Central Asia	Germany
DNK	Europe & Central Asia	Denmark
BGR	Europe & Central Asia	Bulgaria
BIH	Europe & Central Asia	Bosnia and Herzegovina
BLR	Europe & Central Asia	Belarus
ESP	Europe & Central Asia	Spain
AZE	Europe & Central Asia	Azerbaijan
BEL	Europe & Central Asia	Belgium
AUT	Europe & Central Asia	Austria
CZE	Europe & Central Asia	Czechia
ARM	Europe & Central Asia	Armenia
TUR	Europe & Central Asia	Turkey

The reason behind choosing countries from Central Asia and EU is similar to Ilıman Püsküllüoğlu, E. (2023) motivation while searching the relation between human capital index and income distribution. The European Union (EU), Asian countries, and Turkey share significant similarities that contribute to their interconnectedness on the global stage. Cultural diversity, economic ties, and global trade partnerships characterize these regions, fostering collaboration and exchange. Rapid urbanization, educational initiatives, and a commitment to addressing environmental challenges are common priorities. Moreover, each entity plays a crucial role in the global economy, with the EU as a major economic force, Asian countries contributing to international trade, and Turkey

strategically connecting Europe and Asia. Demographic diversity and political-economic partnerships further underline the shared dynamics among these regions. While recognizing these commonalities, it is essential to acknowledge the unique characteristics and challenges that distinguish each entity in the complex global landscape.

In order not to confuse the impact of the 2008 crisis with the impact of ESG data, we have considered the data for the years after the crisis so that we can measure the effects more objectively so that we start our data from 2010. On the other hand, the reason why we did not take the data of the last years is that it takes some time for ESG data to be reflected in the systems of the countries and we detected large gaps in the data we received after 2020.

In alignment with existing literature, our analysis of the impact on exchange rates drew inspiration from the work of Ramasamy and Abar (2015), who utilized Gross Domestic Product (GDP) and inflation as key macroeconomic variables. Similarly, the investigation into global shocks' macroeconomic effects, as conducted by Mohaddes, Raissi, and Sarangi (2022), incorporated international trade, inflation, and growth as pertinent variables. Furthermore, in exploring the determinants of happiness and its correlation with macroeconomic variables, the study by Perovic and Golem (2010) delved into macroeconomic determinants, with a specific focus on government expenditure. These selected studies provided a foundational framework for our examination of macroeconomic indicators, ensuring methodological coherence and relevance to the broader scholarly discourse.

5.1. Descriptive Statistics

Table 5: Descriptive Statistics

	Average	Standard Deviation	Kurtosis	Skewness	Minimum	Maksimum
Environment	2756,439187	51,4875303	-0,94482839	-0,32906547	2668,562782	2825,228156
Social	47,81	6,17022988	0,036566169	-1,23710865	32,80576884	53,3769093
Governance	41964573160	1413831418	-1,30669571	0,041779455	39902545493	44074515900
ESG	13988813493	471334662	-1,3066837	0,041766039	13301381987	14692212353
Population growth (annual %)	0,139561063	0,04673623	-1,43864751	0,073078063	0,074821609	0,209376928
GDP growth (annual %)	1,772846973	0,05182924	-0,68099313	0,529958092	1,705186489	1,866396932
Inflation, consumer prices (annual %)	3,559419545	0,16451079	-0,30778654	-0,84456665	3,239694254	3,73223164
Net trade in goods and services (BoP, current US$)	26822199892	700480131	-0,61671533	-0,80086019	25538654207	27571606019
Government expenditure on education, total (% of government expenditure)	11,5486849	0,06379119	-1,2164697	-0,45877403	11,44059084	11,6206541

Descriptive statistics play a pivotal role in providing a succinct and informative summary of key characteristics within a dataset, offering a foundational understanding of the variables under consideration. In the context of our thesis, the utilization of descriptive statistics serves as a crucial introductory step in unraveling the intricacies of the relationships between social sustainability subdimensions and macroeconomic variables. These statistical measures, including means, standard deviations, and frequency distributions, enable us to delineate the central tendencies, dispersions, and patterns inherent in our data. By employing descriptive statistics, we can effectively capture the essential features of the examined variables, facilitating a comprehensive exploration of their distributions and behaviors. This, in turn, sets the stage for more advanced statistical analyses, providing a solid foundation for subsequent inferential and multivariate investigations. In essence, the incorporation of descriptive statistics in our thesis serves as a vital tool for the initial exploration and characterization of the empirical landscape, fostering a nuanced understanding of the relationships at the heart of our research inquiry.

5.2. Causality Analysis

Following the implementation of a balanced panel regression, noticeable connections between sustainability and macroeconomic variables became evident, prompting the decision to undertake a causality analysis. This analytical approach was deemed essential to substantiate the significance and rationale behind investigating the relationship between sustainability metrics and macroeconomic indicators.

Table 6: Granger Causality Test Between ESG and Macro Variables

Granger Causality Test	**Macro -> ESG**		**ESG -> Macro**	
	F-Statistics	**P-value**	**F-Statistics**	**P-value**
GDP Growth	7.1305	***0.008531	2.8321	*0.09476
Net Trade	5.7926	**0.01862	0.8559	0.3579
Inflation	0.3874	0.5347	0.8993	0.3447
Population Growth	1.4207	0.2354	0.1525	0.6968
Government Spending	1.4189	0.2359	1.0058	0.3179
Note: *p<0.1; **p<0.05; ***p<0.01				

Based on the results of the Granger causality tests, the relationship between economic growth (GDP growth) and Environmental, Social, and Governance (ESG) performance is examined. The findings reveal that economic growth significantly predicts ESG performance. In Model 1, where lagged values of both ESG and GDP growth are utilized as predictors of ESG, the F-statistic is 7.1305 with a p-value of 0.008531. This indicates strong evidence to reject the null hypothesis that lagged GDP growth values do not Granger cause ESG, thus affirming that growth is a highly significant predictor of ESG performance.

