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Scientific Conference

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Association of Economists
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UdEkoM Balkan

ΠΑΝΕΠΙΣΤΗΜΙΟ ΚΡΗΤΗΣ
UNIVERSITY OF CRETE

9TH INTERNATIONAL SCIENTIFIC CONFERENCE
ERAZ 2023

KNOWLEDGE BASED SUSTAINABLE DEVELOPMENT

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June 1, 2023

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Preface

Economic development refers to enhancing economic activities in a society, resulting in positive changes in both the socio-economic structure and living standards. Sustainable economic development aims to eradicate poverty, inequality, and unemployment, ultimately promoting social inclusion and improving the overall quality of life. Consequently, analyzing this crucial issue requires a highly interdisciplinary approach.

The issue of sustainable economic development has gained recognition and attention from esteemed academic institutions in the Balkans region and beyond. Notably, Faculty of Logistics, University of Maribor, Maribor (Slovenia); University of National and World Economy - UNWE, Sofia (Bulgaria); Center for Political Research and Documentation (KEPET), Research Laboratory of the Department of Political Science of University of Crete (Greece); Institute of Public Finance - Zagreb (Croatia); Faculty of Tourism and Hospitality Ohrid, University of St. Kliment Ohridski from Bitola (North Macedonia) along with the Association of Economists and Managers of the Balkans have recognized the following issue and organized the 9th International Scientific Conference titled: ***Knowledge Based Sustainable Development – ERAZ 2023*** in Prague, Czech Republic on June 1, 2023 in a hybrid format (in-person, online and virtually).

The primary aim of the conference was to facilitate the gathering of the academic community, including experts, scientists, engineers, researchers, students, and other interested parties, with the purpose of disseminating scientific knowledge and promoting personal and collective growth. To achieve this goal, the conference provided a platform for the presentation and publication of scientific papers, as well as interactive discussions and other forms of interpersonal exchange, which enabled participants to share their experiences and knowledge. The conference program was designed to cover the latest scientific developments in the following areas:

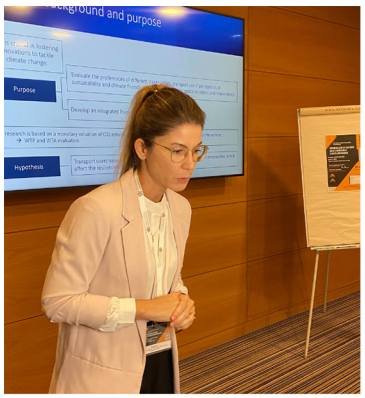
- Sustainable Development Management,
- Impact of Energy Consumption on Sustainable Development,
- Exploration of Green Finance's Role in Sustainable Development,
- Energy and Renewable Energy,
- Corporate Governance and Sustainability,
- Cryptocurrency and Financial Markets,
- Foreign Direct Investment and Sustainable Development,
- Internalization of Businesses and its Relation to Sustainability and International Trade,
- Biotech Industry and Collaboration,
- Work Quality and Social Sustainability,
- Thematic Analyses of Sustainable Development Goals (SDGs),
- Studies on Sustainable Business Models and Consumption,
- Impact of the Gig Economy on Sustainable Development,
- Female Education and Entrepreneurship in Support of Sustainable Development,
- Artificial Intelligence and Machine Learning,
- Algorithmic Human Resource Management,
- Consumer Behavior and Pandemic Consequences,
- Economic Analysis and Policies,
- Sustainable Tourism Development,
- Regenerative Tourism,
- Tourism Impacts on Pollution,
- Foreign Direct Investments in the Tourism Industry,

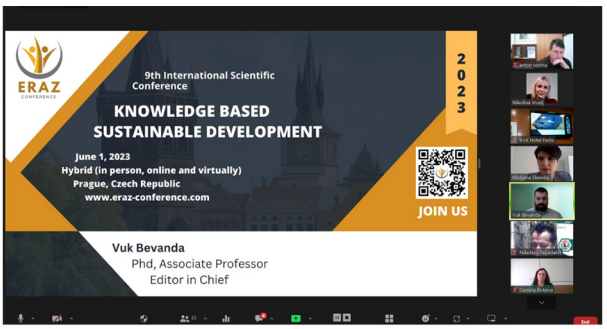
- Impact of Telework on Employee Psychological Departure,
- Innovative Careers,
- Challenges Affecting the Development of Human Resources,
- Economic Aspects of Sustainability and Bioeconomy in Agriculture and Food Sectors,
- Climate Change Impacts on Agricultural Production,
- Sustainable Recycling Solutions in the Agro-Food Industry
- Water and Air Purification Technologies,
- Healthy and Protected Environment,
- Socio-Economic Effects of Migration, etc.

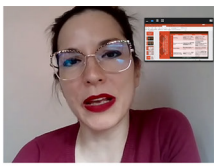
Within publications from the ERAZ 2023 conference:

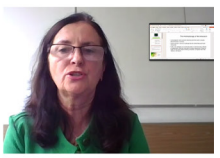
- 20 double blind peer reviewed papers have been published in the International Scientific Conference ERAZ 2023 – Knowledge Based Sustainable Development – **Selected Papers**,
- 69 double blind peer reviewed papers have been published in the International Scientific Conference ERAZ 2023 – Knowledge Based Sustainable Development – **Conference Proceedings**,
- 72 abstracts have been published in the International Scientific Conference ERAZ 2023 – Knowledge Based Sustainable Development – **Book of Abstracts**.

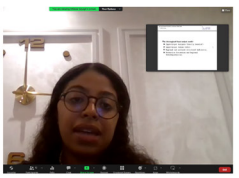
ERAZ 2023 publications have nearly **1.000 pages**. The conference attracted the participation of over **300 researchers** from **30 different countries**. These researchers came from a diverse range of academic institutions, such as universities, eminent faculties, and scientific institutes, as well as from colleges, various ministries, local governments, public and private enterprises, multinational companies, and associations.

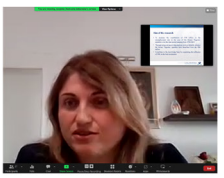












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From Personal Transformation to Sustainable Development

Irina Todorova[1]

Received: August 15, 2023
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Keywords:
Personal transformation;
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Abstract: *The transition to sustainable development requires a fundamental shift in thinking that for years has been outlining a destructive line of consumption with devastating consequences. Nature's inability to accept the results of human actions, and man's ability to absorb the devastating results on his health, have made it clear that unless man changes his attitude, he will soon become a victim of his actions. This paper analyses the theories of fundamental transformation towards sustainable production and consumption discussed in the social science field.*

1. INTRODUCTION

The severe consequences of human actions aimed at satisfying 21st-century specific consumption needs strongly suggest that if people do not change their behaviour, the consequences of their actions will catch up with them and have an increasingly destructive impact on them. Awareness of the response that prepares the nature of past human actions has stimulated scientific inquiry into both the causes of their origins and the variables on which their change depends. The difficulty in finding these answers has challenged social scientists (Frantzeskaki & Loorbach, 2010; Grin et al., 2010; Smith et al., 2005), as well as scientists from almost all fields, have found complex changes in recent years. The need for timely action triggered a series of political meetings, debates, and decisions (Organisation for Economic Co-operation and Development [OECD], 2011; United Nations Environment Programme [UNEP], 2011). All this intensified its development in the early 20th century. The deteriorating situation calls for urgent measures, which we witness not only in the scientific literature but also in the series of political decisions of the last decade.

This article is part of a series of scholarly articles devoted to the search for the answer to how change can be brought about, advancing the hypothesis that sustainable development in all areas of public life will come about when we witness the personal transformation and the integration of sustainable development into individual human consciousness.

This article wants to reassure the reader that the start of this process has already taken place and scientists have the opportunity to discover its dimensions in various smaller and larger manifestations of our social life.

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2. RESEARCH FIELDS OF POLITICAL AND SOCIAL SCIENCE ENGAGED IN THE STUDY OF SOCIO-TECHNICAL TRANSITIONS TO SUSTAINABILITY

Markard et al. (2012) distinguish several research fields of political and social science engaged in the study of sustainability transitions. These are the now popular Four Frameworks that focus on transition studies. The first two, Transition Management and Strategic Niche Management focus on designing innovation processes that foster the development of innovations that have the potential to contribute to the development of sustainable systems, as opposed to innovations that do not have such potential (Loorbach & Van Raak, 2006). According to Loorbach and Van Raak (2006), the first framework - Transition management "was for the first time defined in 2000 as a policy or governance approach and later developed into a policy model to deal with long-term desired change and sustainable development" (p. 1). According to Kemp et al. (2007), transition management considers societal change as a result of the interplay among various relevant participants across different levels of society within a dynamic societal environment. It underscores the necessity for the principles and techniques of Transition management to be mindful of the changing societal conditions (Kemp et al., 2007, p. 3). These problems include the fact that different people have different perspectives on the nature of problems and different preferences for their solutions (Kemp et al., 2007, p. 4). Moreover, humans are at different stages of their evolutionary development, from which they perceive the changes that occur in all spheres of social life. Their perception and the subsequent stage of analysis and interpretation are strongly influenced by their capacity for understanding, the prior theoretical reasoning available to them, and the basis on which they analyze the state of current problems. Ethnic, cultural and religious specificities, place additional emphasis on interpretive schemes of explanation. All this leads to differences in the final decisions and concrete actions that different people will take within a similar reality. This complicates attempts to control behavior, especially in cases where we need emergency measures and rapid changes in behavior. Control, according to Kemp et al. (2007), should not be distributed on a top-down basis. It should be spread among diverse participants holding varying beliefs, interests, and resources (Kemp et al., 2007, p. 4). Taking into account the differences in people's beliefs and actions and creating new forms of governance in the context of highly dynamic climate change puts researchers in a "vise" who on one hand have to study the dynamics in the development of cultural, ethnic, religious, regional, and other relations to contemporary changes and on the other hand have to intensively search for approaches to guide them. Now that we are finding more clearly than ever that we need to replace short-term goals with a long-term perspective in order to take account of the consequences of our actions in the future and ensure that they are sustainable over time, we need a fundamentally new approach, the basis of which must be the potential of our present actions in terms of its future dimensions. According to Kemp et al. (2007), we need a form of governance that is concerned with expressing long-term goals and managing transitions. "The essence of transition management is that substance and process go hand-in-hand, creating partisan-mutual adjustment against long-term transition goals" (p. 4).

Loorbach (2007) highlights the fact that we have been witnessing for years - modern institutions and policies have mainly focused on achieving short and medium-term goals and problems (p.11), which naturally leads to achieving short and medium-term results with different effects on future development. In itself, the process of formulating short-term goals would not be problematic if these goals were steps on the path to a global goal, properly situated in the context of sustainable development. But if its dimensions possess the limits of a specific short-term goal, isolated from the future or contradictory to sustainable development,

then it realizes itself, within the set goals, possibly achieving its intentions, but possibly negatively affecting sustainable development. According to Loorbach (2007), setting long-term goals and developing strategies to achieve them can be accomplished by overcoming individuals' existing routines, mindsets, and physical and mental barriers (p. 11). In his view, this is the only way to achieve a new course of sustainable development, a course that starts from a shared sense of urgency and replaces ideas of iconic growth with ideas of "sustainability, social equality, democracy, quality of life and reflexivity" (Loorbach, 2007, p. 11). This, says Loorbach (2007), means reassessing the core values and standards of our society "at all levels: how we collaborate, innovate and modernize" (p. 11), our collective consciousness and sensitivity to environmental and societal issues, and what values and qualities we want to preserve and develop for the future (Loorbach, 2007, p.11).

The shift from short-term to long-term planning, linked to the ideas of sustainable development, changes not only the time perspective of the new tasks. It fundamentally changes the understanding of the meaning of the end goal. The urgency of which Loorbach speaks is confirmed by the abundant evidence of hard-to-manage consequences of human actions to date. All of them provide strong evidence for the reason that we have found ways to successfully achieve our short-term goals, but that they have carried different long-term consequences in different areas of our lives. And if we are to make a fundamental change in our thinking today, that change should be focused on the short or long-term nature of the actions planned, but most of all, on their long-term positive effect on all. This new perspective emerged in the negative response that, like a boomerang, nature returned to us to show us that the way we planned our actions up to that point could have a devastating effect on us. And if until recently this prospect seemed possible, but in a future so imminent and distant from us that it was not even certain whether it would ever come to pass, today nature has shown us that the effects of our actions inconsistent with her, with short-term consequences, can have equally inconsistent short-term negative effects on us - today. The boomerang effect of our actions carries an important message about the possible results of our actions, but it also shows that what we will receive in the future will be what we send to it today. The situation in which we find ourselves prompts a transformation, a sharp turn towards humanization, an awareness of the effect of individual actions on all, and a choice of what effect we want to achieve.

People are at different stages of their development. They are aware of problems in different ways, influenced by age, ethnic, ethnographic, national and religious factors. Taking this fact into account would make an undeniable contribution to the search for new approaches to the management of their behavior, but at the same time, it should be borne in mind that, in addition to theories that take into account the undeniable differences, there are theories that take into account the undeniable similarities between people, no matter in which part of the world their lives take place. Take, for example, the hierarchical structure of needs created by Abraham Maslow, which arranges - in an order specific and universal to all people - our human needs. Regardless of people's backgrounds and the conditions under which they live today, the overwhelming majority of people want to feed their children and ensure their health; to provide security and peace of mind for their families; to love and be loved; to support and be supported; to develop themselves in the best way for themselves and others. These and other common, fundamental, inherent human needs, similar for all of us, regardless of age, ethnicity and culture, education and social status, create a basis of convergence, the consideration of which can help us find policies for change just as much as those policies that take into account the differences between us. Moreover, since what brings people together has always been greater than what

separates them from each other, seeking approaches based on fundamental similarities is likely to be more successful. And further, because these convergences address fundamental human needs, people are much more likely to respond to them than to policies that address their differences.

The second framework, resembling some extent the first, appeared at about the same time and place, and similar personalities, such as that of René Kemp, underlie its development. This framework takes the name Strategic Niche Management and was introduced in the late 1990s as a new concept that combines policy tools for managing technological innovation with research models in so-called niches (Loorbach & Van Raak, 2006). As per Kemp et al. (1998), Strategic Niche Management represents an essential and self-aware element within deliberate transformative processes of societal systems (p. 12). In the words of Loorbach and Van Raak (2006) Strategic Niche Management refers to the process of consciously managing niche formation processes through real-life experiments (p. 2). Embedded is the concept that people's needs and wants as consumers are dynamic and influenced by their experiences. Their dynamic nature implies opportunities for change. Strategic Niche Management combines the social character of sustainable development with the development of new technologies and "supplies" the dynamics of technological development with social relevance. Although it is technology-centered (Loorbach & Van Raak, 2006, p. 9), this concept also places special emphasis on the environmental benefits of different technological options and encourages sustainability.

In some publications, we seem to find a critique of the framework that technology remains the starting point in its development and the idea of supply and demand takes center stage, but despite this real emphasis, the framework makes an elegant transition from the previously dominant principles to the idea that they can function within the idea of sustainable development. This framework suggests that new technologies, which all aspire to, even if they follow the principles of supply and demand, can offer users technologies that are consistent with the principles of sustainable development.

Weber et al. (1999, p. 11) wrote that experiments conducted within different protected niches should be designed to take into account different technological but also organizational, and social contexts. They also introduce additional dimensions of success, extending the framework used to evaluate it to date. Defining as successful this experiment also contributes to the transition toward a more sustainable system (Weber et al., 1999, p. 79).

One of the main ideas of Strategic Niche Management is that by experimenting with new technologies and new socio-technical arrangements, processes of co-evolution can be stimulated (Hoogma et al., 2005). According to Hoogma et al. (2005), technological change has become a central feature of modern societies, but the consequences of human actions show that we cannot continue to produce and consume as we have done. Change confronts us with the urgent need to direct everything we produce towards sustainability, but this is difficult to do as quickly as change shows us it is necessary. According to Hoogma et al. (2005), the need for change occurs before the necessary tools and policies are in place to achieve that change. There is a lack of a plan for a sustainable future and there is a need to experiment with alternative pathways (Hoogma et al., 2005). Strategic Niche Management is an opportunity to create protected spaces to develop new technology, to experiment and search for better and sustainable alternatives, and pathways to integrate them. Strategic Niche Management presents an imperative and necessary effort to bring social science understandings and innovation research into evolutionary economics (Lopolito et

al., 2022), opportunities to understand complex and multidimensional transformations in socioeconomic systems towards more sustainable patterns of production and consumption (Köhler et al., 2019). Giganti and Falcone (2022) propose that the key to comprehending the potential substitution of the prevailing sociotechnical system lies in concentrating on sociotechnical niches and the governance endeavors linked to them. This involves a kind of introspective governance that arises from joint efforts, centered on the core concept of substituting established (harmful) technologies with novel (eco-friendly) alternatives (Voss et al., 2006, p. 1).

Over the years, the socio-technical multi-level perspective (MLP) has become one of the main frameworks for the study of sustainability transitions (Geels, 2019; Köhler et al., 2019; Markard et al., 2012; Smith et al., 2010). It has added to the other components of socio-technical system transformations, the social-psychological phenomena under which people perceive, endorse, support or reject innovations. Although the focus on these is not the basis of this conceptual framework, in many publications we see a search for a link between consumer behavior and the factors that determine it. The clarity that the endorsement of innovation is dependent on people's beliefs, interpretations and expectations leads to the understanding that socio-technical transitions and changes in consumer practices are intertwined, with changes in technology including changes in consumer practices, policies, cultural meanings, infrastructures, and business models (Geels, 2018), public policies and markets (Elzen et al., 2003) and vice versa.

According to this framework, there are three levels at which processes interact: the first level is the level of current structures and practices; the second level is the level of deeply embedded cultural patterns; and the third level is the level of "radical innovation" where actors drive the development of technological innovations (Geels & Schot, 2007). The multilevel perspective postulates that "transitions occur through processes of interaction within and between three analytical levels: niches, socio-technical regimes, and socio-technical landscapes" (El Bilali, 2019).

According to Geels (2020), socio-technical transitions are interpretive and are dependent on people's expectations, visions, beliefs, meanings and interpretations that shape their motivations and preferences. They influence the social acceptance of certain innovations and the legitimacy of policy efforts. The discrepancies between beliefs and interpretations mean that transitions will not emerge based on consensus, on the contrary. They will spark controversy, debate, and struggle (Roberts & Geels, 2018). Interactions between innovations and existing regimes may also cause struggles: struggles between new and old companies, struggles between new and old technologies, discursive struggles from framing problems and solutions, struggles between dominant logic and new patterns, and political struggles. Consequently, according to Geels et al. (2016), transitions can be subject to contestation and controversy if actors change their beliefs and goals, or if there is increasing contestation of particular pathways. Conversely, transitions can be subject to consensus, on the occasions in which they meet people's beliefs.

A socio-technical multi-level perspective poses an important question in evolutionary terms, a question that has challenged transitions for hundreds of years. Namely, sustainable transitions to the next stage of development are possible when there is a synchronization between innovation (in whatever form - ideas, policies, new engineering solutions) and people's understandings. The ideas of socio-technical transitions and the tools for their implementation reflect and will always reflect the progress of a more dynamic, innovative and inventive part of society, endowed with the knowledge and capabilities to conceive of the need for innovation, to create their projects and to find ways to implement them. Although its level of development ensures

the progress of the whole society, its ideas will find their sustainable realization when they are adopted by the rest of society. This means that the elements of transition depend on a part of society, but if it does not ensure that they are integrated into the consciousness of the rest of society, their development will remain questionable. Socio-technical transition should therefore set out the idea that bringing innovations down to the understanding of all people is an important, and perhaps primary, issue in defining the people of their development. And since millennia of human history abound with examples that forcing society to accept the "new" is temporary, and that actual integration into consciousness ensures the persistence of perception and behavior, it is more than clear that efforts must be directed toward approaches that ensure actual understanding, awareness, and consent to the new. Of course, enforcing people's behavior, finding mechanisms to sanction non-compliance, and introducing an obligation to adhere to certain behaviors can and often does provide a quick and direct route to innovation. This is a very important issue when the complexity of the situation requires urgent measures that do not provide the necessary time for public reflection and acceptance. In this case, the appropriate policy would provide timely action, but if it is not then integrated into people's minds and recognized as an action they want to stick to, it will be temporary and only function within the framework of the relevant policy or sanction.

The complexity of the human psyche is hardly random and requires the simultaneous movement of all members of society in a common direction. The reason why one part of society possesses more knowledge than another is hardly accidental. It is hardly accidental that the mechanism for the movement of the whole is tied to the dependence between the insights of a part of the people and the ability of another part to bring its understanding to it. It requires innovators to make their insights understandable, ensuring their success only if they make their efforts to have those insights understood and people willing to join them.

The negative consequences of human actions, which have long since passed the limit of nature's capacity to bear them, restarted this mechanism with particular force. And it encouraged people with more opportunities to lend a hand to people with fewer ones to move forward together. Amazingly, instead of "avenging action" and punitive action for what he did, nature, as a truly loving mother, stimulated man through mechanisms of humanization.

Technological innovation systems is another conceptual framework aimed at exploring the factors that influence the adoption of innovations and the development of technological changes made in the context of sustainable development. It is interested in the time it takes for technological innovations to diffuse at scale (Ortt & Kamp, 2022), the risks that innovators and entrepreneurs take from the creation of new technology to its successful large-scale diffusion, the impact of protected niches as an opportunity for lower-risk production. Technological Innovation Systems focus more on learning flows of knowledge than on learning flows of mere goods and services (Carlsson & Stankiewicz, 1991, p. 111) and creating technological novelty (Bergek, 2019, p. 203). It is interested in a set of infrastructures involved in the generation, distribution, and use of technology (Bergek, 2019, p. 203). Central to this conceptual framework since its creation is the understanding that technological change is determined by the characteristics of a social structure within which firms and institutes are embedded (Freeman, 1995). It highlights the role of the characteristics of societal structures in the adoption of technological innovation and sustainable development.

3. DISCUSSION

The transition to sustainable development is a complex and very dynamic process; a process dependent on many factors and the interactions between them. Its implementation, which involves different levels, participants, and internal and external conditions, depends on a series of transformations. Transition begins with a change in beliefs, values, political convictions, deep-rooted cultural patterns of thinking, and factors that influence people's preferences and motivations. Such change leads to changes in governance, dominant practices, and socio-technical systems. Changes in all levels of this system, carry out the development of technological innovations and opportunities for the implementation of the transformation towards sustainable development.

The emphasis of the dominant body of theoretical frameworks analyzing the transition to sustainability on new technologies and the mechanisms for their imperative adoption among consumers is understandable, given the dynamic changes in the climate that suggest daily that time is limited. But when we talk about change, and place so much emphasis on the economic principles by which we want to achieve it, we leave behind the fact that change requires people, not just a change in their consumer behavior, but a fundamental change in their relationship to the world around them. From now on, people must not just decide what car to replace the car they have been using and whether to dispose of their waste separately, but must fundamentally change the basis on which they make these decisions. If up to this point, social and economic status have defined the limits of possibilities and presupposed situational choices, and mass production has guaranteed the replacement of what has been purchased after the expiry date, today this basis must change its direction. This means not just a change in people's consumption. It means a fundamental change in understanding the meaning, the fact of consumption, and its effects on self and others. And because these issues uniquely bind people together and similarly threaten the existence of all, they invite simultaneous action today, regardless of ethnicity, religion, and social and economic status.

4. CONCLUSION

With each passing year, the changes man makes to the world in which he has been given to live to suggest that the values that guide the satisfaction of his needs are destroying all basic resources. It does not require a scientific search to see that temperature changes and winds do not enable us to grow our crops unless we use artificially created stimuli for this purpose. But new technologies are needed to discover the causes of the increasingly specific diseases of our children and elderly parents, to combat the dropped age limits of chronic diseases. We have developed unsustainable patterns of consumption and production in socio-technical systems (Köhler et al., 2019) and without needing special scientific approaches, we can predict what the effects will be on us.

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Co-movements between Dirty and Clean Energy: A Time-Frequency Perspective

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Abstract: *The recent worldwide pandemic of 2020 and Russia's invasion of Ukraine in 2022 have sparked interest in understanding the links between clean and dirty energy markets. This research investigates the co-movements of clean energy and dirty energy stock indexes before and during the 2020 and 2022 events. The study focuses on the Brent Crude Spot, Euro Stoxx Oil & Gas, NASDAQ Clean Edge Green Energy, WilderHill Clean Energy, and Clean Energy Fuels stock indexes from May 3, 2018, to May 2, 2023. The goal is to determine if the events of 2020 and 2022 have increased co-movements between clean and dirty energy stock indexes, potentially challenging portfolio diversification. The results show that co-movements have increased, but portfolio diversification was no longer efficient during the tranquil period in international markets. These findings hold relevance for investors, policymakers, and other players in the energy financial market.*

1. INTRODUCTION

Against the backdrop of heightened global awareness concerning carbon emission reduction and the transition to clean energy sources, substantial investments have been directed towards renewable energy technologies, encompassing solar, wind, hydro, and geothermal solutions. This surge in clean energy has not only positioned itself as an ecological imperative but has also emerged as a catalyst for economic development in many countries. Emblematic of this commitment to tracking and advancing the clean energy market is the establishment of the WilderHill Clean Energy Index in 2004. This index diligently monitors the performance of companies engaged in developing and producing clean energy technologies, aligning with sustainable and developmental goals (Dias, Horta, et al., 2023).

The recent proliferation of clean energy indexes exemplifies the transformative potential of these financial markets, providing investors with a channel to align their financial objectives with climate concerns and sustainable development aspirations. Clean energy investments have garnered significant attention from investors, mirroring global efforts by policymakers to mitigate climate risks and foster sustainable economics (Lee & Baek, 2018; Xia et al., 2019).

Despite the remarkable ascent of clean energy markets, traditional dirty energy continues to dominate the world's primary energy sources. Moreover, as clean energy is often cast as an alternative to conventional sources, the growth and sustainability of the clean energy industry are inherently intertwined with traditional energy markets. The global push for decarbonization,

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particularly following the 2015 Paris Climate Accord and COP26, has catalyzed regulatory bodies, companies, financial institutions, and investors to replace dirty energy with cleaner alternatives, fostering sustainable development. Investing in clean energy sources is increasingly viewed as pivotal in achieving the COP26 goals and promoting sustainable economic growth (Farid et al., 2023; Papageorgiou et al., 2017; Ren & Lucey, 2021, 2022).

Our study makes several noteworthy contributions to the existing literature. Firstly, while prior investigations into the relationship between dirty and clean energy markets primarily focused on interconnections with the crude oil market, our research extends this inquiry to comprehensively examine the movements of both dirty and clean energy stock markets. This study broadens the scope to encompass a diverse array of dirty energy stock markets, including fossil fuels such as natural gas, diesel, and others, beyond the traditional focus on crude oil (Reboredo, 2015). The inclusion of indexes like the Brent Crude Spot and the Euro Stoxx Oil & Gas alongside the Nasdaq Clean Edge Green Energy and WilderHill Clean Energy indexes enriches our understanding of the linkages between dirty and clean energy stock indexes. Secondly, our research pioneers the examination of the impact of 2020 and 2022 events on the structural dynamics and correlations between dirty and clean energy stock markets, shedding light on sustainable development pathways. The effects of the COVID-19 pandemic on energy prices and stock markets have been extensively studied, namely by the authors Mzoughi and Urom (2021), den Ouden (2021), and Ghabri et al. (2021). However, our work addresses the critical gap concerning the impact of the events of 2020 and 2022 on the relationship between clean energy stock indexes and dirty energy, offering insights for sustainable development strategies. Lastly, the study employs a time-frequency approach to explore the interconnections between dirty and clean energy markets by dividing the sample into two subperiods: Tranquil (May 3, 2018, to December 31, 2019) and Stress (January 1, 2020, to May 2, 2023), encompassing the events of 2020 and 2022. This innovative approach adds depth to our understanding of sustainable economic development in the context of energy markets.

The paper is structured to present research, emphasizing intersections between sustainable development goals and energy market dynamics. Section 2 discusses relevant literature, providing a foundation for exploring sustainable development pathways. In Section 3, we detail data and outline econometric methodologies, ensuring transparency and replicability. Section 4 presents empirical findings with a thorough discussion, offering insights for sustainable economic development. Finally, Section 5 encapsulates the main findings and outlines future directions, ensuring a cohesive exploration of dirty and clean energy markets within the context of sustainability.

2. LITERATURE REVIEW

In recent years, there has been an increasing interest in understanding the relationship between dirty and clean energy, particularly in light of events such as the COVID-19 pandemic in 2020 and energy market instability in 2022. The generation of renewable energy has been acknowledged as a critical aspect of tackling energy and climate change issues. However, the advancement of renewable energy is frequently limited by traditional fossil energy pricing. Exploring the interconnections between these two energy sources is thus critical for promoting renewable energy development and meeting sustainable energy goals (Fuentes & Herrera, 2020; Naeem et al., 2022; Ren & Lucey, 2022).

The authors, Henriques and Sadorsky (2008), examined the correlations between clean energy stock indexes and other asset classes, as well as the relationship between alternative energy

stock prices, technology stocks, oil prices, and interest rates. The researchers discovered a correlation between the fluctuations in technology stock prices and individual oil prices and their subsequent impact on the stock prices of alternative energy companies. Similarly, Huang et al. (2011) performed research on the interaction between crude oil prices and the performance of alternative energy company stocks. They discovered that, since the end of 2006, oil prices have had a significant impact on the performance of alternative energy company stocks.

Several authors, including Bondia et al. (2016), Ferrer et al. (2018), and Wang and Cai (2018), have examined the synchronizations between oil prices, technology, financial variables, and clean energy stock indexes. In their study, (Bondia et al., 2016) observed a correlation, in the short term, between the stock prices of alternative energy companies and the stock prices of technology companies, oil prices, and interest rates. Nevertheless, the study conducted by Ferrer et al. (2018) revealed that there is no substantial impact of crude oil prices on the stock market performance of renewable energy companies, in both the short and long term. This observation implies that the alternative energy industry may be gradually diverging from the traditional energy market. According to Wang and Cai (2018), the carbon market can explain the fluctuations seen in the stock prices of clean energy companies. Furthermore, the stock prices of clean energy companies influence the carbon market.

According to the findings of Vrînceanu et al. (2020), there exists a weak connection between oil markets and renewable energy markets. This suggests that the development and progress of the renewable energy industry are relatively less affected by changes in oil prices. In contrast, the study conducted by Ren and Lucey (2021) examined the shocks between clean energy stock indexes and cryptocurrencies, specifically focusing on their energy consumption levels. The findings of the study show that clean energy has a greater propensity to serve as a safe haven for cryptocurrencies with a higher environmental impact as opposed to those with a lower environmental impact, particularly during times characterized by uncertainty.

More recently, Avazkhodjaev et al. (2022) published research on the shocks between renewable energy prices and clean energy in green economy stock prices between December 2010 and July 2021. The authors found that in renewable and clean energy production, negative shocks outnumber positive shocks. They additionally found that the prices of renewable energy production exhibit a positive (or negative) impact on the stock prices of the green economy. In their research, Farid et al. (2023) examined the co-movements between clean energy and dirty energy stock indexes both before and after the COVID-19 pandemic. The authors used an extensive sample of dirty energy, such as crude oil, heating oil, diesel, gasoline, and natural gas. The study found weak linkages between short-term clean and dirty energy stocks as well as a distinctive segmentation effect between dirty and clean energy markets.

3. METHODOLOGY AND DATA

3.1. Data

The daily price index was used as the data source. The Brent Crude Spot (BRENT) and Euro Stoxx Oil & Gas (EUSTOXX) indexes represent the stock market for dirty energy, while the clean energy stock market is represented by the indexes Nasdaq Clean Edge Green Energy (CELS), WilderHill Clean Energy (ECO), and Clean Energy Fuels (CLNE), during the period from May 3, 2018, to May 2, 2023. We divided the sample into two subperiods to examine whether the events

of 2020 and 2022 increased the co-movements. The Tranquil period lasts from May 2018 to December 2019, whereas the Stress period lasts from January 2020 to May 2023. The daily prices are in US dollars and were obtained from the Thomson Reuters Eikon database.

3.2. Methodology

This research will be carried out in phases. In the first step, we will present the graphs, in returns, to examine how the data is dispersed relative to the average. To explain the characteristics of the sample, we will use the main descriptive statistics measures and the Jarque and Bera (1980) adherence test to determine if we are dealing with distributions that are Gaussian in nature. To evaluate the assumption of stationarity in the time series, we will use the panel unit root tests proposed by Hadri (2000) as well as the unit root tests developed by Phillips and Perron (1988), specifically the Fisher Chi-square test and the Choi Z-statistic. The PP test, which is a variant of Fisher's chi-square test and is often referred to as the Pesaran test, assesses the interdependence among panel data by using Fisher's chi-square statistics. The Choi Z-stat test, proposed by Choi (2001), is used to examine the existence of cross-dependence in panel data. In order to address the study question, the Granger VAR (vector autoregressive) causality econometric model will be used. This statistical model is often used to examine the causal relationship between variables in a multi-variable time series scenario. Within a VAR model, the Granger causality concept is based on the idea that if past values of one variable aid in the prediction of another variable, then the first variable is deemed "Granger's cause" for the second variable. See the authors' papers, Granger (1969) and Granger and Newbold (1974) for a deeper understanding.

4. RESULTS

Figure 1 shows the evolution, in returns, of the Brent Crude Spot, Euro Stoxx Oil & Gas, Nasdaq Clean Edge Green Energy, WilderHill Clean Energy, and Clean Energy Fuels stock indexes from May 3, 2018, to May 2, 2023. During the first half of 2020, there was a significant dispersion of data around the mean, which is in line with the market impact caused by the global pandemic. In the context of international markets, Dias, Chambino, et al. (2023), Chambino et al. (2023), and Dias, Horta, et al. (2023) support these results.

Table 1 presents a summary of the major descriptive statistics for the stock indexes Brent Crude Spot, Euro Stoxx Oil & Gas, Nasdaq Clean Edge Green Energy, WilderHill Clean Energy, and Clean Energy Fuels, from May 3, 2018, to May 2, 2023. Upon analyzing the results, it was seen that all stock indexes exhibit positive mean returns. In terms of the index with the highest risk, it is evident that BRENT has the most significant deviation from the mean (0.038992). In order to ascertain the presence of Gaussian distributions, it can be seen that the skewness exhibits non-zero values (deviating from the reference value), while the kurtoses also provide evidence of values above 3. To support the findings, the Jarque and Bera (1980) test rejects H_0 at a 1% significance level. These findings were expected owing to the presence of fat tails, i.e., extreme values, as a consequence of the events of 2020 and 2022.

The results of the panel unit root tests of Phillips and Perron (1988) - Fisher Chi-square, and Choi Z-stat, as well as the Hadri (2000) test, are shown in Tables 2 and 3. These tests assess the presence of unit roots in the time series. The intersection of tests with opposite null hypotheses is employed to ensure robustness in evaluating the lag level in each time series until it reaches equilibrium (mean 0 and variance 1). The findings show that the time series exhibits unit roots

upon estimating the original price series. To achieve stationarity, it was necessary to apply a logarithmic transformation to the first differences, allowing it to demonstrate the rejection of the null hypothesis in Phillips and Perron's (1988) test - Fisher Chi-square and Choi Z-stat. In reference to the Hadri (2000) test, it is evident that the null hypothesis is not rejected, confirming the validity of the fundamental assumptions for the estimation of VAR models.

To better evaluate the impact of the 2020 (COVID-19 pandemic issue) and 2022 (armed conflict between Russia and Ukraine) events on market relationships, the entire period has been divided into two subperiods: Tranquil (3 May 2018 to 31 December 2019) and Stress (from 1 January 2020 until 2 May 2023). The first stage in calculating the autoregressive vector involves eliminating the potential for autocorrelation among the serial residuals. In this context, the information criteria provided in Table 4 allow us to ascertain that, during the Tranquil period, the sequential modified LR test statistic, conducted at a significance level of 5%, reveals a lag of 8 days for the estimate of the VAR model. The results of the VAR Residual Serial Correlation LM tests are shown in Table 5. It was seen that the test confirms the lack of autocorrelation with a lag of 9 days. Consequently, the VAR Lag Order Selection Criteria test is validated with 8 lags.

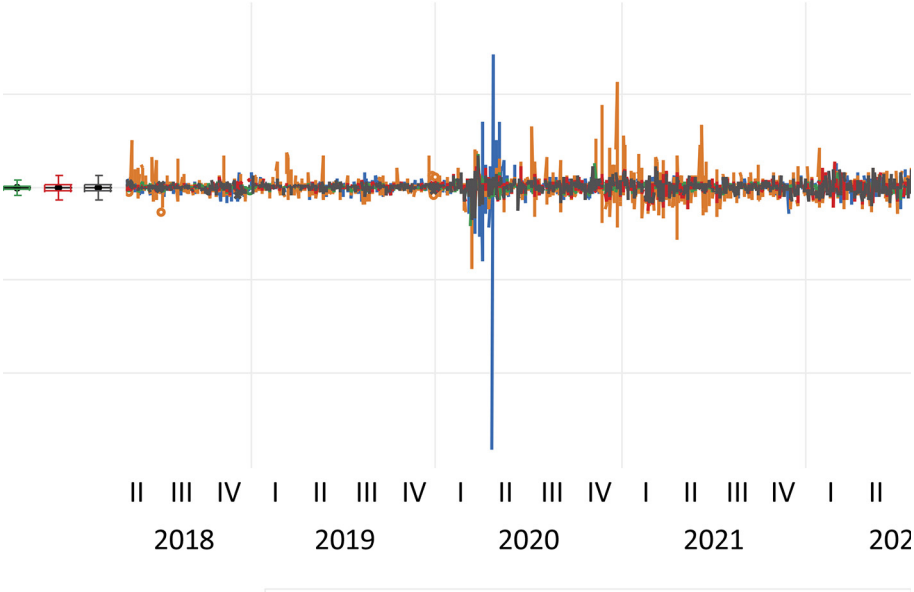

Figure 1. Evolution, in returns, of the financial markets under study during the period from May 3, 2018, to May 2, 2023

Source: Own elaboration

Table 1. Descriptive statistics of the financial markets under study during the period from May 3, 2018, to May 2, 2023

	BRENT	CLNE	EUSTOXX	CELS	ECO
Mean	0.000431	0.000482	0.000104	0.000571	0.000125
Std. Dev.	0.038992	0.040084	0.012673	0.018702	0.019707
Skewness	- 11.31994	1.459962	- 0.602354	- 0.138421	- 0.094281
Kurtosis	418.9986	24.10483	37.57033	9.279764	10.20693
Jarque-Bera	13205589	34537.25	91038.18	3006.210	3954.463
Probability	0.000000	0.000000	0.000000	0.000000	0.000000
Observations	1826	1826	1826	1826	1826

Source: Own elaboration

Table 2. Phillips-Perron panel unit root test, in returns, concerning the financial markets under analysis, from May 3, 2018, to May 2, 2023

Null Hypothesis: Unit root (individual unit root process)			
Method		**Statistic**	**Prob.***
PP - Fisher Chi-square		92.1034	0.0000
PP - Choi Z-stat		-8.31597	0.0000
Series	**Prob.**	**Bandwidth**	**Obs.**
BRENT	0.0001	50.0	1824
CLNE	0.0001	49.0	1824
EUSTOXX	0.0001	50.0	1824
CELS	0.0001	50.0	1824
ECO	0.0001	50.0	1824

Note: * Probabilities for Fisher tests are computed using an asymptotic Chi-square distribution. All other tests assume asymptotic normality.

Source: Own elaboration

Table 3. Hadri panel unit root test, in returns, concerning the financial markets under analysis, from May 3, 2018, to May 2, 2023

Null Hypothesis: Stationarity				
Method			**Statistic**	**Prob.***
Hadri Z-stat			-2.29080	0.9890
Heteroscedastic Consistent Z-stat			-2.19829	0.9860
Series	**LM**	**Variance HAC**	**Bandwidth**	**Obs.**
BRENT	0.0185	64.79990	50.0	1825
CLNE	0.0249	0.242582	49.0	1825
EUSTOXX	0.0202	1038.727	50.0	1825
CELS	0.0123	5444.951	50.0	1825
ECO	0.0247	219.5319	50.0	1825

Notes: High autocorrelation leads to severe size distortion in Hadri test, leading to over-rejection of the null hypothesis. * Probabilities are computed assuming asymptotic normality.

Source: Own elaboration

Table 4. VAR Lag Order Selection Criteria for the Tranquil Subperiod

Lag	**LogL**	**LR**	**FPE**	**AIC**	**SC**	**HQ**
0	9034.874	NA	5.01e-20	-30.25083	-30.21405	-30.23651
1	9208.867	344.4887	3.04e-20*	-30.74997*	-30.52927*	-30.66404*
2	9219.317	20.51470	3.19e-20	-30.70123	-30.29661	-30.54368
3	9225.911	12.83573	3.40e-20	-30.63957	-30.05104	-30.41041
4	9231.721	11.21058	3.62e-20	-30.57528	-29.80283	-30.27451
5	9248.896	32.85458	3.72e-20	-30.54907	-29.59270	-30.17669
6	9264.265	29.14149	3.84e-20	-30.51680	-29.37652	-30.07281
7	9290.155	48.65859	3.83e-20	-30.51978	-29.19559	-30.00419
8	9310.481	37.85995*	3.89e-20	-30.50413	-28.99601	-29.91692
9	9324.476	25.83350	4.04e-20	-30.46726	-28.77523	-29.80844
10	9331.170	12.24396	4.30e-20	-30.40593	-28.52999	-29.67550

Notes: * Indicates the lag order selected by the criterion. LR: sequential modified LR test statistic (each test at 5% level). FPE: Final prediction error. AIC: Akaike information criterion. SC: Schwarz information criterion. HQ: Hannan-Quinn information criterion.

Source: Own elaboration (software: Eviews12)

Table 5. VAR Residual Serial Correlation LM tests for the Tranquil subperiod

VAR Residual Serial Correlation LM Tests						
Lag	**LRE* stat**	**df**	**Prob.**	**Rao F-stat**	**df**	**Prob.**
1	29.73491	25	0.2344	1.191341	(25, 2040.9)	0.2344
2	19.76393	25	0.7591	0.789925	(25, 2040.9)	0.7591
3	10.87555	25	0.9935	0.433733	(25, 2040.9)	0.9935
4	5.096539	25	1.0000	0.202971	(25, 2040.9)	1.0000
5	17.97941	25	0.8433	0.718288	(25, 2040.9)	0.8433
6	26.75205	25	0.3684	1.071051	(25, 2040.9)	0.3684
7	37.55385	25	0.0511	1.507487	(25, 2040.9)	0.0511
8	35.65371	25	0.0770	1.430547	(25, 2040.9)	0.0770
9	26.22323	25	0.3958	1.049744	(25, 2040.9)	0.3958

Source: Own elaboration (software: Eviews12)

The findings of the VAR Granger Causality/Block Exogeneity Wald test for the Tranquil period are shown in Table 6. Based on the evidence provided, we confirm the presence of 9 co-movements between the Brent Crude Spot (BRENT), Euro Stoxx Oil & Gas (EUSTOXX), Nasdaq Clean Edge Green Energy (CELS), WilderHill Clean Energy (ECO), and Clean Energy Fuels (CLNE) stock indexes. According to the findings, the ECO stock index causes 3 shocks in its peers, particularly the CLNE, EUSTOXX, and CELS stock indexes. While the EUSTOXX index causes 2 shocks, namely in the CELS and ECO indexes, the BRENT stock index also causes 2 shocks, exactly in the EUSTOXX and ECO indexes. Furthermore, we confirm that the CLNE stock index causes the EUSTOXX index. The EUSTOXX index is caused by the CELS stock index. In addition, we can see that the most caused stock indexes are the EUSTOXX (4), CELS (2), ECO (2), and lastly, CLNE (1). The findings highlight significant co-movements between clean energy and dirty energy stock indexes, which might threaten the widespread use of effective portfolio diversification strategies.

Table 6. Granger causality/Block Exogeneity Wald tests, of the financial markets under analysis, in the Tranquil subperiod

	BRENT	**CLNE**	**EUSTOXX**	**CELS**	**ECO**
BRENT		1.42581	0.87311	0.83572	0.97627
CLNE	1.61389		0.71752	0.70853	2.93868***
EUSTOXX	14.1423***	2.26310**		4.51052***	7.56182***
CELS	0.84575	0.55594	2.36714**		26.3864***
ECO	2.36463**	0.35807	2.49950**	1.13913	

Note: The asterisks ***, **, * indicate statistical significance at 1%, 5% and 10%, respectively.

Source: Own elaboration (software: Eviews12)

Table 7 presents the criteria for information, specifically focusing on the exclusion of autocorrelation in serial residues. In this context, the information criteria LR are used, specifically the sequential modified LR test statistic, with each test conducted at a significance level of 5%. The acronym FPE stands for Final Prediction Error. The Akaike information criterion (AIC) was used to determine the most effective number of lags, which was found to be 8 days. Table 8 shows the results of the VAR Residual Serial Correlation LM tests. It is seen that the test confirms the lack of autocorrelation with a lag of 9 days, therefore validating the VAR Lag Order Selection Criteria at 8 lags.

Table 7. VAR Lag Order Selection Criteria for the Stress Subperiod

Lag	LogL	LR	FPE	AIC	SC	HQ
0	13489.36	NA	1.39e-16	-22.32511	-22.30401	-22.31716
1	13877.91	773.2397	7.60e-17	-22.92701	-22.80044*	-22.87935
2	13928.17	99.58925	7.28e-17	-22.96882	-22.73677	-22.88143*
3	13940.83	24.98809	7.43e-17	-22.94839	-22.61086	-22.82129
4	13961.24	40.12175	7.49e-17	-22.94080	-22.49779	-22.77398
5	13979.26	35.26238	7.58e-17	-22.92924	-22.38075	-22.72270
6	14007.93	55.87074	7.53e-17	-22.93532	-22.28135	-22.68906
7	14059.80	100.6414	7.21e-17	-22.97980	-22.22036	-22.69382
8	14085.40	49.46333*	7.20e-17*	-22.98080*	-22.11587	-22.65509
9	14098.12	24.47816	7.35e-17	-22.96047	-21.99007	-22.59505
10	14105.74	14.58605	7.56e-17	-22.93169	-21.85581	-22.52654

Notes: * Indicates the lag order selected by the criterion. LR: sequential modified LR test statistic (each test at 5% level). FPE: Final prediction error. AIC: Akaike information criterion. SC: Schwarz information criterion. HQ: Hannan-Quinn information criterion.

Source: Own elaboration (software: Eviews12)

Table 8. VAR Residual Serial Correlation LM tests for the Stress subperiod

Lag	LRE* stat	df	Prob.	Rao F-stat	df	Prob.
1	26.35993	25	0.3886	1.054805	(25, 4310.7)	0.3886
2	14.06282	25	0.9606	0.561930	(25, 4310.7)	0.9606
3	15.81690	25	0.9202	0.632148	(25, 4310.7)	0.9202
4	16.64825	25	0.8942	0.665439	(25, 4310.7)	0.8942
5	25.24499	25	0.4487	1.010060	(25, 4310.7)	0.4487
6	42.57102	25	0.0156	1.706701	(25, 4310.7)	0.0156
7	29.25959	25	0.2532	1.171230	(25, 4310.7)	0.2532
8	34.81122	25	0.0917	1.394352	(25, 4310.7)	0.0917
9	25.81908	25	0.4173	1.033098	(25, 4310.7)	0.4173

Source: Own elaboration (software: Eviews12)

The findings of the VAR Granger Causality/Block Exogeneity Wald test for the Stress subperiod are shown in Table 9. Based on the results, we verified that there are 15 co-movements (out of 20 possible) between the Brent Crude Spot (BRENT), Euro Stoxx Oil & Gas (EUSTOXX), Nasdaq Clean Edge Green Energy (CELS), WilderHill Clean Energy (ECO), and Clean Energy Fuels (CLNE) stock indexes. These co-movements were observed during the period from January 2020 to May 2023. The stock index that has the most influence on its peers is EUSTOXX, which affects all 4 indexes studied (4 out of 4 possibilities). The BRENT stock index influences 3 indexes, notably EUSTOXX, CELS, and ECO. Similarly, the CLNE index is responsible for 3 co-movements: EUROSTOXX, CELS, and ECO. In the same vein, the ECO index causes 3 indexes: CLNE, EUSTOXX, and ECO. Finally, CELS influences 2 stock indexes: CLNE and EUSOTXX. When examining the stock indexes that are most influenced by their peers, we find that the EUROSTOXX (4), CELS (4), ECO (3), CLNE (3), and BRENT (1) stand out as the most caused. The implications of these results raise doubts about the viability of achieving portfolio diversity through the simultaneous inclusion of clean and dirty energy stock indexes. When comparing the two subperiods, it is observed that the number of movements increased from 9 in the Quiet period to 15 in the Stress period, for a total of 20 possible movements. The study results indicate a partial acceptance of the research response, whereby it is seen that co-movements have experienced an increase. However, it is noted that portfolio diversification was no longer efficient during a time characterized by seeming quietness in international markets.

Table 9. Granger causality/Block Exogeneity Wald tests, of the financial markets under analysis, in the Stress subperiod

	BRENT	CLNE	EUSTOXX	CELS	ECO
BRENT		1.32278	4.28153***	1.38253	1.14790
CLNE	0.44257		3.16329***	2.09064**	27.9887***
EUSTOXX	14.5575***	5.16950***		5.27271***	11.0434***
CELS	1.70074*	1.77561*	2.64759***		74.1120***
ECO	3.43269***	1.69712*	7.31964***	1.23737	

Note: The asterisks ***, **, * indicate statistical significance at 1%, 5% and 10%, respectively.

Source: Own elaboration (software: Eviews12)

The identified significant co-movements between clean energy and dirty energy stock indexes hold crucial implications for sustainable development. In the context of sustainable and environmentally conscious investment strategies, the observed correlations can impact the effectiveness of portfolio diversification. If the movements of clean energy stocks closely mirror those of dirty energy stocks, it may limit the potential for investors to diversify their portfolios and allocate resources effectively to sustainable alternatives. This finding is significant for sustainable development goals as it raises questions about the resilience and independence of clean energy investments in the face of broader market trends, particularly those associated with conventional and non-sustainable energy sources. Sustainable development often involves shifting away from traditional, environmentally harmful practices, and understanding the dynamics between clean and dirty energy markets is vital for investors, policymakers, and businesses aiming to contribute to sustainable economic growth and environmental protection. These findings have significant implications for players involved in operating in markets of this kind. This is particularly relevant when considering the inherent difficulty of achieving portfolio diversification in light of the unique risks and dynamics associated with these sectors.