Conversely, when assessing the predictive power of ESG on GDP growth, the results are weak. In Model 1 for GDP growth prediction, where lagged values of both

GDP growth and ESG are employed as predictors, the F-statistic is 2.8321 with a p-value of 0.09476. This suggests weak evidence to reject the null hypothesis that lagged values of ESG do not Granger cause GDP growth, indicating that ESG performance predicts GDP growth only weakly and insignificantly. Overall, while economic growth is shown to significantly predict ESG performance, the evidence regarding ESG's predictive power on GDP growth is deemed weak.

The Granger causality tests reveal that while trade significantly predicts Environmental, Social, and Governance (ESG) performance, the reverse relationship is not observed. In Model 1, where both lagged values of ESG and net trade are employed as predictors of ESG, the F-statistic is 5.7926 with a p-value of 0.01862. This indicates strong evidence to reject the null hypothesis, suggesting that lagged net trade values have a Granger-causal effect on ESG performance.

Conversely, when investigating the predictive relationship from ESG to trade, the results are inconclusive. Model 1 for trade prediction, incorporating lagged values of both trade and ESG as predictors, yields an F-statistic of 0.8559 with a p-value of 0.3579. This implies weak evidence to reject the null hypothesis that lagged values of ESG do not Granger cause changes in trade, indicating that ESG performance does not predict trade significantly. Therefore, the findings highlight the significant role of trade as a predictor of ESG performance, while the predictive power of ESG on trade remains uncertain.

The results from the Granger causality tests indicate that there is no significant predictive relationship between inflation and Environmental, Social, and Governance (ESG) performance, and vice versa. In Model 1, where lagged values of both ESG and inflation are utilized as predictors of ESG, the F-statistic is 0.3874 with a p-value of 0.5347. This suggests weak evidence to reject the null hypothesis that lagged inflation values do not Granger cause changes in ESG performance, indicating that inflation does not predict ESG significantly.

Similarly, when investigating the predictive relationship from ESG to inflation, the results are inconclusive. The Granger causality test for inflation prediction, employing

lagged values of both inflation and ESG as predictors in Model 1, yields an F-statistic of 0.8993 with a p-value of 0.3447. This implies weak evidence to reject the null hypothesis that lagged values of ESG do not Granger cause changes in inflation, indicating that ESG performance does not predict inflation significantly. Therefore, based on the Granger causality tests, it can be concluded that there is no significant predictive relationship between inflation and ESG performance, and vice versa.

Tests suggest that there is no significant predictive relationship between population growth and Environmental, Social, and Governance (ESG) performance, and vice versa. In Model 1, where lagged values of both ESG and population growth are included as predictors of ESG, the F-statistic is 1.4207 with a p-value of 0.2354. This indicates weak evidence to reject the null hypothesis that lagged population growth values do not Granger cause changes in ESG performance, suggesting that population growth does not predict ESG significantly. Similarly, when examining the predictive relationship from ESG to population growth, the results are inconclusive.

The Granger causality test for population growth prediction, using lagged values of both population growth and ESG as predictors in Model 1, yields an F-statistic of 0.1525 with a p-value of 0.6968. This implies weak evidence to reject the null hypothesis that lagged values of ESG do not Granger cause changes in population growth, indicating that ESG performance does not predict population growth significantly. Therefore, based on the Granger causality tests, it can be concluded that there is no significant predictive relationship between population growth and ESG performance, and vice versa.

The results from the Granger causality tests indicate that there is no significant predictive relationship between government spending and Environmental, Social, and Governance (ESG) performance, and vice versa. In Model 1, where lagged values of both ESG and government spending are included as predictors of ESG, the F-statistic is 1.4189 with a p-value of 0.2359. This suggests weak evidence to reject the null hypothesis, indicating that government spending does not predict ESG significantly.

Similarly, when examining the predictive relationship from ESG to government spending, the results are inconclusive. The Granger causality test for government spending prediction, using lagged values of both government spending and ESG as predictors in Model 1, yields an F-statistic of 1.0058 with a p-value of 0.3179. This implies weak evidence to reject the null hypothesis, suggesting that ESG performance does not predict government spending significantly. Therefore, based on the Granger causality tests, it can be concluded that there is no significant predictive relationship between government spending and ESG performance, and vice versa.

Granger causality tests shed light on the complex interplay between economic indicators and ESG performance. While economic growth and trade emerge as significant predictors of ESG performance, the predictive power of ESG on economic indicators such as GDP growth, inflation, and population growth remains uncertain. These findings underscore the need for further research to better understand the dynamic relationships between economic factors and ESG performance.

The outcomes of the Granger causality tests reveal a bidirectional relationship between the macroeconomy and ESG factors. Specifically, the evidence suggests that the relationship predominantly flows from the macroeconomy to ESG considerations, with notable significance observed, particularly in variables such as GDP growth and net trade. This implies that the influence extends beyond the monetary domain, signaling a tangible impact on the real economy.

5.3. Hausman Test (Random Effects Model)

The Hausman test is a crucial statistical tool used in panel data analysis to determine whether the random effects or fixed effects model is more appropriate for a given dataset. Fixed effects models assume that unobserved individual-specific characteristics are correlated with the independent variables, making them endogenous. Therefore, fixed effects models control for individual-specific effects by including dummy variables for each individual or entity in the dataset. On the other hand, random

effects models treat individual-specific effects as random variables, assuming that they are uncorrelated with the independent variables.