5. CONCLUSION

The study examines the impact of 2020 and 2022 events on the co-movements between clean and dirty energy stock indexes, in particular the Brent Crude Spot (BRENT), Euro Stoxx Oil & Gas (EUSTOXX), Nasdaq Clean Edge Green Energy (CELS), WilderHill Clean Energy (ECO), and Clean Energy Fuels (CLNE) stock indexes, from May 3, 2018, to May 2, 2023. The objective of the study was to examine if the occurrences in 2020 and 2022 led to heightened co-movements between clean and dirty energy stock indexes, perhaps posing a challenge to portfolio diversification. The findings show the existence of 9 significant shocks during the tranquil period, which calls into doubt the implementation of the portfolio diversification hypothesis since the shocks are unidirectional and bidirectional between the indexes studied. During the time span, which includes the events of 2020 and 2022, it becomes evident that the magnitude of shocks has increased significantly, rising from 9 to 15 on a scale of 20. The study results show a partial acceptance of the research question, whereby it is seen that co-movements have experienced an increase. However, it is noted that portfolio diversification ceased to be efficient during a time characterized by seeming stability in international markets. The findings of this study resonate with the growing imperative of sustainability in the global energy landscape. As the world increasingly grapples with the challenges posed by climate change and the urgent need for cleaner energy alternatives, the heightened co-movements observed between clean and dirty energy stock indexes underscore a pivotal intersection between financial markets and sustainable development goals. This interplay brings forth a crucial consideration for investors, policymakers,

and market participants involved in shaping the trajectory of financial energy markets. Traditional portfolio diversification strategies face skepticism in the face of significant shocks, raising questions about their efficacy during seemingly stable periods. In this context, the study not only sheds light on the complexities of financial markets but also emphasizes the importance of aligning investment strategies with sustainability objectives. Acknowledging these challenges presents an opportunity for stakeholders to adapt their approaches and regulations, fostering the advancement of measures that bolster the resilience and sustainability of clean energy stock indexes. By doing so, the financial sector can play a transformative role in advancing sustainable development goals, ensuring a harmonious coexistence between economic growth and environmental responsibility.

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Interregional Analysis of Energy Consumption and Sustainable Development in Morocco

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Abstract: *This article presents a multi-regional assessment of energy consumption optimization in Morocco using an inter-regional input-output model in 2019. It aims to present a theoretical analysis of energy optimization and sustainable development models. The study results reveal that different regions of Morocco face distinct challenges in energy consumption and that certain sectors such as oil refining and energy products, electricity and water, as well as transportation, have the highest energy consumption multipliers, suggesting that investment in renewable energy sources and energy efficiency initiatives are essential to reducing energy consumption in the long term and helping Morocco to achieve its energy efficiency objectives.*

1. INTRODUCTION

Morocco has committed to a long-term goal of reducing greenhouse gas emissions in the energy sector by 45.5% by 2030 as part of its effort to create an environmentally friendly economy (Fragkos, 2023). To achieve this, the country is focusing on increasing efficiency measures and adopting clean technologies, particularly in the electricity and water sectors. As Morocco aims to ultimately achieve a zero-emission economy, it is crucial to consider the potential implications of new energy scenarios. In addition to environmental benefits, such scenarios could also stimulate economic growth and job creation (Boulakhbar et al., 2020).

To gain a comprehensive understanding of future energy consumption trends in Morocco and assess the social, economic, and environmental impacts of the electricity sector, a multi-sectoral and multi-regional assessment using quantitative tools is necessary (Dettner & Blohm, 2021). This assessment should utilize input-output analysis and connect bottom-up and top-down models to link energy system models with macroeconomic models. By doing so, a feedback effect between energy cost and energy service needs can be included in the analysis (Rocco et al., 2018).

This article aims to present the theoretical framework and findings of a multisectoral and multiregional evaluation of energy consumption optimization in Morocco. The first step is to define the interregional input-output model and explain why this methodology was chosen. Then, the structural indicators to be used in the assessment will be introduced. The ultimate goal is to provide a comprehensive theoretical analysis of energy optimization models and the sustainable development of Moroccan energy resources. The decision to adopt a multisectoral and multiregional approach to evaluate energy consumption optimization in Morocco using this model is

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largely motivated by previous studies that have integrated energy system models with macroeconomics to achieve optimal energy consumption and balance energy cost and demand.

The Ministry of Economy and Finance and Policy Center for the New South's 2020 report titled "Structural analysis of short-term economic scenarios for Morocco: a multi-sectoral and multi-regional approach" serves as the primary justification for using the interregional input-output model methodology to analyze energy consumption and its impact on the Moroccan economy. This report provides reliable information and methodological approaches on the potential short-term effects of different financing plans aimed at mitigating the consequences of the COVID-19 crisis in terms of economic growth, job creation, inclusion, and long-term sustainability at the regional level (Mohammed et al., 2022).

In addition to this report, several studies published in indexed journals support the rationale for this methodology and highlight its advantages and disadvantages, as well as the results of the ensuing discussion. Moreover, the justification for this methodology is strengthened by referring to various studies published in indexed journals from different countries. These studies highlight the significance of adopting this methodology and bring to light its advantages, disadvantages, and the outcomes of the ensuing discussions.

Furthermore, Bekhet et al. (2016) conducted a study on the energy consumption and performance of Malaysia's manufacturing sectors during the 2008-2009 global financial crisis using the output multiplier approach based on the input-output model. They used two Malaysian input-output tables from 2005 and 2010 and found significant changes in the output multipliers of the manufacturing sectors between these two years. The energy and manufacturing sectors' output multipliers experienced a decline during the global financial crisis due to the export-oriented industries' downturn during that period. They concluded that good planning in the manufacturing sector is crucial to reducing the high dependence on imports, skilled labor shortages, lack of competitiveness, and limited indigenous technological capacities, which have contributed to the decline in energy consumption. This study highlights the importance of using the input-output model to analyze energy consumption and sectoral performance during economic crises (Bekhet et al., 2016).

Otherwise, Wen et al. (2020) conducted a study on the energy efficiency of China's construction industry at the provincial level. They used a combination of a multi-regional input-output model and data envelopment analysis. The results of the study indicate that the majority of provincial building sectors are energy inefficient, and the level of regional economic development is strongly associated with energy efficiency performance. While the scale efficiency in the regional construction sectors is relatively high, the technical aspects are insufficient. The study also reveals that interregional energy allocation is more efficient than the energy structure. The authors attribute the inefficient use of dirty and clean energy to the lack of instruments that facilitate clean production processes in the construction industry. To tackle these issues, the authors propose several government measures and market-oriented strategies from institutional, technical, and managerial perspectives.

To conclude, the article is organized as follows: Section 2 introduces the interregional input-output model. Section 3 gives an overview of the data used. Section 4 presents the findings of the evaluation, and Section 5 discusses the conclusions and potential directions for future research.

2. THE INTERREGIONAL INPUT-OUTPUT MODEL

The origin of input-output analysis can be traced back to the early 20th century when Wassily Leontief made significant contributions to the field (Leontief, 1936). Today, the input-output model is widely recognized as one of the most important methodological tools for economic analysis, and its applications have expanded to various fields (Towa et al., 2020).

TES serves as the foundation for more complex models like the Social Accounting Matrix (SAM), which incorporates information on economic agents, creating multipliers and developing macroeconomic models (Feto et al., 2023). SAM is also essential for Computable General Equilibrium (CGE) models, which evaluate interdependencies between sectors and the behavior of different economic agents to assess alternative scenarios arising from shocks affecting an economy (Kimuli et al., 2022).

The input-output methodology draws from several sources such as economic censuses, household income, and expenditure surveys (Wang et al., 2023). However, the national accounts of each country remain the primary source of information from which three tables are generated: the supply table, the use table, and the symmetrical tables, which include the TES. The TES is a two-way matrix providing the composition of the gross value of production in terms of expenses and revenues. It comprises the intermediate input matrix (Z), the final demand matrix (y), and the value-added matrix (VA) (Haddad & Hewings, 2004).

Moreover, the interregional input-output model relies on an interregional input-output table for 2019 divided into 12 regions and 20 branches of activity. This model is calibrated to calculate several regional and sectorial structural indicators, enabling a better understanding of the impact of optimizing energy consumption on economic competitiveness and sustainable development in Morocco under the National Energy Strategy prioritizing efficiency. The indicators will aid decision-makers in assessing the multiple effects of energy strategies and identifying various scenarios to guide energy policy orientation.

The conventional form of the input-output model, as described by Miller and Blair (2009) is presented below:

$$\mathbf{x} = \mathbf{A}\mathbf{x} + \mathbf{f} \tag{1}$$

And

$$\mathbf{X} = (1-\mathbf{A})^{-1}\mathbf{f} = \mathbf{BF} \tag{2}$$

where **x** and **f** are vectors representing gross output and final demand, respectively. **A** is the matrix of technical input-output coefficients, denoted as $\boldsymbol{a}_{ij}$, which is defined as the quantity of product ***i*** required per unit of product ***j*** (in monetary terms), where $\boldsymbol{i}, \boldsymbol{j} = \boldsymbol{j}, \ldots, \boldsymbol{n}$. The matrix **B** is the inverse of the Leontief matrix.

By using equation (2), we are able to compute the gross production levels required to fulfill specific levels of final demand. Additionally, we can utilize this equation to approximate the impacts of augmenting sectoral gross output on energy consumption. To achieve this, we need to multiply the economy's gross production vector, **x**, with a diagonal matrix, **V**, which consists

of the specific coefficients related to the particular activity examined, along with the anticipated outcomes.

$$\Delta \mathbf{x} = \mathbf{B}\Delta \mathbf{f} \tag{3}$$

Similarly,

$$\Delta \mathbf{v} = \widehat{\mathbf{V}}\Delta \mathbf{x} = \widehat{\mathbf{V}}\mathbf{B}\Delta \mathbf{f} \tag{4}$$

Or; $\Delta \mathbf{v}$ is a vector of results containing the impacts on alternative dimensions. By taking equations (1) and (2) into account in an inter-regional context with **r** regions, we can express the equation as follows:

$$\mathbf{x} = \begin{bmatrix} \mathbf{x}^1 \\ \vdots \\ \mathbf{x}^{\mathrm{R}} \end{bmatrix}; \mathbf{A} = \begin{bmatrix} \mathbf{A}^{11} & \cdots & \mathbf{A}^{1\mathrm{R}} \\ \vdots & \ddots & \vdots \\ \mathbf{A}^{\mathrm{R}1} & \cdots & \mathbf{A}^{\mathrm{RR}} \end{bmatrix}; \mathbf{f} = \begin{bmatrix} \mathbf{f}^1 \\ \vdots \\ \mathbf{f}^{\mathrm{R}} \end{bmatrix}; \text{ and } \mathbf{B} = \begin{bmatrix} \mathbf{B}^{11} & \cdots & \mathbf{B}^{1\mathrm{R}} \\ \vdots & \ddots & \vdots \\ \mathbf{B}^{\mathrm{R}1} & \cdots & \mathbf{B}^{\mathrm{RR}} \end{bmatrix} \tag{5}$$

and

$$\begin{aligned} \mathbf{x}^1 &= \mathbf{B}^{11}\mathbf{f}^1 + \cdots + \mathbf{B}^{1\mathrm{R}^{\mathrm{R}}}\mathrm{R} \\ &\vdots \\ \mathbf{x}^{\mathrm{R}} &= \mathbf{B}^{\mathrm{R}1}\mathbf{f}^1 + \cdots + \mathbf{B}^{\mathrm{RR}}\mathbf{f}^{\mathrm{R}} \end{aligned} \tag{6}$$

By using equation (6), we can estimate how changes in final demand components can affect regional and national production. It is evident from equation (6) that a region's production depends on various factors, including direct injections of funds into the region and injections into other regions, based on the level of interregional integration between different regions of the country.

3. DATA AND METHODOLOGY USED

The figure displayed below illustrates the configuration of the interregional input and output flows database, along with additional sectoral data pertaining to energy consumption at the regional level.

		transformation sectors							final demand					total demand
		11	⋯	rn	…	$r1$	⋯	rn						
transformation sectors	11	$\mathbf{Z}_{11}^{11}$	⋯	$\mathbf{Z}_{1n}^{11}$	…	$\mathbf{Z}_{11}^{1r}$	⋯	$\mathbf{Z}_{1n}^{1r}$	$\mathbf{c}_1^{1\bullet}$	$\mathbf{i}_1^{1\bullet}$	$\mathbf{g}_1^{1\bullet}$	$\mathbf{h}_1^{1\bullet}$	$\mathbf{e}_1^{1\bullet}$	x_1^1
	⋮	⋮	⋱	⋮	…	⋮	⋱	⋮	⋮	⋮	⋮	⋮	⋮	⋮
	$1n$	$\mathbf{Z}_{n1}^{11}$	⋯	$\mathbf{Z}_{nn}^{11}$	…	$\mathbf{Z}_{n1}^{1r}$	⋯	$\mathbf{Z}_{nn}^{1r}$	$\mathbf{c}_n^{1\bullet}$	$\mathbf{i}_n^{1\bullet}$	$\mathbf{g}_n^{1\bullet}$	$\mathbf{h}_n^{1\bullet}$	$\mathbf{e}_n^{1\bullet}$	x_n^1
	⋮	⋮	⋱	⋮	…	⋮	⋱	⋮	⋮	⋮	⋮	⋮	⋮	⋮
	$r1$	$\mathbf{Z}_{11}^{r1}$	⋯	$\mathbf{Z}_{1n}^{r1}$	…	$\mathbf{Z}_{11}^{rr}$	⋯	$\mathbf{Z}_{1n}^{rr}$	$\mathbf{c}_1^{r\bullet}$	$\mathbf{i}_1^{r\bullet}$	$\mathbf{g}_1^{r\bullet}$	$\mathbf{h}_1^{r\bullet}$	$\mathbf{e}_1^{r\bullet}$	x_1^r
	⋮	⋮	⋱	⋮	…	⋮	⋱	⋮	⋮	⋮	⋮	⋮	⋮	⋮
	rn	$\mathbf{Z}_{n1}^{r1}$	⋯	$\mathbf{Z}_{nn}^{r1}$	…	$\mathbf{Z}_{n1}^{rr}$	⋯	$\mathbf{Z}_{nn}^{rr}$	$\mathbf{c}_n^{r\bullet}$	$\mathbf{i}_n^{r\bullet}$	$\mathbf{g}_n^{r\bullet}$	$\mathbf{h}_n^{r\bullet}$	$\mathbf{e}_n^{r\bullet}$	x_n^r
Import		m_1^1	⋯	m_n^1	…	m_1^r	⋯	m_n^r	$m_c^\bullet$	$m_i^\bullet$	$m_g^\bullet$		$m_e^\bullet$	m
indirect tax		t_1^1	⋯	t_n^1	…	t_1^r	⋯	t_n^r	$t_c^\bullet$	$t_i^\bullet$	$t_g^\bullet$		$t_e^\bullet$	t
add values		n_1^1	⋯	n_n^1	…	n_1^r	⋯	n_n^r						n
total expenses		x_1^1	⋯	x_n^1	…	x_1^r	⋯	x_n^r	c	i	g	h	e	
employment	1	L_{11}^1	⋯	L_{1n}^1	…	L_{11}^r	⋯	L_{1n}^r						L_1
	⋮		⋮		…		⋮							⋮
	q	L_{q1}^1	⋯	L_{qn}^1	…	L_{q1}^r	⋯	L_{qn}^r						L_q
energy consumption		$ENRG_{q1}^1$	⋯	$ENRG_{qn}^1$	…	$ENRG_{q1}^r$	⋯	$ENRG_{qn}^r$						$ENRG$

Figure 1. The configuration of the interregional input and output flows database

Source: Own research

- z_{ij}^{rs}, with $i, j = 1, \ldots, n$ and $r, s = 1, \ldots, r$ denotes inter-industry sales from industry i of region r to industry j in region s;
- m_i^s and t_i^s with $i = 1, \ldots, n, c, i. g, h, e$ represent, respectively, imports and indirect taxes paid in region s;
- n_j^s, with $j = 1, \ldots, n$ and $s = 1, \ldots, r$ denotes payments made by sectors for all value-added items in region s;
- $c_i^r, i_i^r, g_i^r, h_i^r e_i^r$ and $i = 1, \ldots, n$ and $r = 1, \ldots, r$ denote regional components of final demand, f_i^r household purchases, investment purchases, government purchases, non-profit institution purchases serving households and exports from region s;
- x_i^r, with $i = 1, \ldots, n$ and and $r = 1, \ldots, r$ is the total sectoral output of region r; L_{ij}^s with $i = 1, \ldots, q$ and $j = 1, \ldots, n$ and $s = 1, \ldots, r$ represents the total number of workers per sector in region s;
- $ENRG_i^s$ with $i = 1, \ldots, n$ and $s = 1, \ldots, r$ represents the total energy consumption by sector i in region s.

To estimate the environmental impacts of the Moroccan economy, we utilize sector coefficients sourced from the Eora database (Lenzen et al., 2013). These coefficients are instrumental in calculating the energy consumption multiplier. With the aid of this database, we can obtain a comprehensive breakdown of energy consumption across various industrial sectors at the national level, specifically for the year 2019.

4. RESULTS

Energy intensity refers to the proportion between the energy consumed by various sectors (Energy consumption) and the production of input-output tables (Value added) (Zhang et al., 2022).

The figure depicted below exhibits the energy consumption intensity coefficient (TJ/GB in GHS million) across different sectors. The majority of the sectors exhibit either zero or insignificant energy consumption intensity coefficients. However, there is one noteworthy exception - the petroleum refining and energy products sector, which possesses an intensity coefficient of 5.27. This finding implies that this sector consumes significantly more energy in comparison to other sectors. Consequently, this sector must adopt a more efficient and sustainable approach towards energy consumption.

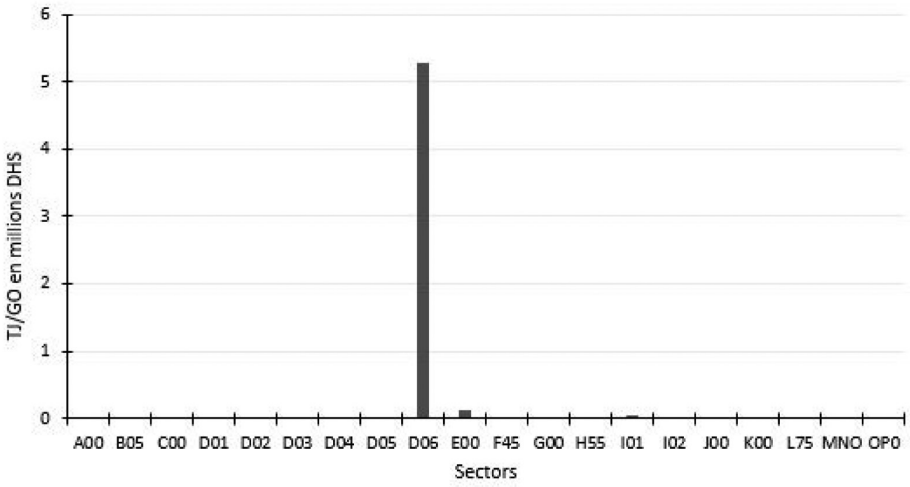

Figure 2. The intensity coefficient of energy consumption by sector in Morocco

Source: Own calculations

For every sector (*j*) in a specific region (*r*), an energy consumption multiplier is established. This multiplier is determined by the combined value of energy consumption across all sectors and regions that are necessary to fulfill a final demand of one dirham in the production of sector j (Yu et al., 2010). Furthermore, the multiplier effect can be separated into two distinct components: intra-regional (internal multiplier) and inter-regional (external multiplier) effects. The internal multiplier represents the product impacts of the sectors in the region where the change in final demand has been initiated, while the external multiplier demonstrates the effects on other regions within the system (inter-regional ripple effects) (White et al., 2018).

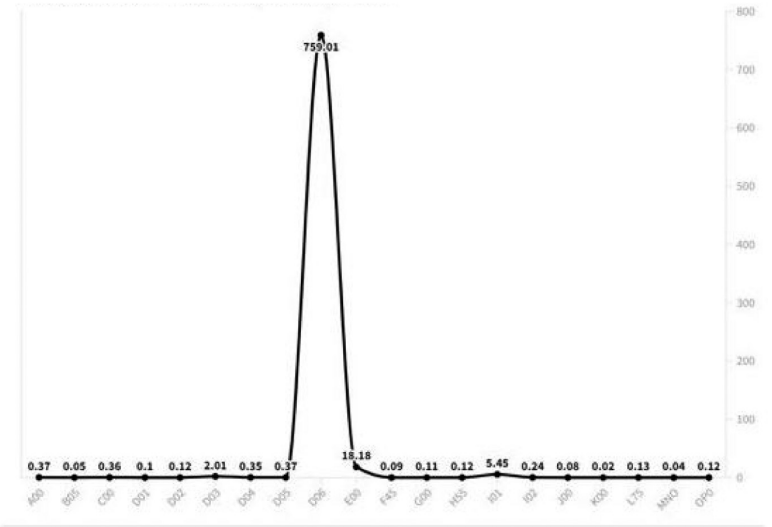

Figure 3. Energy consumption multiplier in 2019 by sector

Source: Own calculations

Regarding the energy consumption levels of each sector in 2019, the aforementioned figure indicates that sectors D06 (oil refining and other energy products), E00 (Electricity and water), and I01 (transport) possess the highest energy consumption multipliers, which are 759.01, 18.18, and 5.44 TJ/GB in millions DHS, respectively. This finding highlights that these sectors are significantly energy-intensive. Conversely, sectors MNO, K00, F45, and B05 exhibit the lowest energy consumption multipliers, which are 0.04, 0.09, and 0.05 TJ/GB in millions DHS, respectively. This signifies that these sectors are comparatively more energy-efficient in Morocco.

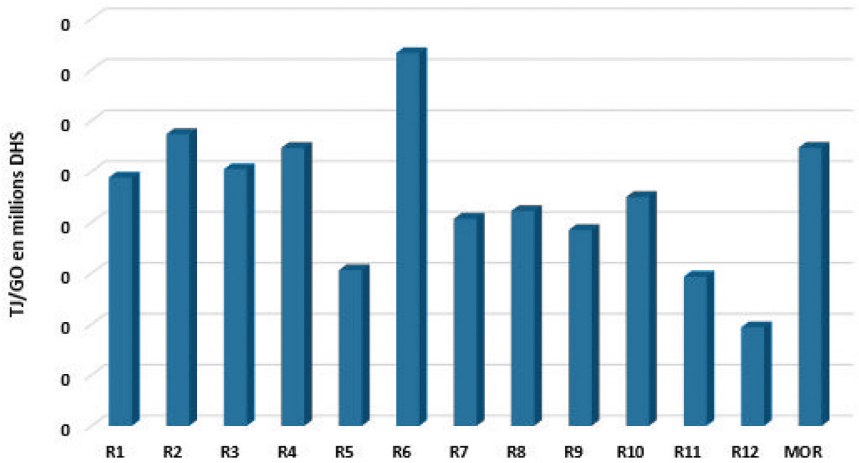

Figure 4. Average energy consumption multiplier by region in 2019

Source: Own calculations

Regarding the regional distribution of the average energy consumption multipliers in 2019 in Morocco, it is evident that these multipliers differ significantly from one region to another. The Grand Casablanca-Settat region holds the highest average multiplier of 0.15 TJ/GB in million DHS, followed by the Oriental region with 0.11 TJ/GB in million DHS. Conversely, the Dakhla-Oued Eddahab region records the lowest average multiplier at 0.04 TJ/GB in millions DHS. This discrepancy in the average energy consumption multipliers across regions highlights the economic inequality that exists between various regions of Morocco. Regions with the highest average multipliers are typically the most industrialized and appealing, while regions with the lowest average multipliers are usually the least industrialized.

The analysis of intra-regional and inter-regional shares is crucial in formulating a rational policy to optimize energy consumption, and examine regional differences, spatial patterns, and dynamic evolution of energy consumption intensity (Hong et al., 2019). This analysis is significant in identifying areas where policy interventions can enhance energy efficiency and reduce energy consumption. It also provides insight into the structural changes, energy and emissions flow within and between regions, enabling intra-regional and inter-regional collaboration to improve energy efficiency (Nejati & Shah, 2023).

To illustrate, the following figure displays the intra-regional and inter-regional shares of the average energy consumption multipliers across 20 sectors in the 12 regions of Morocco. The shares are expressed as percentages, providing an overview of the level of dependence between regions.

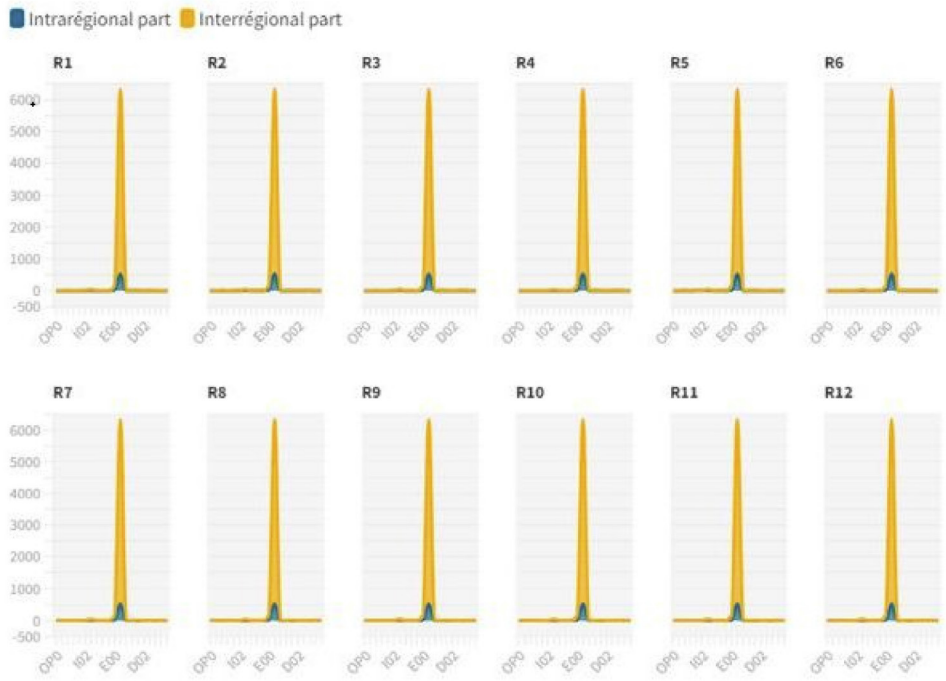

Figure 5. The intra-regional and inter-regional shares of average energy consumption multipliers in 2019

Source: Own calculations

The two energy-consuming sectors are "oil refining and other energy products" and "electricity and water." Furthermore, some regions have a higher interregional distribution, meaning that these regions need more energy consumption than others, perhaps energy audits, energy efficiency labels, and energy standardization will solve this problem due to differences in

economic, technological, demographic, and climatic systems. Alongside these energy efficiency measures, investments in renewable energy such as solar, wind, geothermal, and hydropower are essential to reduce energy consumption in the long term and help Morocco achieve its energy efficiency target.