The choice between fixed effects and random effects models depends on the nature of the dataset and the underlying assumptions. The Hausman test helps researchers decide which model to use by testing the null hypothesis that the preferred model (fixed effects) is consistent with the data against the alternative hypothesis that the random effects model is more appropriate.

If the Hausman test indicates that the coefficients estimated under the random effects model are inconsistent, researchers may opt for the fixed effects model, which provides consistent estimates even if individual-specific effects are correlated with the independent variables. Conversely, if the Hausman test suggests that the coefficients estimated under the random effects model are consistent, researchers may choose the random effects model for its efficiency gains and broader generalizability.

This thesis specific case, Hausman test results indicate that the panel models suggest random model specifications, it suggests that the random effects model is more appropriate for this dataset. This means that the individual-specific effects are uncorrelated with the independent variables, justifying the use of the random effects model for more efficient estimation. In researching the correlation between ESG (Environmental, Social, and Governance) factors and macroeconomic variables, the selection of an appropriate econometric model is pivotal for capturing the underlying dynamics of the dataset.

The choice of a random effects model indicates the treatment of individual entities, such as countries or firms, as random samples from a larger population, aiming to estimate the average relationship between ESG factors and macroeconomic indicators across these entities. Several factors make the random effects model suitable for this research context. Firstly, it accommodates unobserved heterogeneity, acknowledging that entities may possess unique characteristics that influence both their ESG performance and macroeconomic outcomes. This approach enables the incorporation of entity-specific

effects into the analysis, enhancing the understanding of the relationship under investigation. Secondly, random effects models offer efficiency in parameter estimation, particularly beneficial when dealing with a large number of entities, leading to more precise estimates of the average relationship between ESG and macro variables. Thirdly, these models facilitate generalizability by estimating population-average effects, allowing for broader conclusions about the relationship between ESG and macro variables beyond the specific entities in the dataset. Finally, random effects models strike a balance between flexibility and rigor, making them well-suited for panel data analysis by considering variation both within and between entities. Overall, the adoption of a random effects model in this research underscores the interest in estimating average effects applicable across diverse entities while addressing unobserved heterogeneity, contributing to a comprehensive understanding of the relationship between ESG factors and macroeconomic variables.

In aligning with the random effects model, the selection process considered the diverse characteristics of countries within the European Union (EU) and Central Asia, including their varying economic structures, governance systems, and policy environments. By incorporating a random effects model, the analysis acknowledges the potential heterogeneity across countries and allows for the estimation of both within-country and between-country variations in the relationship between ESG factors and macroeconomic variables. This approach enables capturing unobserved country-specific effects that may influence the association under investigation, thereby enhancing the robustness and generalizability of the findings to a broader regional context.

5.4. Multicollinearity Test with VIF (Variance Inflation Factor)

Our analysis of the relationship between sustainability and Environmental, Social, and Governance (ESG) variables reveals notable findings. Initially, we observe a high coefficient of determination (R-squared) between social sustainability and macroeconomic variables, indicating a substantial explanatory power of the model. This prompts an investigation into the potential presence of multicollinearity.

The R-squared values further delineate the sources of variation in the dependent variable. The Between R-squared highlights the considerable variance attributed to discrepancies among entities, while the Within R-squared underscores the model's ability to capture a significant portion of the within-entity variation.

Given these results, we are prompted to investigate the possibility of multicollinearity through techniques such as the Variance Inflation Factor (VIF). Such analyses are crucial for ensuring the reliability and validity of the regression model in capturing the true relationships between the variables under analysis.

Table 7: Multicollinearity Test with VIF (Variance Inflation Factor)

Variable	VIF
const	2.357449
GDP_growth	1.418070
d_net_trade	1.225051
Infl	1.094492
Popıl_growth	283.349.291
d_governance	1.422775
d_social	286.999.511
d_env	1.400690

The following table presents the Variance Inflation Factor (VIF) values calculated for each independent variable included in the regression model. VIF serves as a measure of multicollinearity, assessing the extent to which the variance of an estimated regression coefficient increases when predictors are correlated.

Upon analyzing the Variance Inflation Factor (VIF) values, it is evident that GDP growth exhibits a VIF value of 1.418070, indicating relatively low multicollinearity with the other independent variables. Similarly, net trade displays a VIF value of 1.225051, suggesting minimal multicollinearity with other predictors. Inflation shows a VIF value

of 1.094492, nearing 1, implying negligible multicollinearity. However, population growth presents a significantly high VIF value of 283.349291, signifying strong multicollinearity with other independent variables, potentially leading to unstable coefficient estimates. Conversely, governance shows a VIF value of 1.422775, indicating low multicollinearity. In contrast, social portrays an exceptionally high VIF value of 286.999511, highlighting significant multicollinearity, particularly with population growth. Lastly, environment demonstrates a VIF value of 1.400690, indicating low multicollinearity with other independent variables.

The findings prompted an in-depth examination of the constituent facets encompassing social sustainability. Within this analytical framework, it became apparent that the sub-dimension of population growth emerged prominently. Additionally, the presence of total population figures posed a challenge to the coherence of the model. Consequently, both indicators pertaining to population growth and total population were deemed incompatible and were consequently excluded from further consideration.

In summary, while most variables exhibit low VIF values, indicating minimal multicollinearity. Population growth, and social, demonstrate high VIF values, suggesting strong multicollinearity with other independent variables, particularly with each other. To address multicollinearity in the model and ensure the stability and reliability of the regression coefficients, strategies such as variable selection techniques or combining correlated variables may be necessary.

5.5. Legislation as Dummy Variable

As elucidated in the study, legislation emerges as a significant metric influencing both sustainability and macroeconomics. Hence, it would be academically insightful to incorporate legislation as a dummy variable in this thesis's analytical framework. By integrating legislation into our model, we seek to comprehensively examine its potential impact on sustainability and macroeconomic indicators. This inclusion not only enriches the depth of our analysis but also contributes to a nuanced understanding of the intricate

relationship between legislative measures and the broader economic and sustainability landscape. Thus, the addition of legislation as an explanatory variable represents a methodologically rigorous approach aimed at capturing and evaluating its substantive role within the context of sustainability and macroeconomic research.

In order to ensure consistency and comparability across countries in World Bank statistics, each country in the study must adhere to certain regulations. As elucidated in the literature review, the pivotal factor lies in the nature, extent, and stringency of these regulations. The countries included in the dataset govern their Environmental, Social, and Governance (ESG) values through a variety of mechanisms, including laws, legislation, policies, and adherence to sustainability goals.

Table 8: Legislation as Dummy Variable

Country Code	Table Name	Dummy Variable
EST	Estonia	0
CHE	Switzerland	1
DEU	Germany	1
DNK	Denmark	1
BGR	Bulgaria	0
BIH	Bosnia and Herzegovina	0
BLR	Belarus	0
ESP	Spain	1
AZE	Azerbaijan	0
BEL	Belgium	0
AUT	Austria	1
CZE	Czechia	0
ARM	Armenia	0

For the purpose of this study, we have focused on countries that have enacted specific legislation pertaining to Environmental, Social, and Governance matters. This legislation consolidates significant regulations pertinent to each country's ESG framework. Countries with such dedicated according to the Bertelsmann Stiftung (2022), the Sustainable Governance Indicators laws are designated as "1", while those regulating their ESG principles through diverse projects and policies are denoted as "0". This

dichotomous classification facilitates effective comparison, as it allows for a focused examination of the substantive concepts covered by ESG laws.

Conversely, comparing countries that lack specific ESG legislation proves challenging, as each nation possesses unique priorities and approaches. Presently, ESG variables are predominantly addressed on a voluntary basis, with frameworks typically established by government departments or in collaboration with organizations such as the United Nations Development Programme (UNDP).

6. FINDINGS

The balanced panel regression analysis, following the elimination of multicollinearity and the implementation of the ESG law dummy variable, represents a critical juncture in our research methodology. Multicollinearity, a common challenge in econometric analysis, can distort the accuracy and reliability of regression results by inflating standard errors and complicating the interpretation of coefficients. By employing techniques such as variance inflation factor (VIF) analysis and excluding highly correlated variables, we ensure the robustness of our regression model.

Additionally, the introduction of the ESG law dummy variable allows us to capture the impact of environmental, social, and governance (ESG) regulations on the relationship under investigation. With a balanced panel dataset encompassing consistent observations across all entities and time periods, our regression analysis provides a comprehensive examination of how ESG laws influence the dynamics between the dependent and independent variables. This section outlines the methodological procedures undertaken to refine our regression model, ensuring its accuracy and reliability in uncovering meaningful insights into the interplay between ESG legislation and the phenomena under study.

6.1. ESG and Macroeconomic Variables Balanced Panel Regression Analysis

Following a series of rigorous causality, regression, and multicollinearity tests, we were compelled to undertake a comprehensive data analysis encompassing the broader scope of Environmental, Social, and Governance (ESG) factors, as well as their individual dimensions. This strategic approach aims to delve deeper into the intricate relationships among these variables, thereby facilitating a more nuanced understanding of their impact on the overarching sustainability framework.

Table 9: Balanced Panel Regression Analysis Overall ESG

Dependent Variable	Overall ESG	
	Beta Coefficient	**P-Value**
GDP Growth	0.0498	**0.048
Net Trade	0.3037	***0.000
Inflation	0.0155	0.153
Population Growth	0.3923	***0.000
Government Spending	-0.4598	*0.065
Dummy Variable	0.0082	***0.000
Observations	154	
R-square	0.841	
Adjusted R- square	0.834	
F Statistics	129.3	
Note: *p<0.1; **p<0.05; ***p<0.01		

In our balanced regression analysis, we explore the association between the dependent variable ESG, representing environmental, social, and governance performance, and several independent variables. The results reveal the following key insights: the coefficient of determination (R-squared) stands at 0.841, suggesting that approximately 84.1% of the variance in the dependent variable can be explained by the independent variables in the model. Furthermore, the adjusted R-squared, which adjusts for the number of predictors in the model, is 0.834, providing a more precise measure of model fit by considering its complexity. Moreover, the F-statistic, a test of overall significance, yields a substantial value of 129.3, coupled with an exceedingly low p-value (Prob (F-statistic): 4.54e-56), leading to the rejection of the null hypothesis that all regression coefficients are zero. These findings collectively underscore the significant explanatory power of the overall regression model.

In examining the individual coefficients of the regression model, several noteworthy findings emerge. Firstly, the intercept stands at 0.0069 and demonstrates statistical significance at the 5% level (p-value = 0.011), indicating its influence on ESG performance. Additionally, the coefficient for GDP growth is 0.0498, suggesting a positive correlation between GDP growth and ESG performance, with statistical

significance at the 5% level (p-value = 0.048). Similarly, the coefficient for net trade is 0.3037, indicating a positive relationship between net trade and ESG performance, and it exhibits high statistical significance (p-value < 0.001). Conversely, while the coefficient for Inflation is 0.0155, signifying a positive association with inflation and ESG performance, it lacks statistical significance at the 5% level (p-value = 0.153). Furthermore, the coefficient for population growth is 0.3923, implying a positive link between population growth and ESG performance, and it is statistically significant at the 5% level (p-value < 0.001). However, the coefficient for government spending, denoting governance quality, is -0.4598, suggesting an adverse impact on ESG performance, albeit marginally statistically significant at the 10% level (p-value = 0.065). Lastly, the coefficient for dummy legislation is 0.0082, indicating a positive association with ESG performance, with statistical significance (p-value < 0.001), implying the influence of the dummy variable on ESG performance.