In summary, the research conducted in this study reveals energy consumption patterns in various Moroccan regions and sectors, providing valuable information for the development of energy efficiency strategies. The study shows that various Moroccan regions face specific challenges in energy consumption and that local authorities can benefit from a well-designed energy advisory program to improve the level of security. Ultimately, this increases per capita access to energy and can contribute to sustainable economic and social development by ensuring energy security and sustainability.

The above data demonstrates the significance of conducting a comprehensive multi-sectorial assessment to optimize energy consumption in Morocco. The analysis of the energy consumption multipliers across different sectors reveals substantial variations. This information can be leveraged to identify potential opportunities to enhance energy efficiency, reduce pollution, and promote sustainable economic growth and development at both national and regional levels. To achieve this, an action plan tailored to each sector can be formulated and implemented, which would help in reducing energy consumption and achieving a more favorable environmental balance. To further examine the multipliers, we will now delve into the structural decomposition analysis (SDA), which helps identify the influence of external factors such as technology, demand, and demographic changes on variations in total energy consumption. This analysis involves both SDA and index decomposition analysis (IDA). The SDA method is particularly useful for estimating the impact of factors based on input-output tables, especially consumption coefficient matrices, and it has been found to offer more advantages than IDA (Zhu et al., 2022).

The figures below show the distribution of energy sources by sector and region in Morocco in 2019. The graph reveals that the main sources of energy are households, exports, investments and the government at 67%. Exports are the second largest, accounting for 28% and 33% of total energy consumption respectively. The latter contribution comes marginally from investment and government, contributing 2% and 5% and 1% and 4% respectively.

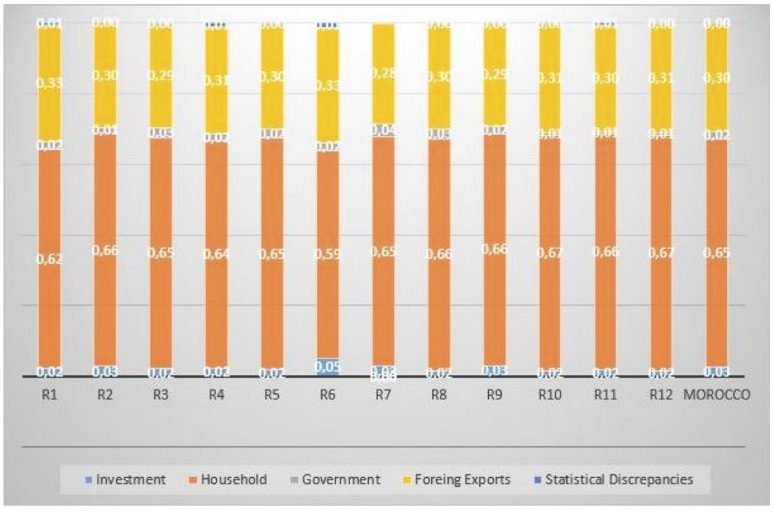

Figure 6. The main sources by sector and by region of energy consumption in Morocco in 2019
Source: Own calculations

On average, households account for 65% of total energy demand in most regions of Morocco, while exports are secondary, contributing on average 30% of total needs, while investments represent only 3% of total energy demand. These findings highlight the need for active measures, particularly in households, to reduce energy consumption through the adoption of energy-saving technologies and environmentally friendly practices. Energy consumption implementing efficiency measures and encouraging users to invest in environmentally friendly technologies can be costly. Additionally, investments in renewable energy and energy-efficient technologies can help reduce energy consumption and greenhouse gas emissions.

5. CONCLUSION

The article analyzes the importance of thinking about the capacity implications of the latest eventualities of new energy scenarios while Morocco ultimately aims to achieve a zero-emission economy. To benefit from comprehensive expertise on future energy supply trends in Morocco and assess the social, economic and environmental impacts of energy consumption, a multi-sector and multi-regional assessment using quantitative tools is necessary. In addition, the article presented the theoretical framework and results of a multi-sector and multi-regional evaluation of the optimization of energy consumption in Morocco.

The initial step involved defining the interregional input-output model and explaining the rationale behind choosing this methodology. Following that, the structural indicators used in the assessment were introduced. The ultimate objective was to offer a comprehensive theoretical analysis of energy optimization and sustainable development models for Moroccan energy resources. Furthermore, the article highlights investment in renewable energy sources such as solar, wind, geothermal, and hydroelectric power, as well as energy efficiency initiatives such as energy audits and energy labels. Energy efficiency and energy standards are essential to reduce energy consumption in the long term and help Morocco achieve its goals. Finally, the analysis carried out in this study highlights the level of energy consumption in various regions and sectors of Morocco, providing information for developing energy consumption optimization strategies.

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Green Finance for Sustainable Development in the Western Balkans

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Abstract: *This paper explores the concept of sustainable development and green finance, their importance, and how they are related with a focus on Western Balkans perspectives.*

The main hypothesis presented is that green finance has the potential to be a key factor in encouraging sustainable development in the Western Balkans because it can contribute to the development of a more resilient and sustainable future for all countries in the region, regardless of their borders or differences in culture or identity.

The author uses a qualitative and quality research approach, using a combination of literature review and empirical data to explore the relationship between sustainable development and green finance. The literature review will involve a comprehensive literature analysis on sustainable development and green finance, including academic sources, institutional reports, case studies, etc. In conclusion, the paper finds that sustainable finance is progressively gaining prominence in Western Balkan countries, aligning with European and global trends.

1. PRESENTATION OF THE SITUATION

Sustainable development is considered the needed model to tackle the societal challenges of the 21st century. Contemporary society faces important challenges, among which the confrontation with global warming, climate change, and its consequences for society and nature itself. Also, the challenge of society to reduce inequality in the possession of resources and income, the distribution and redistribution of resources and income, as well as numerous phenomena that have followed the model of social development concerning resources and income in society, such as poverty reduction, equal opportunities, social justice, exclusion and social inclusion, gender issues, etc. We face the challenges in question at the local, national, regional, and global levels. As we discuss the above challenges, we bring to attention the mobilization of society and its actors to build and apply a development model that also offers solutions in relation to the challenges and consequences of the existing development model. This model is articulated as a model of sustainable development (UN, 1992).

Sustainable Development is defined as a model of development, through which contemporary society faces current and future challenges in its interaction with nature such as global warming, climate change, and its consequences. The first argument through which a sustainable model of development tackles these changes is the global warming phenomenon.

The term "global warming" describes the gradual rise in Earth's average temperature brought on by human activities like burning fossil fuels and deforestation, which cause greenhouse gases to be released into the atmosphere. The climate system is changing significantly as a result of

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this temperature rise, including changes to precipitation patterns, a rise in sea level, and more frequent and intense heatwaves, droughts, and extreme weather events (NASA, 2021). The direct result of global warming that society must address is climate change. The phrase "climate change" is an all-encompassing phrase that describes many modifications that the Earth's climate system is undergoing, such as variations in temperature, precipitation, sea level, ocean acidity, and the frequency and intensity of extreme weather events (IPCC, 2021).

The increase in global temperatures is causing more frequent and intense heatwaves, droughts, wildfires, and hurricanes as a result of climate change and global warming. The social and economic consequences of climate change are already causing the most vulnerable populations significant suffering (NASA, 2021). Food and water shortages, forced relocation due to climate change and extreme weather, an increased risk of disease outbreaks, and detrimental effects on mental health and well-being are just a few of these consequences (IPCC, 2021). Low-lying and coastal regions, arid and semi-arid regions, and areas with high temperatures and humidity are particularly vulnerable to the effects of climate change, which are not evenly distributed throughout the world (IPCC, 2021). The global community has set a goal of keeping the Earth's temperature increase to 1.5°C above pre-industrial levels to afford the effects of global warming. It will be necessary to drastically reduce greenhouse gas emissions and move quickly toward a low-carbon economy to meet this objective (UNFCCC, 2015). Ecosystems are being severely disrupted by rising temperatures and shifting weather patterns, and many species are finding it difficult to adapt.

This increase in temperature due to human activity is causing a range of climate changes and social consequences worldwide, such as the temperature rise, as the global temperature has increased by 1.1°C since the pre-industrial era and is projected to rise by 1.5°C above pre-industrial levels by 2040-2050 without drastic action (IPCC, 2021). Climate change is causing also extreme weather events with more frequent and severe heatwaves, droughts, floods, hurricanes, and wildfires. For example, the 2021 Texas winter storm resulted in over 4 million power outages and at least 210 deaths (NOAA, 2021). Another significant effect is the rise of the sea level, where the sea level has risen by 20cm since the pre-industrial era and is projected to rise by 30-110cm by 2100. This will cause more frequent and severe coastal flooding and erosion (IPCC, 2021). Ecosystem impacts are also very evident as a result of the climate since the change of weather is causing habitat loss, biodiversity decline, and ecosystem disruptions. For example, coral reefs are under threat due to ocean warming and acidification (IPCC, 2021). The health effects of climate change are visible, including worsening air pollution, waterborne illnesses, food insecurity, and mental health problems. According to data from the World Health Organization, air pollution, for instance, contributed to 7 million premature deaths globally in 2019 (WHO, 2021). In addition, infrastructure, agriculture, and tourism losses brought on by climate change are having a significant negative economic impact. For instance, Hurricane Katrina in 2005 resulted in $161 billion in damages (NOAA, 2021).

Facing society with the above-mentioned challenges of the century on global warming and the reduction of social inequalities, as well as the application of the model of sustainable development, requires financial resources, beyond policies, strategies, and programs of development projects and the application of the model in question. Green Finance is considered an instrument and tool to support and apply the model in question, and the objectives articulated in global summits, among which the UN Summit for SD Goal 2030, has been achieved. In these challenges, the Western Balkans was undoubtedly included as a region (UN, 2015), with an eye toward the EU standard, considered vulnerable due to the composition of the political and social map dictated by its turbulent and troubled historical past.

2. LITERATURE REVIEW ON SUSTAINABLE DEVELOPMENT AND GREEN FINANCE

Scientific literature suggests that sustainable development and green finance are two interconnected concepts that are becoming increasingly important in the world of finance and business. The mobilization of financial resources to support sustainable economic growth, lower carbon emissions, and safeguard the environment is known as "green finance." Green finance, according to the United Nations Environment Program (UNEP), is the practice of allocating money to environmentally responsible projects.

The financial flows that support sustainable economic growth while lowering greenhouse gas emissions and minimizing environmental degradation are referred to as "green finance" (UNEP, 2021a). As a crucial tool for advancing sustainable development today, green finance has emerged (Smith, 2020). Meanwhile, businesses and investors alike are realizing the value of adopting sustainable finance principles (UNEP, 2021b). To achieve the Sustainable Development Goals, sustainable finance involves incorporating environmental, social, and governance considerations into financial decision-making (UNEP, 2021b). Through the integration of environmental, social, and governance (ESG) factors, sustainable finance can help to promote long-term value creation and contribute to the achievement of the Sustainable Development Goals (SDGs) (UNEP, 2018a). The integration of environmental, social, and governance (ESG) factors in investment decision-making is essential for achieving sustainable development" (Aldowaish et al., 2022).

According to the literature, sustainable development principles can be attained by incorporating ESG factors into investment decision-making, which is another way to achieve sustainable development goals (UNEP, 2018b). United Nations Framework Convention on Climate Change (UNFCCC, 2015) states that the Paris Agreement, which was signed in 2015 by 195 nations, aims to keep global warming to well below 2 degrees Celsius above pre-industrial levels and work toward 1.5 degrees Celsius (PV). Significant investments in green finance and sustainable development programs will be required to meet this objective. According to Jones and Lee (2019), practical evidence suggests that spending on renewable energy has the potential to make a significant contribution to the goals of sustainable development. According to the sources mentioned above, the topics of green finance and sustainable development are crucial to the study of economics and finance. By providing funding for environmentally friendly projects, as Berg et al. (2019) demonstrate, green finance can be a critical component of supporting sustainable development. UNEP emphasized this point as well, citing how important sustainable development is to the long-term health of the planet and how green finance can help to ensure that it is accomplished (UNEP, 2018c). Beyond the other arguments, the development of green finance has the potential to drive the transition to a low-carbon economy, which is critical for mitigating climate change" (Baker et al., 2018) since applying principles of sustainable finance can help to guide investors towards investments that are environmentally and socially responsible (OECD, 2020). Considering the cited references, it can be argued that green finance has become an important tool for promoting sustainable development. Research has shown that investing in green infrastructure can lead to significant economic benefits, including job creation and increased productivity (World Bank, 2019). This demonstrates that green finance is not only beneficial for the environment but also for the economy and society as a whole. Also, for other authors green finance is a critical tool for supporting sustainable development (Gao et al., 2021). Green finance can lessen the effects of climate change by making investments in projects that promote environmental protection. Governments and corporate actors still need to finance the green economy. Given the previously mentioned justifications, allocating investments to green finance for sustainable development requires the

establishment of efficient institutionalized legislative and administrative frameworks. The issuance of green bonds has reached record levels in recent years, making them a popular instrument in the green finance market (Climate Bonds Initiative, 2021). These bonds are used to finance environmentally friendly projects such as renewable energy and energy efficiency initiatives (Zhang et al., 2020). It's evident also that sustainable finance initiatives such as green bonds and social impact bonds are gaining traction in the global financial market (UNEP, 2018c). There are many cases where the green bond market has grown significantly in recent years as a means of financing environmentally sustainable projects.

3. DISCUSSIONS AND FINDINGS

The first question addressed consists in the following argument: How can green finance contribute to regional Sustainable Development? The UN Sustainable Development Goal (SDG) 2030 Goal 9.1 calls on governments and society to: promote economic growth and human well-being, and develop high-quality, dependable, sustainable, and resilient infrastructure, including regional and cross-border infrastructure, with a focus on ensuring equitable and affordable access for all (SDG Goal 9.1). Particularly in the most vulnerable and impoverished nations, where domestic resources are scarce, international public finance plays a crucial role in completing national efforts to mobilize public resources. The Sustainable Development Goals (SDGs) by the UN (2015) set forth demand: Ensure that everyone has access to affordable, reliable, environmentally friendly, and modern energy by strengthening the implementation and revitalization of the Global Partnership for Sustainable Development (UNSD Goal 17). (UNSD Goal 7) Encourage Sustainable and Inclusive Economic Growth, full and profitable employment and decent work for all (UNSD Goal 8) build reliable Infrastructure, promote inclusive and Sustainable industrialization, and foster Innovation (UNSD Goal 9). Taking into consideration all the above mention we can conclude that driving the Western Balkans development model towards a sustainable model with green and Sustainable Financing generates benefits to the society and nature, to the present and the future of society.

Another topic for our discussion is based on the argument: How can green finance support a Sustainable EU perspective for the Western Balkan countries? Green investments, according to the European Commission (2018), "reduce carbon emissions and pollution, improve energy and resource efficiency, and prevent the loss of biodiversity and ecosystem services." Several financial instruments, such as green bonds, green loans, and sustainable investment funds for the Western Balkans, can be used to implement green finance (Bocken et al., 2021). With the adoption of the Sustainable Finance Action Plan in 2018, the EU significantly increased its efforts to promote sustainable finance to achieve a sustainable future (European Commission, 2018). New financial instruments, like green bonds and sustainability-linked loans, that are intended to encourage investment in sustainable projects are being developed as a result of the EU's sustainable finance agenda (EIB, 2021). The EU Taxonomy Regulation, which establishes a framework for determining whether an economic activity is environmentally sustainable and seeks to direct investments towards sustainable projects, was adopted by the EU to promote the achievement of the SD goals (European Parliament, 2020). The sustainable finance taxonomy that the EU has established aims to create a common language for investors to identify environmentally sustainable economic activities, as stated in the EU Parliament's declaration (European Parliament, 2021). The European Green Deal is a roadmap for achieving this goal through a variety of strategies to help the EU become a global leader in its commitment to becoming climate-neutral by 2050. Moreover, the European Green Deal serves as a guide to achieving this

objective through a variety of policy measures, such as sustainable finance (European Commission, 2018). According to EIB, the EU's Green Deal is a comprehensive strategy with a strong emphasis on sustainable finance to transform the EU into a climate-neutral economy by 2050 (European Investment Bank, 2021). The EU has been at the forefront of efforts to promote green finance and sustainable development by taking these actions (European Commission, 2021). According to a report by the European Bank for Reconstruction and Development (EBRD), green finance is becoming increasingly important in the Western Balkans (EBRD, 2021). EU is at the forefront of the Western Balkans toward a sustainable future. A concrete action is the Green Agenda for the Western Balkans, a joint initiative between the EU and the Western Balkan countries (EBRD, 2020). It aims to support the transition to a low-carbon economy in the region, for green investments in the Western Balkans, as well as policy reforms to promote sustainable growth (COM, 2020). In recent years, financial institutions have been actively promoting green finance in the Western Balkans, according to official data and sources. This activity is intended to support the region's transition to a low-carbon, climate-resilient economy and to help the EU meet its target of reducing greenhouse gas emissions by 55% by 2030. For instance, the EIB started the Green Finance Initiative (GFI) to encourage sustainable development in the Western Balkans (EIB, 2020). The initiative includes a range of activities, such as promoting energy efficiency and renewable energy, improving water and waste management, supporting sustainable transport and urban development, and increasing access to green finance for businesses and households in the Western Balkans. EIB also is working with local banks and financial institutions to develop green finance products that can support sustainable investments such as providing credit lines, guarantees, and other financial instruments to encourage investment in renewable energy, energy efficiency, and sustainable transport. It is evident also that there are present joint initiatives among financial stakeholders aiming to invest in sustainable and green finance in the Western Balkans. As an example, we can bring to attention the Western Balkans Sustainable Energy Direct Financing Facility, a joint initiative between the EIB and the European Bank for Reconstruction and Development (EBRD). This program aims to offer households and businesses in the Western Balkans direct financing for renewable energy investments. The creation of a classification system, green bond standards, and guidelines for incorporating environmental, social, and governance considerations into investment decision-making are all part of the EU's sustainable finance agenda (European Central Bank, 2021). Kovacevic and Radovic-Markovic (2021) assert that the Western Balkans have difficulty obtaining green financing due to its scarcity and high cost. Through the financing of renewable energy, green finance helps to advance sustainable development. Solar, wind, and other renewable energy sources are essential for lowering carbon emissions and addressing climate change. By providing financial support for renewable energy projects, green finance can help to accelerate the transition to a low-carbon economy.

Another way that green finance promotes sustainable development is through the financing of sustainable infrastructure. Infrastructure projects such as public transportation systems, green buildings, and sustainable water and waste management systems are essential for promoting sustainable development. By providing financial support for sustainable infrastructure projects, green finance can help to promote economic growth, reduce carbon emissions, and protect the environment. Through the funding of environmentally friendly forestry and agriculture, green finance can further the cause of sustainable development. Sustainable farming and forestry methods can improve soil health, encourage biodiversity, and lower carbon emissions. By providing financial support for sustainable agriculture and forestry projects, green finance can help to promote sustainable land use and protect the environment.

Regional Cooperation Council (RCC) has been very active in contributing to EU SD initiatives. By endorsing the Green Agenda for the Western Balkans (GAWB) at the Summit in Sofia in 2020 and the GAWB Action Plan at the Brdo Summit in October 2021, the region has also committed to achieving carbon neutrality by 2050 and aligning with the key components of the European Green Deal, in line with the EU's ambition to become climate-neutral by 2050 (RCC, 2021). World Bank also considers that the adoption of sustainable practices in the region has been hindered by a lack of awareness and education (World Bank, 2019). Intersectional analysis by the World Resource Institute (WRI, 2021) examines the role of climate finance in addressing gender inequalities, particularly in developing countries. These considerations are very important for Western Balkans taking an intersectional approach to climate finance, which considers how gender intersects with other forms of inequality, such as race, class, and geography. The authors of these reports argue that addressing gender inequalities is essential to ensure the effectiveness and sustainability of climate finance interventions. EU aims to create a healthy and well-being society, data coming from the European Environmental Agency shows significant side effects coming from the poisons of PM2.5 in Western Balkan countries (EEA, 2020). The World Bank also has said that green infrastructure supports the creation of new jobs, drives economic growth, and delivers benefits to society (World Bank, 2020). A model of Sustainable development and green finance will benefit the Western Balkans. It is optimistic to see that international financial institutions are driving the process of sustainable development through green finance in Balkan countries. For instance, the EBRD is thinking about funding the Western Balkans Sustainable Energy Direct Financing Facility ("We BSEDFF" or the "Facility") with an additional EUR 50 million, bringing the total commitment to EUR 100 million. The We BSEDFF was initially approved on November 11, 2008, and is now being replenished. The facility will keep giving local businesses in Albania, Bosnia and Herzegovina, Croatia, FYR Macedonia, Montenegro, and Serbia debt financing for renewable energy and energy efficiency. Individual loans made through the Facility will continue to range in size from 1 million to 6 million euros (EBRD, 2021). The EU bank, European Investment Bank provides EUR 120 million for renewable energy projects in the Western Balkans, according to the Balkan Green Energy News (2021). It also includes information on the specific projects that will receive funding, which include solar, wind, and hydropower projects. Digitizing society and economy contribute to a sustainable future of the Western Balkans. In order to advance their regional engagement in the digital space, the European Union and its Member States have established the Digital for Development (D4D) Hub for the EU Neighboring Countries, which was announced at the Western Balkans Digital Summit (2023). A case study of the Women Entrepreneurs Finance Initiative (We-Fi) by the IFC in 2021 examines the role of green finance in empowering women entrepreneurs in developing countries. Green finance can promote inclusiveness by providing financing for sustainable projects that benefit local communities. For example, green finance can be used to fund renewable energy projects that provide access to electricity in rural areas. This can help to reduce poverty and improve the standard of living in these communities. Green finance can also be used to fund sustainable agriculture projects that benefit small-scale farmers. By providing financing for these projects, green finance can promote economic growth and reduce inequality. Among the other international prestigious institutions, the RCC (2021), has demonstrated very significant work and contribution to the Western Balkan country's developments based on the sustainable model of development, green economy and finance, recycling economy, etc. Official study and research as a reference in support of discussions regarding the SD and green finance realities and perspectives in the Western Balkans are presented. 370 (three hundred and seventy) people were questioned on different issues that influence the presence and perspectives of green finance and sustainability across six countries of the Western

Balkan area (RCC, 2022). In regards to the question linked to green finance and incentives, the dominant answer supports the argument on the Fiscal incentives for a green economy that are argued as the first condition, followed by Improving legislation regulating the green economy and environmental standards, then education and awareness-raising programs to motivate sustainable consumption, green public procurements, etc.

4. CONCLUSION

This paper finds that sustainable finance is becoming increasingly mainstream in Western Balkan countries embracing the European and global trends. There are growing claims that various financial players in the Western Balkans are considering sustainability when making financial decisions in both the public and private financial markets. This opinion is supported by surveys that covered both public and private markets. This includes commercial banks, insurers, institutional investors, development banks, and some of the biggest private equity firms. In the larger scheme of things, financial institutions with a sustainable perspective can contribute significantly to the growth of a green economy. They have the choice not to finance or lend money for projects or business models that are unreliable in terms of the environment or society. Additionally, sustainable and innovative business models may be given preference. Policy interventions, improvement of legislations, financial and fiscal instruments as well as other supports are required to foster the green finance investment toward a sustainable development of the Western Balkans.

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Sustainable Development Goals and FDI – Case of Albania

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Abstract: *Sustainable Development Goals were adopted by countries in 2016, as a way to fight poverty, protect the planet and ensure sustainable development, while Foreign Direct Investments are inflows of investments that are very important for host countries, especially those in development. They enable the transfer of technology, create new jobs, provide inflows of foreign currency, etc. Their impact on the economic development of the host countries is very large and can also affect the realization of the SDGs.*

The purpose of this article is to analyze the impact of FDI on some SDGs in Albania. For this purpose, the ARDL model with data for the period 1999-2021 will be used. There are relatively few studies that have analyzed this relationship, and this article completes the existing literature on this topic. The results of the study can help in the design of policies regarding FDI that enhance rather than compromise the fulfillment of the SDGs.

1. INTRODUCTION

With the conclusion of the Millennium Development Goals program, the United Nations General Assembly introduced the 17 Sustainable Development Goals (SDGs), the purpose of which is to serve as a shared blueprint for peace and prosperity for people and the planet (United Nations, n.d.). The fulfillment of the SDGs will enable sustainable development, equality and justice, dignified working and living conditions, quality education, and environmental protection. The realization of most of these objectives is expected to be done by 2030, while there is no deadline for some of them. The SDGs are detailed in 169 targets, which are measured through 232 indicators, which will stimulate actions for the main issues of humanity and the planet (United Nations, 2015).