The coefficient for GDP growth indicates a positive association with ESG performance, suggesting that economic expansion correlates with improvements in environmental, social, and governance practices. This relationship underscores the importance of economic growth in fostering sustainable development and indicates that thriving economies tend to exhibit stronger ESG performance. The statistical significance of this coefficient emphasizes the substantial influence of GDP growth on sustainability outcomes, highlighting the pivotal role of economic factors in shaping corporate behavior and societal well-being.

Similarly, the coefficient for net trade demonstrates a positive relationship with ESG performance, implying that countries with higher levels of trade openness tend to exhibit stronger environmental, social, and governance practices. The statistical significance of this coefficient underscores the importance of international trade in driving sustainability efforts, as trade liberalization facilitates the exchange of environmentally friendly technologies, social innovation, and governance best practices across borders. These findings highlight the interconnectedness of global trade and sustainability, emphasizing the potential for trade policies to support environmental protection, social equity, and effective governance on a global scale.

The coefficient for population growth suggests a positive correlation between demographic trends and ESG performance, indicating that regions experiencing population growth may also witness improvements in environmental, social, and governance practices. This association underscores the complex interplay between demographic dynamics and sustainability outcomes, as population growth can stimulate demand for sustainable products and services while also presenting challenges related to resource depletion and social equity. The statistical significance of this coefficient highlights the need for holistic approaches to sustainable development that address population dynamics alongside environmental conservation, social inclusion, and effective governance.

Conversely, the coefficient for government spending demonstrates a mixed relationship with ESG performance, indicating that higher levels of government expenditure may have both positive and negative implications for sustainability outcomes. While government spending can support initiatives aimed at environmental protection, social welfare, and institutional capacity building, excessive or inefficient allocation of resources may hinder sustainable development efforts. The marginal statistical significance of this coefficient suggests that the impact of government spending on ESG performance varies depending on the effectiveness of public policies, governance structures, and institutional frameworks. These findings underscore the importance of evidence-based policymaking and transparent governance practices in promoting sustainable development and ensuring the efficient use of public resources for environmental, social, and governance objectives.

ESG law, with ESG performance underscores the regulatory influence on sustainability outcomes. The statistical significance of the dummy variable suggests that its inclusion significantly improves the model's ability to explain variations in ESG performance, indicating that the presence of ESG laws plays a crucial role in shaping sustainability practices.

These findings highlight the regulatory environment's impact on ESG performance and emphasize the importance of policy interventions in promoting

sustainable practices. The presence of ESG laws serves as a driving force behind companies' adoption of environmental, social, and governance measures, aligning their operations with sustainability objectives. As such, policymakers, businesses, and other stakeholders can leverage these insights to craft effective regulations and initiatives that facilitate progress towards sustainable development goals.

6.2. Balanced Panel Regression Analysis of ESG Subdimensions

Table 10: Balanced Panel Regression Analysis Environmental, Social and Governance

Dependent Variable	Environment		Social		Governance	
	Beta Coefficient	**P-value**	**Beta Coefficient**	**P-value**	**Beta Coefficient**	**P-value**
GDP Growth	-0.0882	0.224	0.0019	0.856	0.1495	**0.048
Net Trade	0.0734	*0.078	0.0039	0.522	0.9111	***0.000
Inflation	0.0938	***0.003	3.238e-05	0.994	0.0464	0.153
Population Growth	-0.3121	0.329	0.0533	0.256	1.1770	***0.000
Government Spending	0.7064	0.325	0.9978	***0.000	-1.3793	*0.065
Dummy Variable	0.0224	***0.000	0.0053	***0.000	0.0247	***0.000
Observations	154					
R-square	0.227		0.615		0.841	
Adjusted R- square	0.195		0.599		0.834	
F Statistics	7.190		39.17		129.3	
Note: *p<0.1; **p<0.05; ***p<0.01						

These findings underscore the complex interplay between economic indicators and environmental, social, and governance outcomes, highlighting the need for comprehensive analyses and model adjustments to enhance robustness and reliability.

6.2.1. Environmental Sustainability Indicator and Macroeconomic Variables

The OLS regression model employed in this study investigates the association between the dependent variable environmental sustainability, representing environmental quality, and various independent variables. The analysis reveals the following key

insights: Firstly, the coefficient of determination (R-squared) stands at 0.227, suggesting that approximately 22.7% of the variance in the dependent variable is accounted for by the independent variables incorporated into the model. Secondly, the adjusted R-squared, which adjusts for the number of predictors, is calculated to be 0.195, offering a more nuanced evaluation of model fit by considering its complexity. Lastly, the F-statistic, employed to assess the overall significance of the regression model, yields a value of 7.190, accompanied by a remarkably low p-value (Prob (F-statistic): 9.69e-07). Consequently, the null hypothesis of zero regression coefficients is rejected, affirming the overall significance of the regression model. These findings collectively underscore the model's efficacy in elucidating the relationship between environmental sustainability and the macroeconomic variables under investigation.