Goals from 1 to 3 aim to create conditions for a dignified life. They aim to eradicate all forms of poverty, improve food security, and promote sustainable agriculture, well-being, and health care for all people. Goals 4 and 5 aim to ensure quality and inclusive education as well as gender equality, promoting women's rights and combating discrimination. Improving hygiene conditions for a dignified life, ensuring access to clean water, waste management and ensuring access to renewable energy are the purposes of goals 6 and 7. The fulfillment of goals 8, 9 and 10 will ensure economic growth and dignified working conditions, sustainable industrialization and promotion of innovation and reduction of inequalities between countries, but also between different regions within the same country. Goals 11 to 15 are focused on building eco-sustainable cities and communities, sustainable production and consumption, undertaking actions to combat climate change and sustainable use of natural resources. Goal 16 aims to promote inclusive societies, ensure access to justice and build an effective system of accountability by public institutions. The fulfillment of the objectives requires commitment and cooperation from all countries in the world and this is also the purpose of goal 17.

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Understandably, the realization of the SDGs requires significant public and private sector investments. A very important source of financing, especially in developing countries, is Foreign Direct Investment (UNCTAD, 2014). FDI provides modernization, economic development, and employment (Demena & van Bergeijk, 2019; OECD, 2002). The purpose of this article is to analyze if FDI in Albania affects the fulfillment of goals 10 and 13. These goals have several indicators, but in this study, the Palma index will be used as an indicator of inequality and CO2 emission as an indicator of climate change. To our knowledge, there are relatively few studies that have studied the impact of FDI on the fulfillment of the SDGs in Albania, therefore this paper will complement the literature in this field.

2. LITERATURE REVIEW

Different researchers have analyzed the possible impact of FDI on income inequality, reaching mixed results. In a study in Egypt, Rezk et al. (2022) concluded that an increase in FDI during the period 1972-2017 was accompanied by a decrease in the Gini coefficient. Different specifications of the empirical model support the same conclusion, suggesting that Egypt should promote an open-door policy for FDI because this has the additional benefit of reducing income inequality. Lee et al. (2022), in a study of 37 countries during the period 2001-2015, studied the relationship between FDI and income inequality. They conclude that FDI helps in reducing income inequality, but they see this as related to financial development. After reaching a certain stage of financial development, the effect of FDI decreases. Yuldashev et al. (2023) also find a negative impact of FDI on income inequality, but they suggest that the effect of FDI is stronger when there is a high level of human capital. In a panel study of 16 African countries during the period 1980 to 2013, Kaulihowa and Adjasi (2018) found a U-shaped relationship between FDI on inequality. They suggest that FDI has a positive impact on income distribution, but this impact diminishes with the continued growth of FDI, so even though FDI promotes economic growth, this is not necessarily accompanied by a reduction in inequality. Using panel cointegration models, in a study of Latin American countries for the period 1980-2000, Herzer et al. (2014) found a positive impact of FDI on income inequality, presenting a policy dilemma for these countries. In a study of 29 less developed countries for the period 1970-1990, Sylwester (2005) found no significant relationship between FDI and income inequality. Wang et al. (2023) analyzed a dataset of 126 countries to highlight the channels through which FDI affects income inequality. Using a GLS model, they concluded that the effect of FDI inflows on income distribution depends on the economic development of the host countries. In emerging economies, FDI flows are accompanied by a reduction in income inequality distribution, while in developed countries the effect is the opposite: the increase in FDI flows results in an increase in inequality. Nguyen (2021) suggested that the impact of FDI on income depends on government performance. The author studied 24 developed countries, with a high evaluation of governance performance, and 37 developing countries, with a low evaluation of it. He concluded that the increase in FDI inflows is accompanied by an increase in income inequality in developed countries and a decrease in inequality in developing countries, but the increase in government performance narrows the income gap between different social groups in both categories of countries under study.

An issue that deserves attention is the impact of FDI on the environment. The increase in emissions due to them can undermine the economic benefits they bring, but on the other hand, new eco-sustainable technologies that are transferred through FDI can have a positive impact on the environment. This not-very-clear impact is supported by the results of studies, which have reached

mixed conclusions about the possible impact of FDI on the environment. Huang et al. (2022), in a study of the G20 countries, concluded that the increase in FDI inflows is accompanied by an increase in carbon emissions. However, this effect is mitigated in countries with high economic development and quality regulatory systems. Wang and Huang (2022), using panel data for East Asian countries for the period 2011-2020, concluded that in the short term, the increase in the current and previous levels of FDI is accompanied by an increase in CO2 emissions, while in the long term, this effect is insignificant. From a meta-analysis carried out on 65 previous studies on the effect of FDI on emissions, Demena and Afesorgbor (2020) found that the underlying effect of FDI on emissions is insignificant, close to zero. However, when the heterogeneity in these studies is considered, the results indicate a significant inverse relationship between FDI and emissions. The increase in FDI is accompanied by a decrease in emissions. The conclusion remains the same even when the analysis is done for countries at different levels of development as well as for different pollution. Tsoy and Heshmati (2023) study the effect of FDI on the environment on a global scale. In a study of 100 countries, with data for the period 2000-2020, using a dynamic panel model, they analyzed the possible impact of FDI inflows on the environmental performance index. The results of their study do not suggest a statistically significant relationship between them. Apergis et al. (2022) suggested that the effect of FDI inflows on the environment depends on the country of origin. Studying the impact of investments from OECD countries on carbon emissions in the BRICS countries, they reached mixed results: for a subset of OECD countries, they found a positive impact of FDI on carbon emissions, for another subset they found a negative impact, and for another group did not find influence. The authors suggest that the BRICS countries should make a ranking of the investing countries, according to the degree of damage to the environment that their investments cause in the host countries.

3. METHODOLOGY

The study of the possible impact of FDI on income inequality and CO2 emissions is done through the ARDL model, which is a suitable model for analyzing the relationship between variables that have different orders of integration. This model is used when there is a combination of variables I(0) and I(1), but not I(2). The ARDL model allows the dependent variable to be expressed as a lag function of itself as well as the current and lag values of explanatory variables.

$$\Delta Y_t = \beta_0 + \sum_{i=1}^{n} \beta_1 \Delta Y_{t-1} + \sum_{i=0}^{n} \delta_i \Delta X_{t-1} + \theta_1 Y_{t-1} + \theta_2 X_{t-1} + \mu_t \quad (1)$$

where β_1 and δ_i are short-run coefficients, while θ_1 and θ_2 are long-run coefficients.

Two econometric models will be analyzed in this paper, one for the possible impact of FDI on income inequality and the second model for the possible impact on environmental quality:

$$\ln PALMA = f(\ln FDI, \ln TOT, \ln M/GDP, \ln GDPc) \quad (2)$$

$$\ln CO2 = f(\ln FDI, \ln EN, \ln TOT, \ln GDPc) \quad (3)$$

where:

- PALMA index is a proxy per income inequality[4]. The higher the value of the index, the higher the income inequality. The data to calculate this index is obtained from WID.

[4] In the absence of complete data for the GINI index, in this study the PALMA index is used, which is constructed as a ratio of income received by the richest 10% to income received by the poorest 50%, instead of

- CO2 emissions is a proxy for environmental quality. This variable shows emissions from fossil fuel use in industrial processes and product use, expressed as t CO2/capita. The data is from IEA-EDGAR.
- FDI inflow as % of GDP. The data for this variable is obtained from WDI.
- TOT is terms of trade, the ratio of total trade volume to GDP. An increase in TOT is expected to positively affect the reduction of income inequality (Cerdeiro & Komaromi, 2017).
- M/GDP is the ratio of broad money to nominal GDP, which is a proxy for financial development. This ratio shows the rate of monetization in developing economies. The high rate of monetization may be the result of financial underdevelopment, while the low rate indicates consolidated financial markets (De Gregorio & Guidotti, 1995). This variable can have a mixed sign. The data for this variable is obtained from WDI.
- GDPc is real GDP per capita PPP (constant 2017 international $). The data is from WDI.
- EN indicates a ton of oil equivalent per capita. The data is from Enerdata.

All variables are in log form, so their coefficients show elasticity. The dataset is for the period 1999-2021. Data is analyzed with the statistical package EView 12.

4. EMPIRICAL ANALYSIS

The ARDL method used in this study requires that the variables do not have an integration order higher than I(1). For this reason, all the variables in the model will be tested for stationarity through the ADF test, the results of which are given in Table 1.

Table 1. ADF test results

Variables	ADF test results	Integration order
D(lnPALMA)	-4.2201	I(1)
D(lnCO2)	-3.4157	I(1)
D(lnFDI)	-4.0214	I(1)
lnTOT	-4.4086	I(0)
D(lnEN)	-4.0366	I(1)
D(lnM/GDP)	-4.2313	I(1)
lnGDPc	-3.3067	I(0)

Source: Own calculations

The test results show that most of the variables become stationary in the first difference at a 5% level of significance, while two of them, lnTOT and lnGDPc are stationary at level. Since none of the variables has an order of integration higher than I(1), then we perform VAR and AIC for lag order as well as the ARDL test for cointegration for each model, the results of which are given in Table 2.

Table 2. ARDL bound-test results

	Lag order	F-statistic	Lower I(0)	Upper I(1)
Model of income inequality	2,0,1,2,0	4.9617	2.86	4.01
Model of environmental quality	2,2,0,0,1	9.9357	2.86	4.01

Source: Own calculations

It is noted that the F-values are statistically significant for both models at the 5% level, because they are greater than the upper bound value of 4.01, suggesting that there is a long-run association between variables in these models. Tables 3 and 4 give long-run coefficients for both models.

40% that it is in the original index.

Table 3. Income Inequality Model Long-run coefficients

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LNFDI	-0.010540	0.012778	-0.824906	0.4270
LNEN	-0.809980	0.385393	-2.101700	0.0594
LNM/GDP	2.669112	1.159933	2.301092	0.0420
LNGDPc	-0.635912	0.394862	-1.610468	0.1356

Source: Own calculations

The results show that the financial development variable is statistically significant at the 5% significance level. This variable has a positive relationship with income inequality, suggesting that the increase of this variable will increase income inequality even more. The TOT terms of trade variable is statistically significant at the 10% significance level. The negative sign shows that the rate of trade volume is associated with the reduction of income inequality.

Regarding FDI, it is noted that in the long run, there is no relationship between FDI and income inequality because the p-value is greater than the significance level. We get the same conclusion from the analysis of the environmental quality model (Table 4). The FDI variable is statistically insignificant in the long-run relationship. Among other variables included in the model, EN is statistically significant and has a positive impact on CO2 emissions, so the increase in fossil fuel use is accompanied by an increase in CO2 emissions. Meanwhile, TOT is statistically insignificant for CO2 emissions, while GDPc is significant at the 10% level.

Table 4. Environmental Quality Model Long-run coefficients

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LNFDI	0.003990	0.008233	0.484603	0.6375
LNEN	0.668839	0.172068	3.887060	0.0025
LNTOT	0.214380	0.136335	1.572453	0.1441
LNGDPc	0.193755	0.101445	1.909944	0.0825

Source: Own calculations

To evaluate the short-run relationship between the variables, we perform an Error Correction test for both models. Table 5 presents a summary of the short-run coefficients for the income inequality model. It is noted that the ECM term is negative and statistically significant, however, we do not find a short-term relationship between FDI and income inequality.

Table 5. Income inequality model short-run coefficients

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.754976	0.129881	-5.812820	0.0001
D(LNPALMA (-1))	-0.326832	0.159892	-2.044077	0.0656
D(LNTOT)	-0.153144	0.089115	-1.718504	0.1137
D(LNM/GDP)	0.118322	0.154934	0.763693	0.4611
D(LNM/GDP(-1))	-0.890351	0.257395	-3.459087	0.0053
CointEq(-1)*	-0.494308	0.084986	-5.816355	0.0001
R-squared 0.710554		Mean dependent var 0.002082		
Adjusted R-squared 0.614072		S.D. dependent var 0.043390		
S.E. of regression 0.026955		Akaike Info criterion -4.154324		
Sum squared resid 0.010899		Schwarz criterion -3.855889		
Log likelihood 49.62040		Hannah-Quinn criter. -4.089556		
F-statistic 7.364615		Durbin-Watson stat 2.814799		
Prob (F-statistic) 0.001145				

Source: Own calculations

Even the Error Correction term of the model for environmental quality is negative and statistically significant (Table 6). FDI at one lag affects CO2 emissions in the short run. The coefficient is negative and statistically significant at 5%.

Table 6. Environmental quality model short-run coefficients

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-8.399348	1.019718	-8.236931	0.0000
D(LNCO2 (-1))	0.474626	0.122144	3.885783	0.0025
D(LNFDI)	0.002110	0.005209	0.405040	0.6932
D(LNFDI(-1))	-0.014498	0.005214	-2.780729	0.0179
D(LNGDPc)	-0.992098	0.332182	-2.986611	0.0124
CointEq(-1)*	-1.132920	0.137646	-8.230659	0.0000
R-squared 0.838011		Mean dependent var 0.018902		
Adjusted R-squared 0.784014		S.D. dependent var 0.067725		
S.E. of regression 0.031475		Akaike Info criterion -3.844296		
Sum squared resid 0.014860		Schwarz criterion -3.545861		
Log likelihood 46.36511		Hannah-Quinn criter. -3.779528		
F-statistic 15.51976		Durbin-Watson stat 2.481710		
Prob (F-statistic) 0.000018				

Source: Own calculations

Both models in the study are tested for their stability, through the CUSUM test (cumulative sum of recursive residuals) and the CUSUM of squares test (cumulative sum of the square of recursive residuals). The CUSUM test is used to identify systematic changes in the coefficients in the model, while the CUSUM of squares is used to identify unexpected changes in the coefficients.

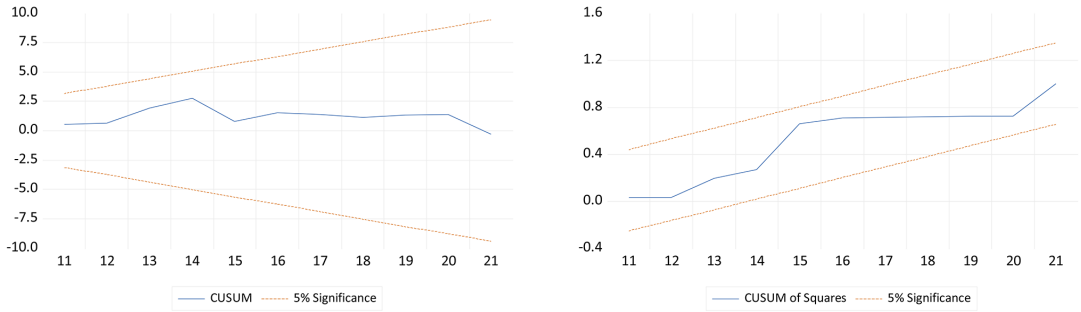

Figure 1. Income inequality model stability

Source: Own calculations

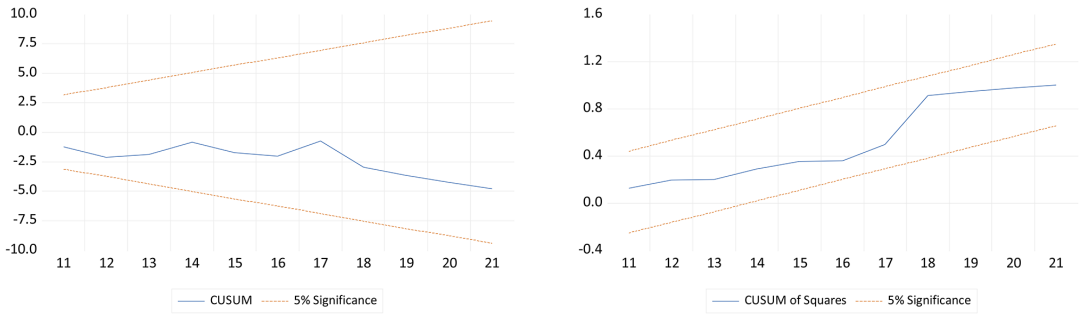

Figure 2. Environmental Quality model stability

Source: Own calculations

It is noted that in both models the coefficients are stable and consistent, so both models can be considered reliable.

5. FUTURE RESEARCH DIRECTIONS

In this study, the impact of FDI on only two indicators is studied. In the future, this study will be expanded, analyzing the possible impact of FDI on other indicators related to SDG no. 10 and 13, but also to other SDGs. Likewise, other variables will be included in the model, which was not possible in this paper due to the short time series. The authors aim to conduct a study on the possible impact of FDI on the SDGs for the Balkan countries.

6. CONCLUSION

The purpose of this study is to identify the possible impact of FDI inflow on the SDGs, specifically those no. 10 and 13. Each SDG has several targets, but in this paper, only two of them have been analyzed: the Palma index as an indicator of income inequality and CO2 emissions as an indicator of environmental quality related to SDG no. 13, climate change. In addition to FDI, the models also include Terms of Trade, Energy consumption, real GDP/capita, and Financial Development as explanatory variables. Since the variables have a mixed order of integration, the ARDL and ECM models were used to find out if there is a long-run or short-run relationship between them.

The results show that FDI has no impact on the inequality of income either in the short run or in the long run, while the variable with the greatest impact is financial development, which has a positive relationship with income inequality, i.e. the increase in the value of this variable, that is, financial underdevelopment emphasizes more inequality. This shows that Albania should apply policies to promote financial development in the country because this will positively contribute to the reduction of income inequality.

Regarding the impact of FDI on CO2 emissions, we do not find any significant relationship in the long run, while FDI at one lag has a short-run relationship with CO2 emissions. The variable with the greatest impact on emissions is EN. This shows that the country should design strategies and promote the use of eco-sustainable alternative energy sources in industrial processes, but also in the use of products, with the aim of reducing the use of fossil fuel.

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Macroeconomic Concentration Index of Corporate Sector Companies

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Keywords:
Concentration;
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Corporation;
National scale

Abstract: *The high concentration of assets and revenues of corporations or large enterprises on a national scale represents a risk that can hinder sustainable development. For instance, in terms of a bank's loan portfolio concentration risk is so crucial that it is a separate significant type of risk in addition to credit risk. In the proposed article a corporate sector concentration index was constructed for countries for which revenue data of TOP-50 or TOP-100 largest enterprises is accessible from open sources. The index is based on the revealed pattern of decrease in the volume indicator of the company (revenue, assets) of the order of 1/n^z, where n is the serial number of the companies ranked in descending order of the indicator, and z is a country-specific parameter. Based on all possibly available open statistics, providing data on 30 countries, the consistency of the statistical hypothesis about the dependence of the corporate sector concentration index on the Human Development Index and Ease of doing business is substantiated.*

1. INTRODUCTION

There are several generally accepted metrics for estimating the concentration of assets, markets, etc. These metrics are actively used to study the issue of asset concentrations in industries, in various businesses, in matters of uneven distribution of benefits, incl. salaries. The first metric is the simplest, it estimates what proportion of the volume is occupied by the largest objects in the amount of N pieces, for example, 10 or 20. Top N or N% companies concentration (CR):

$$CR_N = \sum_{i=1}^{N} MS_i,$$

with MS_i being the market share for each of the N largest manufacturers, in terms of market share.

The second metric is defined as the Gini index and shows the degree of unevenness in the distribution of objects, ordered from large to small. For the first time, this metric was introduced as an economic scientific index (Gini, 1921).

$$Gini = \frac{1}{n(n-1)} \sum_{i=1}^{n} (2i - n - 1) \cdot MS_i,$$

with n being the number of manufacturers in the market, and MS_i being the market share of the manufacturer ordered by increasing size.

The third metric is the Herfindahl–Hirschman index, introduced into scientific use in (Herfindahl, 1950), which has been widely used in theoretical literature.

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$$HHI = \sum_{i=1}^{n} (MS_i)^2 \quad (1)$$

with n being the number of manufacturers in the market, and MS_i being the market share. We will use this index to assess the concentration of companies in a particular country. The reciprocal of this index has direct economic meaning as the Effective Number of the Largest Companies (ENLC):

$$ENLC = 1 \,/\, HHI$$

If MS_i (1) is equal, then $ENLC = n$. The concentration index indicates the degree of monopolization of the economy, showing the risk of concentration, which may impede sustainable development. Banks pay special attention to concentration risk when assessing the required capital to cover credit losses. It is accounted for as a capital penalty (Statement of Policy, 2021) or Granularity adjustment and directly depends on the Herfindahl–Hirschman index calculated from the distribution of loans by exposure volume (Gordy & Luetkebohmert, 2007).

The main problem in assessing the country concentration index is that we do not know the volume of assets of all companies in the country for which we want to calculate this index. The number of legal entities can be measured in hundreds of thousands and even millions. However, the good news is that the Herfindahl-Hirschman index is primarily determined by the largest companies (or corporations) operating in the economy. But how many should be taken into consideration, 100, 1000, 10000 or more? It can be assumed that there is an empirical law of the distribution of assets of companies, sorted in descending order. This hypothetical law is given by the formula

$$A_n \cong \frac{\hat{a}}{n^z} \quad (2)$$

It turns out that it is performed for almost all countries with a high degree of accuracy (Figure 1). The coordinates are taken as the logarithm of revenue and the logarithm of the company number in a descending sorted list.

It can be seen that in the vast majority of observations, the coefficient of determination exceeds 90%, and for some, it is even higher than 99% for the sample of the TOP-100 largest companies in the country. The interpolation dependence is determined by only one exponent z, which is individual for each of the countries. This indicator will allow us to mathematically extrapolate the Herfindahl-Hirschman index to an unspecified number of companies with numbers higher than 100.

It is worth noting that pattern (2) is very reminiscent of Power-Law Distributions in Empirical Data, which is widely observed in empirical data in a diverse range of natural and man-made Phenomena (Clauset et al., 2009) since it was confirmed for the distribution of income and wealth (Benhabib et al., 2011; Champernowne, 1953; Klass et al., 2006; Pareto, 1896; Singh & Maddala, 1976; Toda, 2012; Wold & Whittle, 1957), consumption (Toda, 2017; Toda & Walsh, 2015), firm size (Axtell, 2001; Luttmer, 2007; Stanley et al., 1995), farmland size (Akhundjanov & Chamberlain, 2019), city size (Berliant & Watanabe, 2015; Devadoss et al., 2016; Gabaix, 1999; Ioannides & Overman, 2003; Krugman, 1996), natural gas and oil production (Balthrop, 2016). However, it is important for our study that (2) is not a probabilistic law, but an empirical

fitting of pre-ordered fractions. Therefore, the method for estimating the power component of z should not rely on the maximum likelihood method, which, as shown in many works (see, for example, Deng & Wang, 2023), is the most accurate in estimating the distribution parameter. The exponent z is easily calculated as a regression parameter and tests show that it is statistically significant and has a small statistical error.

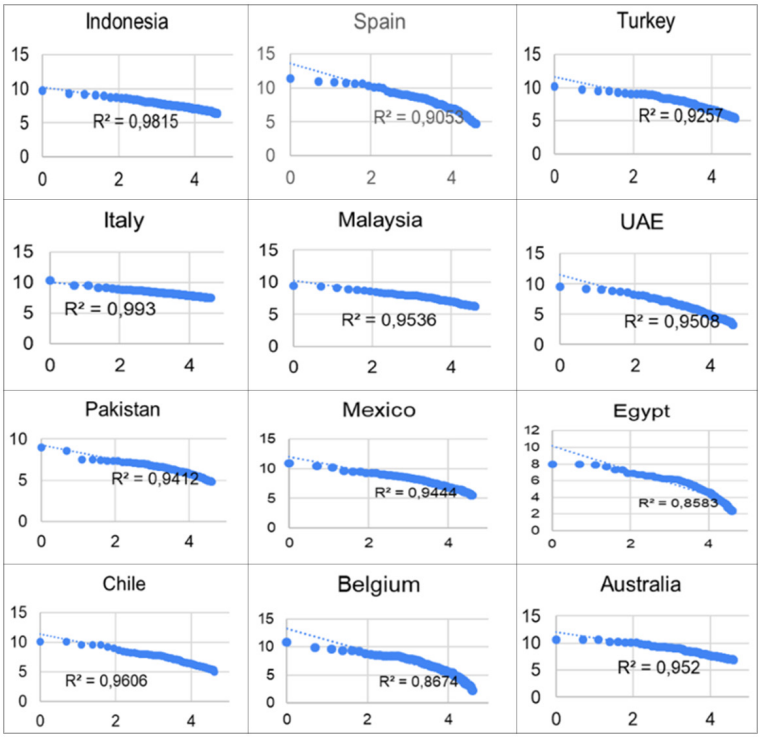

Figure 1. Demonstration of the relevance of the dependence hypothesis (2) for the largest companies sorted in descending order of revenue for a random sample of countries

Source: Own calculations

Thus, each country under study has its exponent in the interpolation function of the distribution in descending order of the assets of the largest companies. As an indicator characterizing the assets, we take the company's annual revenue. The total revenue limiter we offer is the country's Gross Domestic Product for the same period. At this point it is worth making a certain disclaimer, anticipating criticism of the approach. Since the Gross Domestic Product is rather an indicator of the total profit of the economy and not the total revenue of all its subjects. In fact, you need to put a limiter as a multiplicative GDP, but we do not know the rate of return by country; the limiter needed is proportional to the volume of corporations, and the largest contribution to the concentration index is made by the largest ones. Based on these economic assumptions, we believe it is reasonable to set a cap on the volume of Gross Domestic Product since we are examining the index, which is not necessarily equal to the exact value.

2. METHODOLOGY FOR EVALUATION OF THE CONCENTRATION INDEX

Model assumptions:

1. Each country has its own z parameter for the ordered concentration function (2).
2. The assets of the TOP m=100 companies in the country are taken as the annual revenues.
3. The country's GDP is the limiter of total revenue included in the calculation of the concentration index.

Within the framework of the proposed assumptions, formula (1) can be adjusted, having data on the revenue of TOP-m companies, taking into account the GDP limit and the concentration model (2) (see, Appendix). If *HHI* is the quasi Herfindahl-Hirschman Index for a limited number of observations of top companies, for $z > 1/2$ the evaluation formula is used

$$HHI = \left(\frac{\sum_{k=1}^{m} A_k}{\text{GDP}}\right)^2 \cdot \left(\widehat{HHI}_m + \begin{cases} \left[(2z-1)\cdot m^{2z-1}\cdot\left(\zeta(z)+\frac{m^{1-z}}{1-z}\right)^2\right]^{-1}, & if\ |1-z|>\varepsilon \\ \frac{1}{m\cdot(\gamma+ln\,(m))^2}, & if\ |1-z|\le\varepsilon \end{cases} \right) \quad (3)$$

where

$$\widehat{HHI}_m = \frac{\sum_{k=1}^{m} A_k{}^2}{\left(\sum_{k=1}^{m} A_k\right)^2}, \zeta(z)$$

– Riemann zeta function, ε is chosen according to the accuracy of calculations (ε = 0.002 is recomended), γ denotes Euler's constant from Laurent decomposition of the Riemann zeta function (Candelpergher & Coppo, 2020).

$$\gamma = \lim_{N\to\infty}\left(\sum_{n=1}^{N}\frac{1}{n} - \ln(N)\right) = 0.577215665,\ \sum_{k=1}^{m} A_k$$

– the sum of TOP-m assets of companies from the sample.

The next task is to build a macroeconomic model for the dependence of the concentration index (3) on macroeconomic country factors.

3. MACROECONOMIC CONCENTRATION INDEX MODEL

Macroeconomic indices, characterizing the development of the country, were studied by researchers multiple times, and we carefully studied some of the most outstanding ones. For instance, the paper "Corruption and Growth" (Mauro, 1995) illustrates the devastating impact of corruption on the economic growth, prosperity, and wellness of the country. Fighting this phenomenon can be difficult as corruption can be deeply rooted in society and institutional structures. Nevertheless, improving the institutional work, increasing transparency, and strengthening the rule of law can help fight corruption and improve economic growth.

Furthermore, the article "Unemployment in the OECD Since the 1960s: What Do We Know?" (Nickell et al., 2005) contains many important findings on unemployment in Organization for Economic Co-operation and Development (OECD) countries since the 1960s.

The study found that during periods of high unemployment in OECD countries, there was an increase in income inequality, indicating that poverty may be associated with high unemployment. The analysis showed that high unemployment is often associated with policies aimed at reducing poverty, such as lowering the minimum wage or raising taxes, and the decline in unemployment may be due to improved education and training, as well as the development of technology and innovation. The authors of the study conclude that policies to reduce unemployment must take into account both economic and social aspects, including income inequality and social problems associated with poverty.

In addition, there was a research "Institutions and Economic Performance: Cross-Country Tests Using Alternative Institutional Measures" (Knack & Keefer, 1995) exploring the impact of the institutional environment on economic performance across countries. The article presents the results of empirical studies that show that the institutional environment can have a significant impact on economic growth and development. The authors conclude that different institutional arrangements can have different impacts on economic productivity. Some measures, such as the quality of the legal system, the efficiency of the judiciary, and the level of corruption, may be more important for economic development than others, such as the level of taxes and the degree of market freedom. Countries with more developed institutional arrangements, such as an efficient legal system and low corruption, can have a higher level of economic development and a higher standard of living for their citizens. However, the way certain factors correlate with monopolization is still not obvious, and this is the reason for our research.

4. DATA DESCRIPTION

In order to calculate the Effective Number of Largest Companies, it was necessary to use revenues of N largest companies. Among all publicly available data, we could find information on top-600 largest companies for Russia (RAEX-RR, 2021), top-150 for the USA, Canada, Germany, the UK, China, India, Japan, top-100 for 20 countries (France, Norway, Israel, Hong Kong, Egypt, Indonesia, Spain, Turkey, Malaysia, the UAE, the Netherlands, Thailand, Chile, Mexico, Peru, Italy, Australia, Nigeria, Pakistan, Belgium, Sweden) (Statista, 2023) and top-70 for Brazil and South Korea for 2021 (market) as the latest available period. There was also available data for the Russian largest companies from 1995 to 2021 which allowed us to look at ENLC dynamics during 25 years (RAEX-RR, 1995).

For correlation analysis indexes from World Bank Database (2021) were considered. We examined indexes that could be connected with ENLC and used their values for 2021. They can be grouped into political, economic, agricultural, and labour factors.

The full list consists of GDP, Human Development Index (HDI, 2022), Environmental Performance Index (EPI, 2022), Economic Freedom, Share of SME in GDP, Corruption perceptions, Total natural resources rents (% of GDP), Military expenditure (% GDP), the Poverty rate (% population), Gini index, Ores and metals import, Land area (sq. km), Rural population (% of the total population), Agriculture, forestry, and fishing, value added (% of GDP), CO2 emissions (metric tons per capita), GDP growth (annual %), Imports of goods and services (% of GDP), Exports of goods and services (% of GDP), Unemployment (% of the total labour force), Foreign direct investment, net inflows (BoP, current US$), Market capitalization of listed domestic companies (% of GDP), the Business extent of disclosure, Ease of doing business rank, Researchers in R&D (per million people), Logistics performance index.

5. ENLC CALCULATIONS

The above-mentioned formula of ENLC performed the following results. If sorted in ascending order, countries are distributed in the following way (Figure 2). Thus, countries can be divided into 3 groups with Russia and China on the borderlines. The higher the ENLC, the lower the monopolization, which means Nigeria has the lowest level of capital concentration, while South Korea – has the highest.

As mentioned earlier, historical data on the Russian largest companies allowed us to calculate ENLC for a variety of periods (Figure 3). There is a slightly declining trend, which can be interpreted as an increase in corporate sector monopolization. It corresponds to the reality – market leaders enlarge their capital, making smaller competitors abandon the market and preventing potential ones from appearing. The fact that ENLC dynamics match the actual situation proves the efficiency and reliability of the suggested instrument.

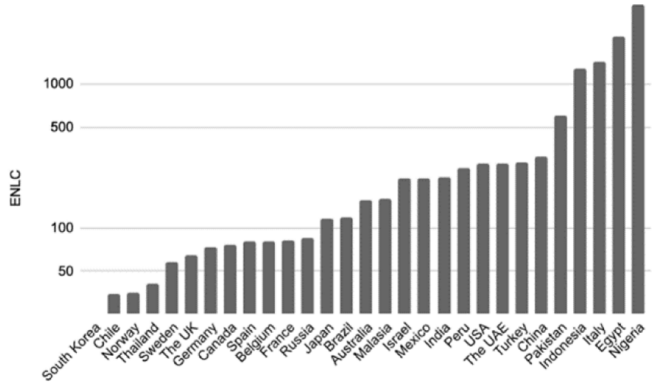

Figure 2. Distribution of countries' ENLC in a logarithmic scale

Source: Own calculations

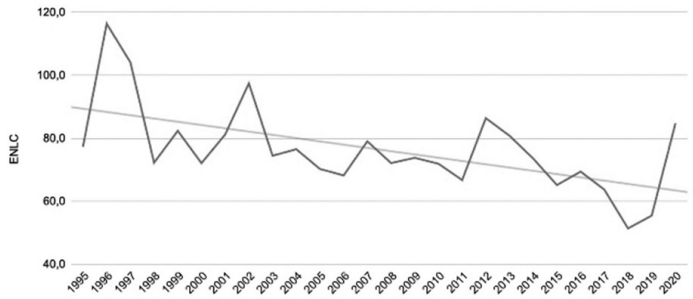

Figure 3. ENLC dynamics in Russia

Source: Own calculations

Table 1. Correlation analysis of ENLC and macroeconomic country indices

World Bank indices	**Correlation**	**Standard Error**	**Significant at 5% significance level**	**Significant at 1% significance level**
Ease of doing business rank	66%	14%	TRUE	TRUE
Human Development Index (HDI)	-61%	15%	TRUE	TRUE
Agriculture, forestry, and fishing, value added (% of GDP)	61%	15%	TRUE	TRUE
Poverty rate, %population	52%	16%	TRUE	TRUE
Rural population (% of total population)	52%	16%	TRUE	TRUE
Market capitalization of listed domestic companies (% of GDP)	-51%	16%	TRUE	TRUE
Corruption perceptions	-48%	17%	TRUE	TRUE
Logistics performance index: Overall (1=low to 5=high)	-48%	17%	TRUE	TRUE
Economic Freedom	-45%	17%	TRUE	FALSE
Researchers in R&D (per million people)	-45%	17%	TRUE	FALSE
EPI	-38%	18%	TRUE	FALSE
CO2 emissions (metric tons per capita)	-36%	18%	TRUE	FALSE
Exports of goods and services (% of GDP)	-35%	18%	FALSE	FALSE
Imports of goods and services (% of GDP)	-29%	18%	FALSE	FALSE
Total natural resources rents (% of GDP)	26%	18%	FALSE	FALSE

Unemployment, total (% of total labour force)	24%	18%	FALSE	FALSE
Military expenditure, %GDP	-23%	18%	FALSE	FALSE
ln(GDP)	-21%	18%	FALSE	FALSE
Share of SME in GDP	-18%	19%	FALSE	FALSE
Land area (sq. km)	-16%	19%	FALSE	FALSE
GDP	-10%	19%	FALSE	FALSE
GDP growth (annual %)	-10%	19%	FALSE	FALSE
Foreign direct investment, net inflows	-9%	19%	FALSE	FALSE
Ores and metals import	-8%	19%	FALSE	FALSE
Gini index	-5%	19%	FALSE	FALSE
Business extent of disclosure index	0%	19%	FALSE	FALSE

Source: Own calculations

As for the next step of the research, the correlation between ENLC and World Bank indices was calculated (Table 1). Among 26 factors only 12 of them showed statistical significance at the level of 5%, and 8 factors were significant at the level of 1%. It was decided to use 12 factors in the following models.

6. MODEL CONSTRUCTION

The main goal of model construction was to find factors that can explain ENLC most accurately and precisely.

First, we built linear regressions on a different number of factors (from 2 to 6) with the highest correlation, making a restriction on coefficient signs that should be of the same sign as the correlation between ENLC and each index. Secondly, AIC was calculated for each model (Table 2), showing the least number for the 2-factor model. Thus, only 2 factors (HDI and Ease of doing business rank) were included in the model.

Table 2. AIC for linear regressions

№ factors	AIC	R_sq
2	-116,64	0,46
3	-115,55	0,48
4	-114,93	0,50
5	-113,24	0,51
6	-111,91	0,52

Source: Own calculations

However, when examining a simple linear regression, we found heteroscedasticity via the predicted values – residuals plot and White's test and needed to change the functional form of the model. The best result was achieved with the semi-log model.

Thus, the final model was the following:

$$\mathrm{Ln}(ENLC) = -4{,}72 \times HDI + 0{,}01 \times Ease\ of\ doing\ business\ rank \quad (4)$$

It had characteristics shown in Table 3.

We conducted tests, checking the correctness of the model, such as White's test, VIF, F-test, Ramsey's test, and correlation analysis. The model showed the absence of multicorrelation and heteroscedasticity, general significance, and correct specification.

Table 3. Final model characteristics

Dep. Variable	Ln_ELNC					
Model	OLS					
Method	Least Squares					
No. Observations	30					
Df Residuals	27					
Df Model	2					
Covariance Type	Nonrobust					
R_squared	0.459					
Adjusted R_Squared	0.418					
F_statistic	11.43					
Prob (F-static)	0.000253					
Log-Likelihood	-40.574					
AIC	87.15					
BIC	91.35					
	coef	**Std err**	**t**	**P > |t|**	**[0.025**	**0.975]**
Intercept	8.56	2.42	3.54	0.001	3.6	13.52
Ease_business	0.01	0.008	1.3	0.2	-0.006	0.027
HDI	-4.72	2.53	-1.87	0.073	-9.92	0.474
Omnibus	0.265					
Prob(Omnibus)	0.88					
Skew	0.19					
Kurtosis	2.73					
Durbin-Watson	1.36					
Jarque-Bera (JB)	0.28					
Prob(JB)	0.87					
Cond. No.	1.10e+03					

Source: Own calculations

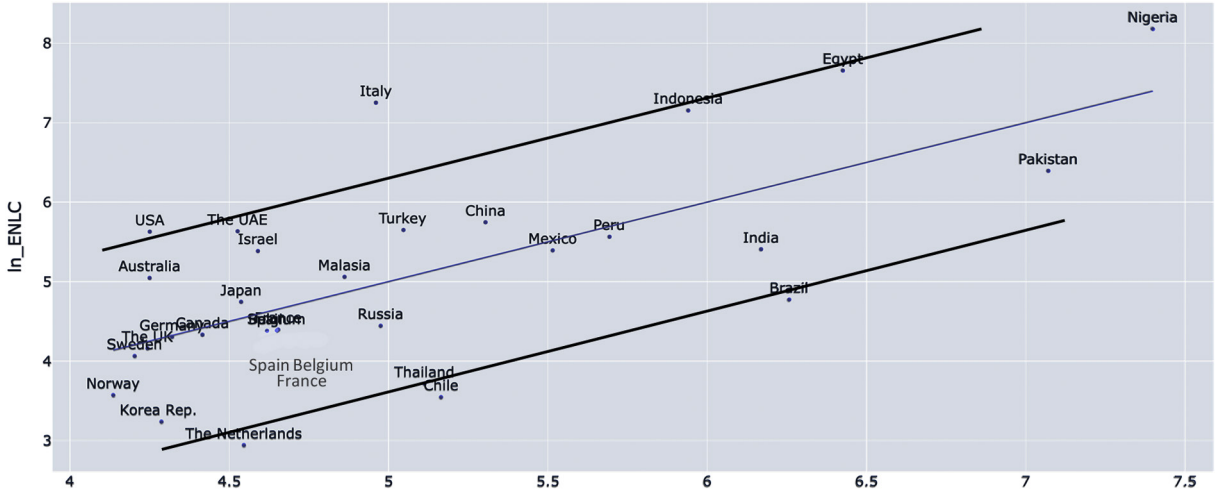

Figure 4. Distribution of countries relative to the predictor of the proposed model. The dotted line marks the deviation at the level of 30%

Source: Own calculations

7. SOCIAL-ECONOMIC HYPOTHESES ABOUT EMITTING COUNTRIES

In our research emitting countries are the countries that appeared to be statistical outliers, thus not being able to be explained by the given model.

The regression was applied to the given data in order to find outliers and therefore suggest possible explanations for the observable result. For most countries predicted values are in adequate intervals, while there are 4 outliers, which are Italy, the Netherlands, Chile, and Brazil (Figure 4). The former has a rather low level of monopolization, while the others vice versa.

After conducting a qualitative country analysis, the following hypotheses were put forward:

1. **Italy** has a very low level of monopolization due to strict antitrust laws, and high involvement of the government and organizations that protect consumers' interests and control the prices of goods and services.
2. **The Netherlands** has a high level of monopolization because the economy is largely focused on highly monopolized industries such as oil and gas, chemical, and metallurgy and the country has complicated legislation for small enterprises.
3. **Chile** has a high level of monopolization because of extremely high poverty and few highly developed industries that are likely to be monopolistic.
4. **Brazil** has a high level of monopolization because of uneven development of regions, high concentration of commodity markets, corruption, low investment, and immense public sector (the largest in Latin America).

Overall, the countries have common reasons to be outliers: there is high involvement of the government, which often suppresses economic development and growth unless key industries are natural monopolies.

8. CONCLUSION

The paper proposes a new country index that measures the concentration of the largest manufacturing companies based on open statistics TOP-70/100 in terms of revenue and GDP of the country. The limited access of the authors to the full statistics of the countries did not allow for calculating the concentration index for most countries; however, it made it possible to make a calculation for 30 countries that happened to be in the available list. Based on this list, a macroeconomic statistical two-dimensional model of the concentration index dependence on macroeconomic indices was built. The most powerful two-dimensional model in terms of the R-square metric was obtained for the Ease of doing business rank and Human Development Index, which makes the expected economic sense. The correlation analysis of the concentration index with other macro-indices was carried out and a significant (at the level of 99%) correlation with eight indices was found. A brief analysis of several countries on the possible reasons for their concentration index deviation from the two-dimensional model is presented. A mathematical derivation of the HHI concentration index formula based on the power law distribution hypothesis, which is substantiated by observations, is presented. The proposed concentration index may be included in the World Bank Database list of macroeconomic country indices as a new reasonable indicator. After expanding the calculation base for a larger number of countries, macroeconomic models and the conclusions of the correlation analysis can be refined.

9. APPENDIX

In this paragraph, the derivation of formula (3) is given. It is well known, see for example theorem 4.11 (Titchmarsh, 1986), that the Riemann zeta function ζ(z), z ∈ R, z > 0, z ≠ 1 satisfies the equation

$$\sum_{k=1}^{n} \frac{1}{k^z} = \zeta(z) + \frac{1}{1-z} n^{1-z} + O(n^{-z}). \tag{1.A}$$

The following constraint is assumed: $\sum_{k=1}^{n} A_k = G$.

It is possible to calculate the «zero approximation» for Herfindahl–Hirschman index

$$\widehat{HHI}_m = \frac{\sum_{k=1}^{m} {A_k}^2}{A^2},$$

formulated for renowned companies TOP-m, $m \ll n, A = \sum_{k=1}^{m} A_k$.

It is necessary to estimate the index $HHI = \frac{1}{G^2} \sum_{k=1}^{n} {A_k}^2$. Obviously,

$$HHI = \frac{1}{G^2} \left(\widehat{HHI}_m \cdot A^2 + \sum_{k=m+1}^{n} {A_k}^2 \right) \tag{2.A}$$

Using hypothesis (2) as well as (1. A) we have

$$\sum_{k=m+1}^{n} {A_k}^2 \cong \sum_{k=m+1}^{n} \left(\frac{\hat{a}}{k^z}\right)^2 = \hat{a}^2 \cdot \left(\sum_{k=1}^{n} \frac{1}{k^{2z}} - \sum_{k=1}^{m} \frac{1}{k^{2z}} \right) \cong$$
$$\cong \frac{\hat{a}^2}{1-2z} (n^{1-2z} - m^{1-2z}) \cong \frac{\hat{a}^2}{2z-1} m^{1-2z}, \text{ since } m \ll n \text{ and } z > \frac{1}{2}.$$

Further, taking into account (1. A), is $A = \sum_{k=1}^{m} A_k \cong \hat{a} \cdot \sum_{k=1}^{m} \frac{1}{k^z} \cong \hat{a} \cdot \left(\zeta(z) + \frac{1}{1-z} m^{1-z} \right)$, then

$$\hat{a} = A \cdot \left(\zeta(z) + \frac{1}{1-z} m^{1-z} \right)^{-1} \tag{3.A}$$

Substituting (3. A) in (2. A), taking into account the estimation for $\sum_{k=m+1}^{n} {A_k}^2$, the sought formula is obtained

$$HHI = \frac{A^2}{G^2} \left(\widehat{HHI}_m + \left[(2z-1) \cdot m^{2z-1} \cdot \left(\zeta(z) + \frac{m^{1-z}}{1-z} \right)^2 \right]^{-1} \right) \tag{4.A}$$

where z > 1/2, z ≠ 1. The last condition can be violated at z ≈ 1, so it is necessary to determine the asymptotics of (4. A) by removing the singularity. The Laurent expansion of the Riemann zeta function about z = 1 is

$$\zeta(z) = \frac{1}{z-1} + \gamma + O(z-1),$$

then

$$\lim_{z \to 1} \left[(2z-1) \cdot m^{2z-1} \cdot \left(\zeta(z) + \frac{m^{1-z}}{1-z} \right)^2 \right] = m \cdot \lim_{z \to 1} \left(\gamma + \frac{m^{1-z}-1}{1-z} \right)^2 = m \cdot (\gamma + \ln(m))^2.$$

From the last equation follows the second part of the formula (3) for values of z close to unity. The parameter ε in (3) was recommended from the practice of calculations for single computer precision of variables.

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Value Creation Processes in the European Biotech Industry: The Role of Collaboration Strategies

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Sustainable competitive advantage

Abstract: *Global-scale competition is based on the ability to generate innovation, particularly in knowledge-intensive sectors such as healthcare, biotech, and pharmaceuticals. The purpose of this paper is to analyze the collaborative strategies pursued by European biotech firms, as preferential ways to promote the innovation processes necessary for value creation. The methodology followed consists of the strategic analysis of European biotech firms to highlight value creation pathways. The main result of the study is the observation that the pursuit of a position of sustainable competitive advantage derives from the ability of European biotech firms to establish different and articulated strategic relationships of a collaborative nature.*

1. INTRODUCTION

Global scale competition is based on the creation, acquisition, absorption, sharing, and transfer of new knowledge. Knowledge creation has significant effects on the speed, quality, and quantity of innovation, while knowledge integration has relevant effects on innovative performance. Firms exploit innovation in a strategic vision: i) to obtain a competitive advantage, both locally and globally; ii) to adapt their strategy to the changing needs of the external environment; and iii) to create value (Arsawan et al., 2022). The propensity for innovation is greatest in the so-called knowledge-intensive sectors (Bloem & Salimi, 2023), namely: pharmaceutical, chemical, biotechnological, electronics, telecommunications, and information technology. Sectors characterized by a higher degree of competition, such as the biotech one, have a greater number of cooperative interactions among firms. The coexistence of competition and collaboration depends on the combination of the characteristics of the sector and the specificities of the business areas. The relevant factors of the biotech sector are: i) the high degree of concentration of firms (dichotomous structure; geographical aggregation); ii) the threat of potential new entrants and the presence of high barriers to entry, such as the need for large financial investments, and investments for the production and the access to distribution channels (Fraterman et al., 2023); iii) the presence of strategic barriers. Furthermore, the ability of firms to establish collaborative relationships with other firms is one of the factors on which depends the survival and development capacity of the firm. From a strategic point of view, the proliferation of different collaboration strategies and strategic alliances for business governance is certainly one of the most interesting aspects of this sector. Numerous sub-sectors are active in the biotech industry (Iseppi & Rosa, 2022; Martin et

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al., 2021): i) healthcare and pharmaceutical applications; ii) agriculture, livestock, veterinary products, and aquaculture; iii) key enabling technologies; and iv) industrial and manufacturing processes. This study aims to analyze the collaborative strategies pursued by European Biotech Firms (EBFs), such as intra- and inter-sectoral alliances and collaborations, as preferential ways to promote the innovation processes necessary for the creation of value. In more detail, the paper intends to analyze the macro-environmental and sectoral dynamics that influence the strategic choices of EBFs and the strategies that allow EBFs to engage in the innovation processes necessary for the creation of value. The following methodology consists of the strategic analysis of EBFs from the macro-environmental and sectoral characteristics up to the analysis of the key activities, and sources of competitive advantage to highlight the main value creation trajectories. The structure of the paper can be summarized as follows: i) definition of the conceptual framework deriving from the analysis of the main theoretical contributions on Inter-Organizational Relationships (IORs); ii) analysis of the biotech industry and identification of the main active business areas; iii) on-desk analysis to explore the main strategic approach of IORs established by EBFs.

2. CONCEPTUAL FRAMEWORK

The cooperative strategic behavior of any firm is remarkably widespread and consequently generates a growing interest of researchers in the field of IORs. IORs enable firms to bridge internal weaknesses and cope with the complexities of the external environment. It is possible to study IORs from multiple perspectives including i) the Resource Based View (Helfat et al., 2023); ii) the Transaction Cost Theory (Rindfleisch, 2020); iii) the Institutional Theory (Di Maggio, 1988); iv) the Knowledge-Based View (Grant, 1996); and v) the Stakeholder Theory (Savage et al., 2010). To date, IOR has become a strategic factor for many firms (Berends & Sydow, 2019). In some sectors, such as biotech, healthcare, and pharmaceutical, competition and cooperation may co-exist, so it is possible to refer to this situation as a co-opetition (Brandenburger & Nalebuff, 2011). Co-opetition depends on the specificity of the context and the activities involved. It is significant in the case of innovation (Corbo et al., 2022) and research and development (R&D). Compared to the traditional vision in which collaboration was seen as an umbrella including cooperation and coordination, recent studies (Kretschmer & Vanneste, 2017) underline the need for further insights, recognizing the distinction between the two concepts. In the field of IORs, some aspects assume particular importance, such as motivations, shapes, characteristics of the partners, and the key contents of the collaboration. These aspects assume different weight and importance in relation to the phase of the life cycle of the alliance (Russo & Cesarani, 2017). It is possible to individuate five fundamental reasons at the basis of IORs, which can coexist: i) development of the asset of resources and skills; ii) improvement of effectiveness and efficiency; iii) expansion of production and distribution capacity; iv) management of competition in the sector; and v) emerging strategies (Caroli, 2021). Firms collaborate, for example, to develop innovations, face major challenges, make supply chains sustainable (Sharma et al., 2022), set standards, carry out creative projects, respond to emergencies, to create value (Le Pennec & Raufflet, 2018). Over time, specialized literature has been developed on specific forms of IOR such as strategic alliances (Russo & Cesarani, 2017), consortia (Yang, 2022), international joint ventures (Nippa & Reuer, 2019), industry-university collaborations (Rybnicek & Königsgruber, 2019), networks and ecosystems (Shipilov & Gawer, 2020), regional clusters (Mitze & Strotebeck, 2019) and meta-organizations. In the context of IORs, the objective/s represent the primary unit of analysis and they can be of a private and/or collective nature, sometimes even opportunistic towards the other partners (Castañer & Oliveira, 2020). Defining the purpose of the collaboration, however, is not the only relevant aspect. In this context, the firm should evaluate: i) the actual potential impact that the collaboration has on the

strategic objectives of the individual partners; ii) the balance between costs and benefits deriving from the agreement; iii) the relationship governance system; and iv) the determination of a correct balance between autonomy and integration of the alliance management of the actors involved. In the context of collaborative relationships, time assumes strategic importance. Indeed, time is a key resource both for the internal dynamics of the collaboration and for relations with the context external to the alliance. Other critical elements for the success of the IOR that should be considered include: i) knowledge sharing and selection of strategic partners (strategic factors), ii) intellectual property rights, economies of scale, spillover effects, market size and volatility, and costs (impacts); and iii) trust, commitment, and opportunism (conditions) and the evaluation of the impact of the overall collaboration strategy. The ability of the firm to collaborate is the basis of the potential success of the IOR. It can be influenced by the relational capital of the firm, the managerial style adopted, the clarity of its strategic objectives, its organizational skills, and its reputation.