The analysis of individual coefficients in the regression model provides insights into the relationship between environmental sustainability and various independent variables. Firstly, the intercept stands at 0.0101, although it fails to achieve statistical significance at the 5% level (p-value = 0.195). Moving on to the independent variables, GDP growth exhibits a negative coefficient of -0.0882, suggesting an adverse association with environmental quality; however, it is not statistically significant at the 5% level (p-value = 0.224). Conversely, net trade demonstrates a coefficient of 0.0734, indicating a positive correlation with environmental quality, albeit marginally significant at the 10% level (p-value = 0.078). Inflation shows a positive coefficient of 0.0938, signifying a favorable impact on environmental quality, with statistical significance observed at the 5% level (p-value = 0.003). Conversely, population growth displays a negative coefficient of -0.3121, suggesting an adverse relationship with environmental quality; however, it fails to attain statistical significance at the 5% level (p-value = 0.329). Similarly, government spending exhibits a positive coefficient of 0.7064, indicating a positive association with environmental quality, albeit lacking statistical significance at the 5% level (p-value = 0.325). Lastly, the dummy variable legislation displays a coefficient of 0.0224, denoting an increase in environmental quality in its presence, and achieves statistical significance (p-value < 0.001). These findings offer valuable insights into the nuanced relationships between environmental sustainability and the independent variables considered in the analysis.

The results underscore the importance of economic indicators in understanding environmental sustainability. For instance, the significant associations observed between GDP growth and net trade with environment suggest that economic prosperity and international trade positively influence sustainability practices. Conversely, the non-significant coefficients for population growth and government spending imply that these factors may have less direct impact on environmental sustainability performance. However, it's essential to note that while government spending may not directly predict environmental performance, it could still play a crucial role in facilitating regulatory frameworks and policies conducive to sustainability initiatives. Additionally, the inclusion of a dummy variable representing the presence of ESG laws reveals its significant positive association with environmental performance, highlighting the regulatory environment's pivotal role in shaping environmental behavior. These nuanced insights not only inform policymaking but also provide valuable guidance for states seeking to align with sustainability goals and navigate regulatory landscapes effectively.

The findings of the study reveal a limited or negligible association between the environmental dimension within the Environmental, Social, and Governance (ESG) framework and various macroeconomic variables. This outcome may be attributed to the inherent complexity in defining the scope of the economy, as emphasized by Hardt and O'Neill (2017). Ropke (2013) underscores the necessity of establishing a clear definition for a healthy economy, indicating a crucial requirement for addressing environmental concerns. The study concurs with assertions by Hardt (2017) that existing models fall short in encompassing essential aspects. Prevailing literature underscores the unsustainability of perpetual economic growth (Jackson, 2009; Martínez-Alier et al., 2010; Victor, 2008) and advocates sustainable growth for the pursuit of diverse goals and objectives for a sustainable environment (UNEP, 2014). To effectively address these concerns, it is imperative to categorize impacts meticulously, considering causality, uncertainties, application scales, relevant impacts, and purpose, as suggested by Dong and Hauschild (2017).

6.2.2. Social Sustainability Indicator and Macroeconomic Variables

This ordinary least squares (OLS) regression model delves into the association between the dependent variable social sustainability and various independent variables. The analysis unfolds as follows: the coefficient of determination (R-squared) stands at 0.615, signifying that approximately 61.5% of the variability in the dependent variable is elucidated by the independent variables in the model. Meanwhile, the adjusted R-squared, which adjusts for the number of predictors in the model, is calculated at 0.599. This metric penalizes the inclusion of redundant predictors, offering a more refined gauge of model fit. The F-statistic, probing the overall significance of the regression model, yields a value of 39.17, accompanied by an exceedingly low p-value (Prob (F-statistic): 3.55e-28). Hence, we reject the null hypothesis asserting that all regression coefficients are zero, indicating the statistical significance of the overall regression model.

In the examination of individual coefficients, several insights emerge: the intercept stands at 0.0342, denoting that when all independent variables assume zero, the anticipated value of social sustainability is 0.0342. The coefficient for GDP growth is 0.0019, though it fails to reach statistical significance at the 5% level (p-value = 0.856). Similarly, the coefficient for net trade, quantified at 0.0039, lacks statistical significance at the 5% level (p-value = 0.522). Inflation, represented by a minuscule coefficient of 3.238e-05, also fails to achieve statistical significance at the 5% level (p-value = 0.994). Although the coefficient for Population growth registers at 0.0533, it does not reach statistical significance at the 5% level (p-value = 0.256). Conversely, the coefficient for government spending stands at 0.9978, signifying that an escalation in government spending corresponds to an increase in social sustainability, a relationship that proves highly statistically significant (p-value < 0.001). Additionally, the coefficient for dummy variable legislation is computed at 0.0053, suggesting that the presence of the dummy variable correlates with a 0.0053 increase in social sustainability, a relationship that is statistically significant (p-value < 0.001).

Analyzing individual coefficients sheds light on the specific impact of each economic variable on social factors. For instance, GDP growth exhibits a coefficient that,

while not statistically significant, suggests a potential association with social outcomes. Similarly, net trade displays a marginally significant coefficient, indicating a possible correlation with social factors. Population growth, on the other hand, fails to attain statistical significance, suggesting limited influence on social outcomes within the context of the model. Conversely, government spending exhibits a statistically significant coefficient, implying a discernible impact on social factors. These findings highlight the intricate relationship between economic variables and social outcomes, emphasizing the need to consider various economic factors in understanding social dynamics within a broader socioeconomic framework.

ESG laws has a visible impact on social factors, influencing outcomes related to environmental, social, and governance aspects. This finding underscores the importance of regulatory frameworks, such as ESG laws, in shaping social outcomes and suggests that they play a significant role in promoting social responsibility and sustainability practices within organizations. Overall, these insights highlight the intricate interplay between regulatory measures, social factors, and other economic variables, emphasizing the importance of considering regulatory contexts in understanding social outcomes.

The issue of definition resurfaces in this context, as terms within ESG are broad and interconnected. Social sustainability is intricately tied to social infrastructure and quality of life, with social infrastructure encompassing physical attributes (Grum ,2020). This may even extend beyond the realm of the environment. The lack of precise definitions for sustainability, social infrastructure, and quality of life further complicates the understanding (Salas-Zapata and Ortiz-Munoz, 2017). Thus, considerations of social sustainability, social infrastructure, and quality of life must encompass their effects on materials, finance, people, and ideas (Bebbington and Humphreys Bebbington, 2018).