3. EUROPEAN BIOTECH INDUSTRY: COMPETITIVE DYNAMICS

Demographic changes, increasing life expectancy, changes in disease patterns, social globalization, and significantly increasing access to health services (OECD, 2022), are playing a crucial role in the growth of the biotech industry worldwide, stimulating greater investment in R&D. The European strategy has highlighted, since 2002, as *life sciences and biotechnology are widely regarded as one of the most promising frontier technologies for the coming decades. Life sciences and biotechnology are enabling technologies - like information technology, they may be applied for a wide range of purposes for private and public benefits. Based on scientific breakthroughs in recent years, the explosion in the knowledge of living systems is set to deliver a continuous stream of new applications* (European Commission, 2002). To date, several factors indicate that the biotech industry is characterized by a strong competitive dynamism. The relevant factors, i.e. those most capable of influencing the strategic behaviors of EBFs, are summarized below (Ho, 2014). The expenditure on R&D as a share of GDP (14.5 trillion euros) (European Union, 2023), in Europe, increased between 2000 and 2021. In 2021, approximately 2.15 % of GDP was spent on R&D in the biotech industry (Statista, 2023). The global growth rate of biotech between 2015 and 2020 was 1.3% (Martin et al., 2021). The biotech industry is characterized by the presence of numerous product and process innovations, which, according to a forecast analysis, will stimulate a fundamental expansion of the sector in the coming years (Global Market Insight Report, 2021). In Europe, as of 2020, there were about 2,820 biotech patents, recording a growth of 23% since 2005 (Statista, 2023). Process innovations are characterized by a high degree of interdependence with the technology sector, the healthcare sector, and the pharmaceutical one. For example, R&D activities have promoted the development of innovative medical technologies such as 3D bioprinting or biosensors, used for personal health monitoring. Another process innovation that has important interdependencies with the healthcare sector is personalized medicine. Personalized medicine is based on the concept that the genome of everyone, interacting with the environment, gives unique characteristics to complex pathologies that can thus be diagnosed and treated more effectively. Finally, new concepts such as cell therapy used for the treatment of oncological pathologies, have the potential to provide regenerative medicine until the pathology is remitted. Regarding product innovations, instead, biopharmacy will register a growth rate, globally, of 9.2% by 2027. The growing use of new ways of developing basic research, such as the use of proteins bio-recombinant, will favor the creation of innovative therapeutic solutions e.g. in the treatment of many chronic diseases. The growing attention to sustainable development is creating challenges for firms in the biotech industry. Indeed, biotech firms can offer a significant contribution in terms of creating solutions, in harmony and balance with

the persistence of living systems. In addition to what has been observed so far, it cannot be neglected that changes occurred as a consequence of the COVID-19 pandemic (Tabish, 2020). Indeed, the pandemic emergency served to underline the strategic importance of the biotech industry for global health and safety, highlighting the key role played by biotech firms in the phases of prevention, treatment and management of the effects generated by pandemics. As an example, it can be cited the capacity to develop valid COVID-19 vaccines in a very short time, producing them on a large scale, and introducing mass vaccines around the world. As of 2022, the global biotech industry has a market size of 414 billion dollars, in which 12,203 firms are active, generating employment equal to 950,250 human resources (IBISWorld, 2023). A biotech firm is defined as a firm engaged in key biotech activities such as the application of at least one biotech technique to produce goods or services and/or the performance of biotech R&D (OECD, 2005). The differentiated and diversified nature of biotech firms does not allow for their clear classification and categorization. Therefore, it can be convenient to recur to the color criterion (DaSilva, 2004), which allows distinguishing the biotech companies according to their belonging to the main sub-sector of activity. Four colors are used: red (health, medical, diagnostics), green (agricultural, environmental biotechnology-biofuels, biofertilizers, bioremediation, geomicrobiology), white (gene-based bioindustries), blue (aquaculture, coastal and marine biotech). It is possible to distinguish biotech firms in relation to their core business. OECD identifies two types of firms i) dedicated biotech firm (DBF)- defined as a biotech active firm whose predominant activity involves the application of biotechnology techniques to produce goods or services and/or the performance of biotechnology R&D; ii) innovative biotech firm (IBF)- defined as a biotech active firm that applies biotechnology techniques to implement new or significantly improved products or processes. The European biotech landscape is multifaceted and mainly consists of i) thousands of firms, ii) hundreds of world-class research institutes, ii) universities, iii) medical centers, and iv) integrated hospitals. The various actors are integrated through shared paths of innovation and financing created within clusters spread across Europe. A study conducted by McKinsey & Company identified 8 clusters that represent half of EBFs. They are mainly located in France, Germany, and the UK (Le Deu & da Silva, 2020). The three largest clusters focus on providing services, immunotherapies, and brain and neuronal therapies. The UK has not only played a disproportionate part in multiple technologies and disease areas but has also been home to 35% of all biotech start-ups in Europe since 2012. Europe represents a favorable context for the development and commercialization of biotech products, being second only to the United States. Approximately 70% of the European market is in five countries: Germany, France, Italy, Spain, and the UK (Fraterman et al., 2023). An analysis conducted by LabiotechEurope has highlighted the relevant characteristics, from a strategic point of view, of the European biotech sector (Labiotech.eu, 2021a). The sector is expected to reach a value of €2 trillion by 2028. EBFs also performed well in 2020. At the end of November, Euronext-listed biotechs reached a total market capitalization of 29.1 billion euros, an increase of around 5 billion euros compared to 2019. Out of 62 biotech firms listed on Euronext, 16 saw their market capitalization grow by at least 100 million euros in 2020. The average market capitalization of biotech firms on Euronext increased by 20 billion euros from the beginning to the end of 2020. This massive industry growth is driven by numerous factors, including favorable government policies, increased launch of new and advanced biopharmaceutical products, continued robust investment, growing demand for synthetic biology, and increasing funding for biotech start-ups. Table 1 shows the European countries that have contributed most significantly to the growth of the sector in terms of the number of public companies present, turnover, market capitalization, and investments in R&D. The market capitalization is the market value of a firm's outstanding shares and represents a relevant factor to consider in choosing investment strategies.

Table 1. European biotech areas

State	Public Companies	Market Capitalization*	Revenue*	R&D*
Sweden	79	22.098	2.704	764 (28%)
UK	56	25.779	969	2.663 (274%)
France	41	16.51	4.636	1.401 (30%)
Germany	23	83.725	23.076	2.172 (9%)
Switzerland	17	13.647	1.207	1.497 (125%)
Denmark	16	61.529	3.937	1.569 (40%)
Norway	15	7.4	215	125 (58%)
Ireland	9	41.461	8.381	2.371 (28%)
Netherlands	7	34.744	3.56	1.1168 (33%)

***values** are in millions of $

Source: Own elaboration based on Ernest & Young, 2023

In 2021, the largest number of public companies was active in Sweden. UK had the highest levels of investment in R&D. Indeed, the UK has always had a reputation for scientific excellence. The country produces 29% of European scientific journals and ranks fourth on the Global Innovation Index with 116.815 jobs created and R&D spending supposed to rise to 2.4% by 2027. Germany, instead, ranks better in terms of total revenue and market capitalization, a performance determined almost entirely by BioNTech in 2021. In 2020, the European Medicine Agency (EMA) issued 97 approvals, including 39 new active ingredients (Figure 1), i.e. 83% more than those approved by the Food and Drug Administration (FDA) in the same year.

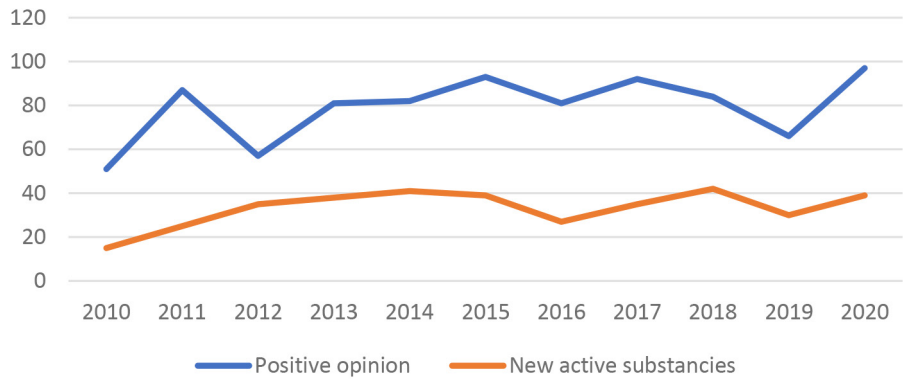

Figure 1. Positive opinions issued by the EMA over 10 years

Source: Own elaboration based on Labiotech.eu, 2021a

Year 2020 was characterized by an increased interest in EBFs from investors. Euronext indicated a 30% increase in the number of institutional investors. Globally, 170 mergers and acquisitions were carried out with EBFs in 2020 (+ 4.7% compared to 2019). Start-ups represent the dynamism factor of the European biotech industry, the trends of recent years highlight their priority commitment to R&D activity, contributing to the construction of solid foundations for growth and innovation. For example, there are currently 823 active biotech firms in Italy alone, of which 29.6% are innovative start-ups (ENEA, 2023). The importance of small biotech firms and their essential role in the development of innovative therapies in Europe is reflected in the EMA market approval rate for small biotech firms, which has increased by more than 100% since 2016. In 2020, the EMA approved about 90% of applications for marketing authorization for new drugs from micro, small or medium-sized biotech firms (Labiotech.eu, 2021b). The strategic peculiarities that characterize the sector mainly derive from its high growth rate. Indeed, the latter determines the need to: i) develop the ability to access funding sources and attract investors; ii) promote collaborative relationships with other operators in the sector and not; iii) favor the development of innovative

solutions, which at the same time favor digitalization; and iv) access distribution channels. In addition, it is necessary to locate firms in strategic areas (clusters) in which a multitude of actors/firms coexist and share the value-creation processes. To date, EBFs are looking for new sources of value, based on a wide range of diversification models and choices, including the development of potential blockbuster drugs and the research of next-generation therapies (Levy, 2023).

4. VALUE CREATION PROCESSES OF EBFS

The analysis of value creation processes in biotech firms requires a broader strategic vision, which extends beyond firm boundaries. Therefore, it is appropriate to consider all the value relationships established by the value constellation firm. In an extended strategic context, such as one of the biotech firms, the firm tends to specialize in certain core activities by activating numerous collaborations of a different nature to achieve adequate supervision over the others. It is possible to identify two macro-areas of activity, mostly but not exclusively involved in the value generation process: production and R&D. These two macro-areas may represent a source of competitive advantage for DBFs engaged in the production of goods and services and for DBFs and IBFs carrying out R&D activities. The large-scale use of IORs in the biotech industry is strategically relevant for access to knowledge. Recently, EBFs have shown a preference for developing innovative paths through IORs rather than through acquisitions of other firms. In 2022 biotech firms signed alliance agreements for a potential value of 132 billion dollars (Ernest & Young, 2023). IORs that are considered worthy of attention for this paper are i) innovative ecosystems; ii) consortia; iii) regional clusters; iv) strategic alliances; v) research joint ventures; and vi) university-industry collaborations.

According to (Granstrand & Holgersson, 2020), "an **innovative ecosystem** is the evolving set of actors, activities, and artifacts, and the institutions and relations, including complementary and substitute relations, that are important for the innovative performance of an actor or a population of actors" (p. 1). A European representative example is IBISBA, a pan-European research infrastructure dedicated to gene-based bioindustries (white). IBISBA brings together the main European public research structures (from 10 European Countries) to provide low carbon and low environmental footprint. The considered ecosystem accelerates the production and translation of cutting-edge knowledge into innovation, sharing expertise and R&D facilities. Firms participating in **R&D consortia** not only can obtain the usual benefits of cooperation but can also further promote communication and mutual learning, because of the common knowledge with other actors of the consortium (Yang, 2022). A representative example is represented, in this case, by the Biobased Industries Consortium (BIC), which includes over 240 firms, covering all the activities of the value chain. The strategic aim of the Consortium is the creation of a sustainable bioeconomy in Europe. The firms participating in the BIC operate both in green and blue biotechnologies and in other complementary sectors. The BIC is also a private partner in the Circular Bio-based Europe Joint Undertaking (CBE JU) - a Public-Private Partnership (PPP), worth €2 billion, with the European Commission. **Regional Clusters** profit from the positive competitive effects deriving from IORs, in addition to more favorable access to funding sources (Olk & West, 2020). Moreover, in the case of Regional Clusters, according to Delgado et al. (2014), "there are multiple types of externalities occurring, including knowledge, skills and input-output linkages" (p. 1785). An interesting example of Regional Clusters can be found in Emilia-Romagna Region (central Italy). In this Region, seven so-called Clust-ERs are active to support the competitiveness of firms operating in the following sectors: healthcare, building and construction, culture and creativity, energy and sustainability, innovation in services, mechatronics and engines. The Clust-ER attaches to the regional network coordinated by ART-ER Attractiveness Research Territory. The Clust-ER Health is an association made of large and small firms,

laboratories of the High Technology Network, research centers, healthcare facilities, and training institutions that share skills, ideas, and resources to support the competitiveness of the Regional Health System. The business areas pertain to red biotechnologies. Clust-ER Health represents a key player in the regional innovation ecosystem, capable of multiplying the opportunities for territorial development through a collaborative approach. Referring to **strategic alliances** it is not possible to avoid referring to a worldwide major event, during which the biotech industry has played a key role, i.e., the COVID-19 pandemic. IORs, in the form of strategic alliances, have been the primary way to promote rapid vaccine development. As an example, it can be mentioned BioNTech (Biopharmaceutical New Technologies), a global firm, born in Germany in 2008, fully integrated, operating in red biotechnologies. Over time, BioNTech has established a variety of relationships with other global pharmaceutical firms, including Genmab, Sanofi, Genentech, Regeneron, Genevant, Fosun Pharma and Pfizer. The strategic alliance with Pfizer, as known, has allowed BioNTech to develop, produce, and market the first FDA-approved mRNA vaccine and the first COVID-19 vaccine. The vaccine development collaboration began in March 2020 and was built on a pre-existing partnership created in 2018, for the development of an mRNA influenza vaccine. Following the scientific success achieved with the first COVID-19 vaccine, the two firms signed a new collaboration which has facilitated the development and commercialization of the mRNA-based vaccine for the prevention of herpes zoster. **Research Joint Ventures** are, instead, a form of IOR that favors the overcoming of the possible gaps existing among R&D policies, the free diffusion of knowledge, private incentives to invest in R&D, and the appropriation of returns (Cassiman, 2018). Very interesting is the case of Xellbiogene, a firm aimed at the development and production of biological drugs and advanced therapies for the management of onco-haematological diseases for other research institutions, pharmaceutical firms, hospitals, and charities. The firm was born as a joint venture between two private Scientific Institutes for Research, Hospitalization and Healthcare operating in the Italian National Health System: Ospedale Pediatrico Bambino Gesù and Fondazione Universitario Policlinico Agostino Gemelli. Finally, **University-Industry** knowledge transfer can be seen as an important driver of innovation and economic growth, requiring two-way knowledge sharing to identify relevant issues, share and develop new insights, as well as the transfer and implementation of knowledge or technology (de Wit-de Vries et al., 2019). Referring to an Italian example, it can be cited the EryDel joint-stock company a spin-off of the University of Urbino. EryDel is active in red biotechnologies and operates in the business of developing innovative medical technologies. It attracted investments from venture capital funds and European loans for more than 30 million euros. The main objective is to commercialize the EryDex System medical device (phase III clinical development), to improve the management of Ataxia Telangiectasia, a rare genetic disease. It still boasts of the strategic collaboration with the University for the clinical industrial development of the results of the basic research conducted in the laboratories of the University.

The importance of the overmentioned relationships is because IORs favor the acceleration of the process of sharing resources and skills, especially in production and R&D activities. The proliferation of different ways of collaboration confirms the macro-environmental and sectoral characteristics, highlighting how innovative paths can be achieved through the activation of IORs. Cooperative contexts are potential platforms for the indirect and direct transmission of knowledge. A systematic analysis of the literature on the role of cooperation in innovative efforts confirmed that IORs have a positive effect on innovation performance (Freire & Gonçalves, 2022). Innovation can only occur in the presence of knowledge sharing (Kremer et al., 2019): a firm that encourages knowledge sharing stimulates innovative capabilities (Castaneda & Cuellar, 2020). The strategic role of IORs arises from the contribution that they make in the context of value creation. The on-desk analysis illustrates that biotech firms engaged in collaborative processes generate innovation by favoring the creation of value.

5. CONCLUSION

The European biotechnology industry is a complex and challenging environment. The study of macro-environmental and sectoral dynamics indicates intense competition determined by the high growth rate of the sector. This implies the need to develop the ability to access funding sources, attract investors, encourage product, and process innovation processes, promote digitization and finally, access distribution channels. Establishing IORs is a critical success factor that positively influences the achievement of a position of competitive advantage. The analysis of the strategic action of the EBFs, conducted in this study, underlined the strategic significance of the IORs. EBFs that activate IORs, favor the sharing of knowledge to support innovative processes by activating virtuous circles of value creation. The paper represents a starting point for more in-depth research, to be conducted through semi-structured and structured interviews, and the administration of questionnaires, aimed at supporting the validation and impacts of the identified strategies.

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Financial Performance and Large Sustainable Companies: What Relationships in the Italian Blue Chips of the MIB ESG Index?

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Abstract: *This study aims to analyze the relationship between financial performance and ESG performance with particular reference to a market segment characterized by high liquidity. The research concerns, in fact, the Italian blue chips that make up the MIB ESG index, that is, the first forty companies among the best sixties. The methodology used is based on a sample of the top ten companies in the index and uses regression analysis, assuming liquidity ratio, debt ratio, ROE and ROA as independent variables, while dependent variables are ESG scores. The results show that relationships between variables are mostly positive. However, they are still rather weak and therefore have room for improvement. The study helps to deepen the knowledge of a market segment still little studied in the literature.*

1. INTRODUCTION

Sustainable development is a crucial phenomenon for the economic success of firms. This consideration has led the literature to question the concrete compatibility (De Bruyn, 2000; Hess, 2013; Xepapadeas, 2005) in the long term between economic growth, environmental protection, and social evolution. Typically, the answer to this question is that, for development to be truly sustainable, it must be inclusive, in other words, it must be able to effectively balance economic goals with social and environmental objectives (Soubbotina, 2004). The problem has involved, especially in recent history, the major world institutions (Ahmed et al., 2022; Al-Qudah et al., 2022) that have acted both as engines and regulators for economic growth that respects the environment and the people who live in it.

In Europe, the issue of environmental and social sustainability has been addressed through a series of actions aimed at improving the management and reporting practices of companies. The integration of ESG (Environmental, Social and Governance) factors in business models is now an essential requirement for firms to have a durable life. However, it is important to consider that the integration of ESG is a complex process that involves the whole business management and requires demanding and costly investments (Friske et al., 2023). In this sense, such integration tends to be easier for financially robust and economically sound companies. This research aims to identify the economic performance of Italian companies that achieve the best ESG performance, in order to verify whether there are significant common elements for the explanation of success in sustainability. Since the companies analyzed belong to different sectors, the search for common traits can be useful in understanding the relationships between financial performance and ESG performance.

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2. LITERATURE REVIEW AND RESEARCH QUESTION

The literature on the relationship between financial performance and sustainability is particularly vast and the number of studies on the subject has grown especially in the last five years. As observed by Friede et al. (2015) *The search for a relationship between environmental, social, and governance (ESG) criteria and corporate financial performance (CFP) can be traced back to the beginning of the 1970s. Scholars and investors have published more than 2000 empirical studies and several review studies on this relation since then* (p. 210).

However, despite this development, the results achieved so far are not homogeneous. This heterogeneity is manifested concerning at least two profiles. First, the relationships between the variables identified by the authors are different, being positive according to some scholars, and negative or null according to others. Secondly, the causality relationship is also not seen in the literature in a univocal way, since sustainability performance can be considered as the cause or the effect of financial performance.

The study conducted by Whelan et al. (2021) found that 58% of studies based on operational variables, such as ROE and ROA, identify positive relationships between ESG performance and financial performance, while 13% found no relationships, 21 % found mixed correlations and 8 % found negative relationships.

Chen and Xie (2022) found that ESG disclosure has a positive effect on financial performance, with heterogeneous impacts. In particular, the positive influence is more marked in high-visibility companies and with ESG investors, as ESG disclosure attracts ESG investors.

Regarding the Italian context, Landi and Sciarelli (2018) noted a growing interest in Corporate Social Responsibility as well as a more reliable ESG disclosure. However, investors do not seem to consider Corporate Social Responsibility in the stock market and therefore the strongly stakeholder-oriented behavior is not compensated with a premium price.

According to Velte (2017), *governance performance has the strongest impact on FINP [Financial Performance] in comparison to environmental and social aspects. One possible explanation for this result could be the longer tradition of corporate governance reporting in Germany since the introduction of the Code 2002 or the increased value relevance for the stakeholder* (p. 176).

DasGupta (2022), on the other hand, has identified an inverse relationship in which financial performance determines ESG results, especially when it shows a decline. In such cases, the worsening of financial performance exerts a strong positive influence on ESG results, as the company seeks to maintain its credibility through sustainable behavior.

According to Zhou et al. (2022), operational management is a significant tool through which the ESG performance of listed companies can increase their market value, and similarly, Dalal and Thaker (2019) have indicated that ESG business results can improve financial performance, measured in both accounting and market value terms.

In line with the aforementioned literature, this study considered the relationships between the economic performance and ESG performance of Italian-listed companies with high equity cap.

In this regard, on the one hand, the pursuit of the ESG objectives requires significant investments with not short recovery times that adversely affect economic performance; on the other hand, it can improve the market position of the company (image, reputation, trust) and promote its economic performance. Finally, it may also be that the two types of performance do not affect each other at all, for example, because the positive and negative effects are compensated. This study accepted all three hypotheses because even if they are opposite each other they are all equally likely. On this basis, the following research question was formulated:

RQ1 Do the relationships between ESG performance and economic performance support each other (positive relationship), or are they opposite each other (negative relationship), or do they not have relationships?

3. METHODOLOGY

3.1. Sample selection

In order to appreciate the economic performance of the best sustainable companies, the research selected a sample of the top ten Italian listed companies included in the MIB ESG index, based on best performers according to the ESG global score as of June 30, 2023 (Moody, 2023).

The sample is representative because the index on which it is based, although recently introduced, includes the largest sustainable Italian companies.

The MIB ESG index is the first ESG index dedicated to Italian blue-chips, designed to identify the major Italian-listed issuers that present the best ESG practices. The MIB ESG index is the second national ESG index of Euronext after the CAC40 ESG launched in March 2021. It was announced by Euronext, the company that controls the Amsterdam, Brussels, Dublin, Lisbon, Oslo, Paris and Milan stock exchanges and launched on 18 October 2021.

The MIB ESG Index combines the measurement of economic performance with the assessment of sustainable practices, according to the principles of the United Nations Global Compact. The methodology behind the index provides a ranking of the top 40 companies based on ESG criteria, selected from the 60 most liquid Italian, excluding those involved in activities not compatible with ESG investments. Governance, transparency of corporate information, respect for the environment and environmental regulations, respect for human rights, diversity and inclusion are some of the main elements that contribute to the index calculation. The components of the index are weighted by the market free float capitalization. The composition of the index will be reviewed quarterly in order to enable the inclusion of new companies whose ESG performance has improved.

According to the Index Rule Book (version 22-01, Effective from June 2022) the companies part of the Index Universe are screened for liquidity. The top 60 in terms of 6 months MDTV (Median Daily Traded Value) are eligible. Companies currently included in the Index are eligible as long as they rank in the top 70 in terms of 6 months MDTV.

According to the Euronext MIB ESG index Benchmark Statement (Euronext, 2022a) *The MIB ESG is designed to reflect the price level trends in the trading of shares listed in Italy. The MIB ESG Index family is designed to reflect the performance of the top 40 companies demonstrating strong Environmental, Social and Governance practices amongst the top 60 liquid Italian*

companies. The MIB ESG index includes the most common ESG investment approaches adopted by institutional and private investors such as norm-based exclusion filters applied in accordance with the UN Global Compact Principles or involvement in coal, controversial weapons and tobacco. The index ambitions are to progressively integrate upcoming EU Taxonomy evolutions and Science Based Targets (SBT) developments (p. 4).