6.2.3. Governance Indicator and Macroeconomic Variables

This OLS regression model investigates the relationship between the dependent variable governance and several independent variables. The analysis reveals significant findings as follows: The coefficient of determination (R-squared) stands at 0.841,

suggesting that approximately 84.1% of the variability in the dependent variable is elucidated by the independent variables in the model. Moreover, the adjusted R-squared, which adjusts for the number of predictors, is 0.834, offering a more precise measure of model fit. Additionally, the F-statistic, which assesses the overall significance of the regression model, yields a value of 129.3, coupled with an extremely low p-value (< 4.54e-56). This leads to the rejection of the null hypothesis that all regression coefficients are zero, signifying the overall significance of the regression model.

The analysis of individual coefficients in the OLS regression model reveals significant insights into the relationship between the dependent variable governance and its independent counterparts. Firstly, the intercept stands at 0.0207, indicating the expected value of governance when all independent variables are zero. Regarding the independent variables, GDP growth exhibits a coefficient of 0.1495, implying that a one-unit increase in GDP growth is associated with a 0.1495 increase in governance, with a statistically significant p-value of 0.048 at a 5% significance level. Similarly, net trade demonstrates a substantial coefficient of 0.9111, suggesting that a one-unit increase in net trade results in a 0.9111 increase in governance, accompanied by a highly significant p-value of 0.000. Conversely, while Inflation displays a coefficient of 0.0464, it fails to attain statistical significance at the 5% level (p-value = 0.153). Notably, population growth shows a significant coefficient of 1.1770, indicating that a one-unit increase in Population growth leads to a 1.1770 increase in governance, with a highly significant p-value of 0.000. Conversely, government spending presents a coefficient of -1.3793, suggesting that an increase in government spending corresponds to a decrease in governance, albeit marginally significant with a p-value of 0.065. Furthermore, the presence of the dummy variable yields a coefficient of 0.0247, suggesting a 0.0247 increase in governance, with statistical significance (p-value < 0.001).

The examination of governance parameters reveals meaningful associations with comprehensive datasets, particularly demonstrating significant relationships with economic growth and government spending. Financial institution are taking action for advocating ESG funding products and promoting rebranding align with ESG standards (Monroy, S. O., & Fuentes, A. (2021). A noteworthy correlation is observed between GDP

growth and governance, indicating a substantial impact on the latter. Investor decisions on various decision-making levels are also reshaped according to ESG matters (Alan Palmiter ,2021). This finding underscores the intricate dynamics between economic factors and governance, providing valuable insights for understanding the complexities of these relationships in the context of macroeconomic variables.

Relationship between governance quality governance and its independent counterparts, including the regulatory impact of ESG law. Notably, the positive coefficient associated with GDP growth suggests a favorable association with governance quality, supported by its statistically significant p-value. Similarly, net trade exhibits a substantial positive coefficient, indicating a significant positive correlation with governance quality. Conversely, while Inflation displays a positive coefficient, its lack of statistical significance suggests a negligible influence on governance quality within the model's framework. The significant positive coefficient for population growth implies a favorable impact on governance quality with higher population growth rates. However, the negative coefficient for government spending suggests a potentially detrimental effect of government spending on governance quality, although marginally significant. Moreover, the presence of the ESG law dummy variable yields a positive coefficient, indicating a positive association with governance quality, supported by its statistical significance.

7. CONCLUSION

The panel regression model chosen for the analysis effectively captures the complexities of the relationship between ESG dimensions and macroeconomic variables. By incorporating diverse data from various entities, it accounts for cross-sectional variations inherent in ESG dimensions. Additionally, its inclusion of time-series data enables the examination of evolving relationships over time, enhancing the analysis's statistical power and reliability. The model's ability to address unobserved heterogeneity and bidirectional relationships further strengthens the accuracy of the results. Moreover, exploring the relationship through an unbalanced dataset could be a promising avenue for further study, offering insights into the impact of varying data structures on the observed relationships.

The absence of comprehensive data on ESG variables is a notable challenge, primarily stemming from the voluntary nature of their measurement. This trend towards voluntary reporting contributes to a higher prevalence of missing data points within the dataset, highlighting the inherent difficulties associated with ESG data collection and analysis. Comparing the implications of balanced versus unbalanced data could serve as a focal point for future research endeavors, providing valuable insights for subsequent studies in this domain.

The selection process involved identifying key trade partners within the European Union (EU) and Central Asia, considering their significant global linkages within Turkey's regional context. Additionally, income level was a crucial criterion, focusing on regions with high and upper-middle income groups. As a result, 14 countries were selected for inclusion in the analysis. To ensure the clarity of results and avoid conflating the impact of the 2008 crisis with ESG data, only data from years after the crisis were considered, starting from 2010. This approach aimed to provide a more objective measurement of the effects. Furthermore, data from the most recent years were excluded due to the time lag in reflecting ESG data in national systems, resulting in large data gaps observed after 2020.

The Granger causality tests illuminate the intricate relationship between economic indicators and ESG (Environmental, Social, and Governance) performance. Notably, economic growth and trade emerge as significant predictors of ESG performance. However, the predictive power of ESG on economic indicators such as GDP growth, inflation, and population growth remains uncertain, highlighting the complexity of these relationships. The results suggest a bidirectional relationship between the macroeconomy and ESG factors, with evidence indicating that the influence predominantly flows from the macroeconomy to ESG considerations. This is particularly evident in variables such as GDP growth and net trade, suggesting a tangible impact on the real economy beyond the monetary domain. These findings underscore the need for further research to comprehensively understand the dynamic interplay between economic factors and ESG performance.

The adoption of a random effects model in the study aligns with the selection process, which carefully considered the diverse characteristics of countries within the European Union (EU) and Central Asia. This approach accounts for variations in economic structures, governance systems, and policy environments across countries. By employing a random effects model, the analysis acknowledges the potential heterogeneity among countries and allows for the estimation of both within-country and between-country variations in the relationship between ESG factors and macroeconomic variables. This method facilitates the capture of unobserved country-specific effects that may influence the association under investigation, thereby enhancing the robustness and generalizability of the findings to a broader regional context.

The research findings prompted a detailed investigation into the various aspects of social sustainability. It was observed within the analytical framework that population growth emerged as a prominent sub-dimension. However, the inclusion of total population figures posed a challenge to the coherence of the model. As a result, both indicators related to population growth and total population were considered incompatible and subsequently excluded from further analysis.

The significance of ESG laws in influencing ESG performance underscores the regulatory impact on sustainability outcomes. The inclusion of a dummy variable representing ESG laws significantly enhances the model's explanatory power, indicating the pivotal role of regulatory frameworks in shaping sustainability practices. These findings underscore the importance of policy interventions in promoting sustainable practices and highlight ESG laws as catalysts for companies' adoption of environmental, social, and governance measures. Policymakers, businesses, and other stakeholders can leverage these insights to design effective regulations and initiatives that drive progress towards sustainable development goals.

The findings emphasize the significance of economic indicators in comprehending environmental, social, and governance (ESG) performance. Notably, the observed significant associations between GDP growth and net trade with ESG performance suggest that economic prosperity and international trade exert a positive influence on sustainability practices. Conversely, the non-significant coefficients for population growth and government spending imply a lesser direct impact on ESG performance. However, government spending may still play a crucial role in facilitating regulatory frameworks conducive to sustainability initiatives. Moreover, the inclusion of a dummy variable representing the presence of ESG laws reveals a significant positive association with ESG performance, highlighting the regulatory environment's pivotal role in shaping corporate behavior. These nuanced insights not only inform policymaking but also offer valuable guidance for businesses aligning with sustainability goals and navigating regulatory landscapes effectively.

The research highlights the pivotal role of economic indicators in understanding environmental sustainability, particularly the positive impact of GDP growth and net trade on sustainability practices. Conversely, population growth and government spending show less direct influence on environmental sustainability. Nevertheless, government spending can facilitate regulatory frameworks conducive to sustainability initiatives. Additionally, the presence of ESG laws significantly correlates with environmental performance, emphasizing their regulatory impact on corporate behavior. Furthermore, ESG laws affect social factors, promoting social responsibility and sustainability

practices within organizations. These findings emphasize the intricate interplay between regulatory measures, economic indicators, and social outcomes, emphasizing the importance of considering regulatory contexts in shaping sustainability efforts.

The analysis examines the relationship between governance quality governance and its independent variables, with a focus on the regulatory impact of ESG law. Findings reveal notable associations between governance quality and various factors. Specifically, GDP growth and net trade show positive coefficients, indicating a favorable correlation with governance quality, supported by their statistical significance. Conversely, while Inflation (Infl) displays a positive coefficient, its lack of statistical significance suggests minimal influence on governance quality. The significant positive coefficient for Population growth suggests a favorable impact with higher population growth rates. However, the negative coefficient for government spending suggests a potentially adverse effect of government spending, albeit marginally significant. Additionally, the presence of the ESG law dummy variable yields a positive coefficient, signifying a positive association with governance quality, supported by its statistical significance. These findings provide comprehensive insights into the nuanced relationship between governance quality and the considered independent variables, elucidating the regulatory influence of ESG legislation on governance dynamics within the broader socioeconomic context.

In conclusion, the panel regression model adopted for this study serves as a robust analytical framework for exploring the intricate relationship between ESG dimensions and macroeconomic variables. By leveraging cross-sectional and time-series data, the model adeptly captures the dynamic nature of this relationship, offering valuable insights into evolving trends over time. The inclusion of instrumental variable techniques and dynamic panel models addresses concerns regarding endogeneity, ensuring more accurate and causal interpretations of the results. Furthermore, the balanced panel data approach, coupled with the random effects model, effectively accounts for heterogeneity across countries, enhancing the generalizability and robustness of the findings to diverse regional contexts. The significant impact of ESG laws on sustainability outcomes underscores the regulatory environment's pivotal role in shaping corporate behavior and

promoting social responsibility. These findings not only inform policymaking but also provide actionable guidance for businesses seeking to align with sustainability objectives and navigate regulatory landscapes effectively. Overall, the comprehensive analysis presented here contributes to our understanding of the complex interplay between economic indicators and ESG performance, highlighting the importance of integrating environmental, social, and governance considerations into macroeconomic frameworks for sustainable development.

In the broader context, whether considering environmental, social, governance, economic, or legal factors, the fundamental imperative remains a profound change and transformation. The world is already moving in this direction, with individual awareness and societal behavior playing pivotal roles. Educating and nurturing people towards sustainable behaviors can pave the way for a more sustainable society, country, and ultimately, a world. Future generations can benefit from setting a new structure, but for those entrenched in and benefiting from the current order, diverse strategies and projects must be considered. Constructing a system based on universal values, ensuring maximal benefit for every segment of society, becomes an overarching goal in fostering a truly sustainable global future.

Technological innovation is indispensable for cultivating a sustainable economy. Traditional economic practices often strain resources and harm the environment. Embracing innovation in areas like renewable energy and eco-friendly manufacturing is crucial for addressing these challenges. Technology not only optimizes resource use but also creates new markets and jobs. It acts as a key driver in balancing economic growth with environmental preservation, fostering a sustainable and resilient future.

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