Financial performance was analyzed based on data from the half-yearly reports as of 30 June 2023 published by the sampled companies. The short-term analysis is consistent with the nature of the MIB ESG index, whose composition varies throughout the year based on the evolution of the performance of Italian blue chips.

3.2. Variables

Based on the research question, this study considered the ESG performance as the dependent variable, and, specifically, the four MIB ESG scores as of 30 June 2023: global score (GLS), environment score (ES), social score (SS) and governance score (GS).

According to the Euronext Index Rule Book (Euronext, 2022b), the ESG factors considered by the benchmark methodology are represented by 38 criteria divided into six areas that, as a whole, define the corporate environmental, social and governance responsibility:
1) Environment,
2) Human rights,
3) Human resources,
4) Community involvement,
5) Business behavior,
6) Corporate governance.

From a methodological point of view, the ESG score is determined in two steps:
1) in the first phase, Moody's ESG Solutions classifies companies based on the 38 factors mentioned above;
2) in the second phase, each company is assigned a Global ESG score, up to a maximum of 100, calculated by weighing all sustainable factors in a given sector.

As an independent variable, the study considered the economic performance of the best sustainable enterprises, using the main financial and profitability indices on 30 June 2023. Specifically, for the financial variables, the research considered the liquidity ratio (LR) and the debt ratio (DR), while for the profitability analysis, the study used Return on Equity (ROE) and Return on Assets (ROA). The formulas for independent variables are illustrated in Table 1.

Table 1. Formulas for independent variables

Liquidity Ratio (LR)	Current assets, net of inventories to short-term debt
Debt Ratio (DR)	Debt to equity
Return on Equity (ROE)	Net income to equity
Return on Assets (ROA)	Operating income to total assets

Source: Own research

The liquidity ratio expresses the ability of the company to support short-term debts with its current assets, while the debt ratio expresses the debt weight in relation to the company's equity. The ROE expresses the return on equity, while the ROA represents the operating profitability of the total assets.

3.3. Empirical model

In order to answer the research question, the study used a linear regression model to identify the relationships between the economic performance variables (independent variables) and the ESG performance variables (dependent variables). Given the variables selected, ESG performance was represented as follows:

$$ESG\ performance = f(liquidity\ ratio,\ debt\ ratio,\ ROE,\ ROA) \quad (1)$$

Research models are expressed by equations (2), (3), (4) and (5).

$$GLS = \beta_0 + \beta_1 LR + \beta_2 DR + \beta_3 ROE + \beta_4 ROA + \varepsilon \quad (2)$$

$$ES = \beta_0 + \beta_1 LR + \beta_2 DR + \beta_3 ROE + \beta_4 ROA + \varepsilon \quad (3)$$

$$SS = \beta_0 + \beta_1 LR + \beta_2 DR + \beta_3 ROE + \beta_4 ROA + \varepsilon \quad (4)$$

$$GS = \beta_0 + \beta_1 LR + \beta_2 DR + \beta_3 ROE + \beta_4 ROA + \varepsilon \quad (5)$$

where,

GLS = global score,
ES = environment score,
SS = social score,
GS = governance score,
β_0 = intercept,
LR = liquidity ratio,
DR = debt ratio,
ROE = return on equity and
ROA = return on assets.

4. FINDINGS AND DISCUSSION

Table 2 shows all ESG scores of the selected top ten companies.

Table 2. Best performers included in the MIB ESG index, based on the ESG global score (as of June 30, 2023)

Company	Weight	Global score	Environment score	Social score	Governance score
POSTE ITALIANE	1,11%	77	70	78	80
ENEL	10,00%	75	78	77	70
TERNA	2,77%	74	77	71	77
TELECOM ITALIA	0,67%	70	67	70	70
ENI	7,77%	70	68	71	72
ITALGAS	0,70%	68	70	64	74
PIRELLI & C	0,36%	68	74	67	62
INTESA SANPAOLO	9,90%	67	72	67	65
ASSICURAZIONI GENERALI	5,16%	66	79	61	68
SNAM	2,55%	66	75	59	72

Source: Moody, 2023

To appreciate the excellence of the sample, this study also considered the weighted average ESG ratings for the 40 companies that make up the index on the same date. Table 3, for each ESG score, shows the average, minimum and maximum values according to the MIB ESG Index Moody's ESG Report 2023 Q2 (Moody, 2023).

Table 3. Weighted average ESG ratings as of June 30, 2023

	Average	Min	Max
Global MIB ESG	63	47	77
Global Eligible Companies	60	36	77
Environment MIB ESG	64	39	79
Environment Eligible Companies	61	22	79
Social MIB ESG	63	44	78
Social Eligible Companies	60	31	78
Governance MIB ESG	63	48	80
Governance Eligible Companies	61	42	80

Source: Moody, 2023

As Table 3 shows, almost all top ten are above average for all ESG scores. The independent variables on 30 June 2023 are shown in Table 4.

Table 4. Independent variables on 30 June 2023

Company	LR	DR	ROE	ROA
POSTE ITALIANE	0.497	26.970	0.120	0.006
ENEL	0.779	3.472	0.067	0.030
TERNA	0.720	2.669	0.018	0.104
TELECOM ITALIA	0.555	2.358	-0.037	0.004
ENI	1.257	1.529	0.049	0.030
ITALGAS	1.129	3.659	0.098	0.033
PIRELLI & C	0.814	1.534	0.045	0.032
INTESA SANPAOLO (*)	0.996	14.293	0.068	0.008
ASSICURAZIONI GENERALI (*)	0.083	16.655	0.085	0.006
SNAM	0.367	2.998	0.092	0.025

(*) For these companies, the ratios LR and DR are not representative because it was not possible to calculate the current share of assets and liabilities.

Source: Own calculations

Table 5 presents the descriptive statistics relating to independent variables.

Table 5. Descriptive statistics for independent variables

Variable	Obs	Mean	Median	Std. Dev.	Min	Max
LR	10	0.720	0.750	0.358	0.083	1.257
DR	10	7.614	3.235	8.700	1.529	26.970
ROE	10	0.06	0.07	0.045	-0.037	0.120
ROA	10	0.028	0.028	0.029	0.004	0.104

Source: Own calculations

The comparison between Table 2 and Table 4 allows us to highlight how the best economic performance is not always associated with the best ESG performance. As regards the liquidity ratio and the debt ratio the best results are achieved by companies that in terms of ESG performance are not at the top, but about half of the ESG ranking. Similarly, if we exclude the first company in the ESG ranking, the best performance of the ROE is achieved by the companies that, in ESG terms, are at the bottom.

To clarify these observations, the Pearson correlation indices represented in Table 6 for all variables provide additional information.

Table 6. Pearson correlation for all variables

	GLS	ES	SS	GS	LR	DR	ROE	ROA
GLS	1.0000							
ES	-0.0333	1.0000						
SS	0.9249	-0.2020	1.0000					
GS	0.6364	-0.1719	0.3850	1.0000				
LR	0.2643	0.2185	0.3557	-0.3320	1.0000			
DR	0.2514	0.0226	0.2179	0.2847	0.0236	1,0000		
ROE	-0.0072	0.2328	-0.1189	0.2424	-0.2854	0,5631	1,0000	
ROA	0.2908	0.3430	0.0984	0.3147	0.1411	-0,4600	-0,2402	1

Source: Own calculations

As regards the correlations of Table 6, this study did not consider it relevant to analyze the relationships between GLS and the remaining ESG scores, as these relationships are the normal result of the calculation and weighting methodology on which the MIB ESG Index is based.

Concerning the other Pearson correlations, Table 6 shows that the relationships between economic performance and ESG performance are almost always positive. Moreover, since neither the debt ratio nor the ROA have negative cases, the conclusion could be that the operational management of the Italian blue chips moves in harmony with the ESG results, while the level of indebtedness does not compromise the relations between the different performances.

However, it is also important to note that the positive relationships are rather weak since the higher one is still less than 0.5. The correlations found by this study are therefore not strong, probably testifying that the factors that can affect economic performance and ESG results are multiple and complex. In particular, the complexity of sustainability explains how the achievement of significant objectives implies an overall commitment that involves the environmental and social dimension, in terms of both investments and costs, as well as culture and organization. At the same time, the benefits of the credibility and reliability of sustainable businesses can be reflected in higher revenues that offset the increased costs of achieving optimal ESG. In any case, it remains important to reiterate that the presence of positive, albeit weak, relations confirms that the pursuit of economic goals and sustainable results are not mutually conflicting but can, on the contrary, support each other.

Although ESG performance is not a strong force for economic success, and although financial strength is not a powerful determinant for achieving ESG goals, the results of this study show that the Italian blue chips are a concrete example of relations almost positive.

Based on this evidence, the study concludes that, in general, the most financially robust companies – such as blue chips – are able to make virtuous links between economic performance and environmental, social and governance sustainability.

A further significant aspect concerns the identification of which independent variables have the greatest impact on ESG scores. For this purpose, the regression equations resulting from this study are shown in Table 7.

Table 7. Regression equations

Dependent variable	Regression equation
GLS	Global score = 66,5167 + 0,0014 * LR + 0,2591 * DR - 0,0152 * ROE + 0,0661 * ROA
ES	Environnent score = 67,5223 + 0,0034 * LR - 0,0273 * DR + 0,0413 * ROE + 0,0551 * ROA
SS	Social score = 64,8843 + 0,0042 * LR + 0,3233 * DR - 0,0350 * ROE + 0,0447 * ROA
GS	Governance score = 68,7160 - 0,0070 * LR + 0,4027 * DR - 0,0122 * ROE + 0,1194 * ROA

Source: Own calculations

A noteworthy aspect is the influence exerted by the DR which represents the weightiest variable for all ESG scores, with the sole exception of the environment score. This result has been interpreted in the literature with the theory that having a higher ESG score brings the advantage of having access to capital at lower costs and consequently having a higher debt. A similar relationship is identified by Cantino et al. (2017), who found that the literature confirms that ESG sustainability performance and disclosure are jointly related to the cost of debt. A significant coefficient was found by Wong et al. (2021), who observed that the debt ratio is also positively related to the value of the enterprise. Hamrouni et al. (2019) showed that long-term and short-term debt levels increase with the disclosure of ESG information, thus suggesting that CSR information plays a significant role in reducing information asymmetry and improving transparency around the ESG activities of companies. This result meets lenders' expectations in terms of extra financial information and attracts sources of debt financing.

5. CONCLUSION

This study highlighted two relevant profiles. First, the economic performance of the blue chips in the MIB ESG index has a positive impact on sustainability. This finding demonstrates that sustainable growth is a virtuous path in which economic performance favors ESG success and, in turn, the implementation of ESG practices improves economic performance. However, although positive, the relationships between the observed variables are still rather weak and this circumstance may mean that there is room for action to be used to optimize the pursuit of sustainable goals. This study considers that an unbalanced relationship between the two performances can represent an obstacle for enterprises to think and act sustainably. In other words, social and environmental sustainability cannot be achieved at the expense of economic sustainability, since only a balanced relationship can be successful in the long term.

Second, this research has shown that financial variables affect ESG results more than profitability and in particular more than variables that measure return on equity (ROE). Specifically, the most effective variable is the debt ratio (DR), so that ESG results improve as debt increases. This effect could represent the main route through which the specific connotations of the blue chips of the MIB ESG index – which, it should be remembered, are the most liquid Italian companies – are reflected in ESG performance. The financial strength of these companies is probably the key to their success in the complex path that leads to sustainability.

As for the limits of this research, one of the most relevant is the time interval of analysis, which refers to a semester. On the one hand, this methodological flaw is justified by the variability of the composition of the index, which is updated every quarter. On the other hand, to better understand the theme, it would have been useful to reconstruct the structural characteristics of the blue chips. In fact, it is much more likely that the ESG performance of these companies is the result of a financial strengthening that has occurred gradually over time, due to many factors

that this study has not considered. Despite this limitation, the results obtained help to deepen the knowledge of the Italian blue chips, to which the literature has not yet devoted extensive discussion. The value of the research lies in the importance of the analyzed sector, which includes the top 40 companies based on ESG criteria, selected from the 60 most liquid Italian companies.

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European Directives and Principal International Frameworks for Corporate Sustainability and Climate Change Reporting: Responding to the Challenges Facing Our Planet

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Abstract: *Over the last few decades, significant progress has been made in the development of a global baseline for corporate sustainability reporting and disclosure, including a focus on climate change issues. However, the author's main concern, and the argument at the heart of the paper, is that the observed proliferation of frameworks focused on sustainability and sustainable development may compromise the comparability of disclosed information, thereby reducing its usefulness and even confusing stakeholders. The author argues that humanity urgently needs to do much more. Based on the author's research, observations and reflections from discussions with leading practitioners and experts, it is suggested that the transparency, consistency and relevance of corporate policies and activities and information on sustainability and climate-related issues, whether provided through voluntary or mandatory reporting and disclosure, are not of sufficient quality to adequately address and respond to the unique challenges facing humanity due to climate change.*

Sustainability disclosure has become an important part of the corporate reporting process, with climate-related information being a key component. The author's thesis is that the trustworthiness, transparency and relevance of climate-related disclosures have proven to be of great importance in achieving disclosure effectiveness and usefulness for interested parties – potential and current investors, creditors, lenders, employees and all members of society and the European Union community. The author aims to highlight, discuss and justify the need for a global framework and coherent standards to support meaningful and consistent disclosure of climate-related matters, risks and opportunities. It will be a prerequisite for improving the transparency and quality of climate-related information and data and will support appropriate decision-making in the management of climate-related risks. The author considers it to be an essential part of the governance, process and system of corporate governance reporting.

The author's paper aims to highlight and discuss the considerations, criticisms and concerns of researchers, professionals and experts on the issues discussed, to outline perspectives for future research and to emphasize that benefits for all members of society, sustainability and sustainable development and the future are highly probable and can therefore be expected. The development of international standards for climate-related disclosure should be seen as the most important part of establishing a global regulatory framework for corporate sustainability reporting at the international level. The research methods used by the author are analysis and synthesis, induction and deduction, descriptive approach, comparison, analogy and observation, as well as a thorough study of many recent academic research and normative sources on the subject.

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1. INTRODUCTION

Over several decades, the humanistic concepts of sustainability and sustainable development have been developed, legally adopted and endorsed by the most influential and respected international organizations such as the United Nations. Powerful social movements and other global events have emerged. Stakeholders have launched international and global initiatives, and dedicated scientists, environmentalists, ecologists and other committed researchers have brought the issue of corporate sustainability reporting to the forefront through in-depth scientific research. Climate change reporting and disclosure have become one of the cornerstones of sustainability reporting. The author does not use the terms 'sustainability' and 'sustainable development' synonymously or interchangeably. The author has considered and discussed the fine distinction between these terms in another study on the subject (Oreshkova, 2022a, 2023). The author believes that it is more appropriate to use the terms 'sustainability reporting and disclosure' or 'reporting and disclosure on sustainability issues' rather than 'non-financial reporting'. The author believes, as do other researchers in the field, that the term 'non-financial' is not the most appropriate because it implies a nuance of meaning that the information it refers to has no financial relevance or significance. Many organizations, initiatives across the world, and practitioners in the field of sustainability reporting refer to 'sustainability information' rather than 'non-financial information'. The author considers it preferable to use 'sustainability information' rather than 'non-financial information'. Directive 2013/34/EU, as amended by the Non-Financial Reporting Directive – 2014/95/EU, should have been amended to reflect this change in terminology. As a result, the new Corporate Sustainability Reporting Directive has been adopted. The author believes that reporting on climate change and climate-related issues, risks and opportunities is the most important part of sustainability reporting. For many companies operating in geographically distant regions of the world, sustainability reporting has evolved from a voluntary opportunity and option to a legal obligation. In particular, certain large companies are expected to contribute to the global response to climate change and mitigate its effects through transparent and relevant information and disclosure. Environmental, social and governance issues, and the risks and opportunities they present, have moved to the top of corporate governance strategies, tactics, and agendas. There is growing evidence that companies are increasingly embracing the concepts of sustainable development. It demonstrates and highlights perceptions, views and insights that the role of business activities undertaken in support of sustainability and sustainable development can be critical to achieving the strategic goal of the United Nations (and not just the goals of stakeholders interested in the relevance of financial indicators).

Combating climate change is one of the European Parliament's top priorities and a structural component of the strategy and long-term policy of the European Union institutions. The main objective of the United Nations Paris Agreement is to limit and mitigate the rise in global temperatures and to avoid a potential increase of 2 degrees Celsius (preferably 1.5 degrees, according to experts) compared to pre-industrial levels. The nature of the target implies that countries, governmental and non-governmental organizations and institutions, initiatives around the world, current and potential investors, creditors and lenders, and other stakeholders will increasingly be expected to play a key role in the transition to a low-carbon economy and sustainable growth. It is an undeniable fact that low-carbon technologies become increasingly competitive today (Oreshkova, 2022b). Large and publicly traded companies are required by EU law to publish regular reports on the social and environmental risks they face and how their activities affect people and the environment (European Commission, 2023a).

2. RESEARCHER CONSIDERATIONS, CRITICISMS AND CONCERNS

European Union legislation, in particular the Non-Financial Reporting Directive (NFRD), requires certain large companies operating in the European Union to provide information on key issues related to sustainability, sustainable development, and climate change. The NFRD was adopted and implemented in the Member States of the European Union to support the sustainability paradigm and the Sustainable Development Goals. EU policy and the NFRD represented a necessary shift towards a more robust regulatory regime and system. However, limitations and weaknesses remained. Researchers such as Tsagas and Villiers (2020) argue that *the NFRD has not achieved its objective of improving the relevance, consistency and comparability of information disclosed by large companies across the European Union because it remains very broad and generic in its approach*. In particular, based on a thorough analysis, the authors show that large companies' sustainability reporting practices are haphazard and arbitrary as they comply with different reporting initiatives and frameworks, making these practices "less rather than more transparent". By providing a comprehensive overview of existing reporting frameworks, Tsagas and Villiers (2020) highlight the global need for greater clarity in such a complex international landscape.

The results of the implementation of the NFRD in the European Union have also been the subject of discussion, analysis and criticism by other authors. The impacts and effects are analyzed by Aureli et al. (2020) in light of the economic, social, societal, governmental and other dominant factors that characterize each of the countries studied. *The in-depth analysis reveals evidence of divergence and discrepancies, catalyzed by differences in the national economic systems of each country. Practices and reporting vary between countries and companies*. The authors argue that accounting studies using institutional theory show that even where there is coercive pressure to converge, local practices and domestic traditions are other types of pressure that play a key role in maintaining divergence. Similarly, legal studies show that attempts at harmonization by the institutions of the European Union are usually challenged by member state authorities seeking to maintain the status quo of the local context, and this may be true of CSR reporting harmonization. The findings of other researchers, Jamali and Neville (2011), argue that local and indigenous historical, cultural, economic and political factors influence and shape the profile of corporate social responsibility (CSR) conceptualization that exists in a given country, and that convergence of different CSR practices is only apparent.

3. THE NEW EU DIRECTIVE ON CORPORATE SUSTAINABILITY REPORTING

European Union (EU) policy responds to climate change in many ways. Tackling climate change is a priority for the European Parliament. The EU has committed itself to a series of targets to reduce greenhouse gas emissions. Global average temperatures have risen significantly since the Industrial Revolution and the last decade, from 2011 to 2020, was the warmest on record, causing concern among scientists, environmentalists and ecologists. The European Commission's 2001 Green Paper "Promoting a European Framework for Corporate Social Responsibility" was the cornerstone of the European Union's policy on corporate social responsibility. However, it was not until the Non-Financial Reporting Directive 2014/95/EU that the regulatory framework for CSR reporting was consolidated.

The new EU Directive on corporate sustainability reporting came into force on 5 January. The Directive introduces detailed reporting requirements and ensures that large companies are obliged to disclose information on sustainability issues such as environmental rights, social

rights, human rights, and governance factors. The CSRD also introduces a certification requirement for sustainability reporting (European Council, 2022) and improves the accessibility of information by requiring it to be published in a separate section of the company's annual report. The aim of the EU institutions, the Parliament, the Council, and the Commission, is to modernize and promote the rules on the production and provision of information on social, environmental and climate change issues using the instruments of EU law. The CSRD is designed and developed to ensure that stakeholders such as investors and other interested parties have access to the information necessary to assess the financial risks arising from social, environmental and climate change issues. A wider range of companies and listed small and medium-sized enterprises will be required to provide sustainability information. All large companies and all listed companies, except listed micro-enterprises, will be required to disclose information on social and environmental issues, risks and opportunities that they consider relevant and material, and on the impacts of their activities on people and the environment. It is expected that the European Green Deal will help current and potential investors, creditors and other lenders, civil society organizations and representatives, customers and other stakeholders to better assess the sustainability performance of companies.

The first reporting companies affected by the adoption of the CSRD in the European Union will have to apply the new rules for the first time in the financial year 2024, for annual reports published in the financial year 2025. The European Sustainability Reporting Standards (ESRS) developed by the European Financial Reporting Advisory Group (EFRAG) will apply to companies subject to the CSRD. On 6 June 2023, the Commission launched a public feedback period on the first set of sustainability reporting standards for companies, taking into account EFRAG's technical advice of November 2022 (European Commission, 2023b). There is considerable evidence and broad consensus that the sustainability information currently provided by companies is insufficient, inadequate, or inappropriate. Based on the author's research, literature review and observations of relevant practice, the author argues that the difficulties and complications in practice are mainly caused by the following reasons:

- ***Non-disclosure, formal and artificial disclosure, or incomplete disclosure**, whether intentional or unintentional, of information that may be material (significant) from the perspective of investors and other stakeholders in the decision-making process;*
- ***Disclosure of information on an inconsistent basis**, which in turn makes it difficult for stakeholders to compare information from period to period, company to company, or industry to industry and to understand trends;*
- ***Uncertainty and even confusion among investors, company employees, and other stakeholders** about whether and to what extent disclosed information can be trusted and relied upon to objectively assess the value of the company;*[2]
- ***Many of the frameworks have different focuses as they are designed for different audiences and use different metrics**, which is where much of the confusion comes from;*
- *The organization, structuring, and presentation of financial and sustainability information, whether intentionally or unintentionally, in a way that **obscures or renders unclear, vague, or inexplicable the material relationships between financial and sustainability performance indicators**;*

[2] The ISSB has issued proposals to create a comprehensive global baseline for sustainability disclosures by 31 March 2022. Additional information states that "enterprise value is the total value of a company – the market value of its equity and its net debt. The information that could be relevant to the assessment of enterprise value is broader than the information reported in the financial statements. It includes information about a company's impacts and dependencies on people, the Planet and the economy when [it is] relevant to the assessment of the company's enterprise value", IFRS Foundation (2022).

- ***Incoherence between inside and outside information**, lack of obvious connection between information inside and outside the financial statements;*
- *The climate-related information provided in the financial statements is sometimes too **high level and inadequate, with many shortcomings identified**;*
- ***The multiplicity of frameworks primarily affects practitioners**, as it introduces complications and difficulties and is of great concern to those who are genuinely committed to the sustainability reporting process;*
- *Due to any or all of the above, **the quality and/or quantity of disclosed information on the material (significant) environmental, social, governance, and other related issues is insufficient, inadequate, or unsatisfactory**.*

It is fair to say that the proliferation of corporate sustainability reporting frameworks around the world is flourishing. The global need for greater coordination of international efforts at a higher level, and the very diverse and varied global landscape, can mean that sustainability reporting tends to become a major barrier to sustainable corporate behaviour and policies, leading to a lack of real incentives for high corporate governance to act more sustainably. Madelyn Antoncic CEO of the Sustainability Accounting Standards Board (SASB) Foundation expressed a similar concern. "When one considers the overall universe of sustainability information that could be relevant for all corporate stakeholders, it can seem overwhelming," Antoncic suggested. This view is echoed by David Parham, SASB's director of research, who is concerned about the proliferation of standards, which Parham says can be a problem for people in all parts of the sustainability community. For the reporter, Parham says, it can mean at best recalculation and at worst the collection of completely different underlying data, depending on the requirements of each framework. "For the user, unless it is apparent that the data has been calculated on a different basis and the underlying methodologies are clearly and transparently articulated, this can make it difficult to compare, and therefore, to make decisions regarding variable performance on a given factor" (Parham, quoted by Gaetano, 2019).

Importantly, many of the frameworks look at different metrics for different audiences. Renee Mikalopas-Cassidy provides evidence and highlights some indicative facts – the Carbon Disclosure Project focuses on a single area, while the International Integrated Reporting Council (IIRC) focuses on a broader range of issues. The Global Reporting Initiative follows a public good model, while the SASB, originally designed for US investors, focuses on the company itself. It was specifically designed to be relevant to the needs of American investors, which can prove problematic when trying to align SASB standards with global partners. Each framework reflects the specificity of the context in which it was developed. The apparent differences can make it difficult to conclude definitively whether a company is sustainable, although Mikalopas-Cassidy says that such a binary approach is unrealistic anyway. An initiative like the Better Alignment Project "works to some extent", says Georg Kell, director of the United Nations Global Compact, which promotes the UN's Sustainable Development Goals (SDG) framework. Despite the project's good intentions, there is a limit to how fully these frameworks can be aligned, concludes Kell, chair of Arabesque, and he is skeptical that there will be any real alignment in the immediate future. However, he does not necessarily see this as a cause for great concern, as he acknowledges the inconvenience of having to wade through all the frameworks; ultimately, Kell sees it as many roads to one destination. As Kell admitted, he is not inclined to define the lack of harmony as a major problem because all frameworks have the same goal and many, many ways to get there. Michael Kraten, a member of the Sustainability Investment Leadership Council, is similarly optimistic but with a different motive. The Council was

established to provide insight into how accountants and lawyers can incorporate sustainability practices that align economic opportunities with sustainable policies. While there are many different sustainability frameworks, the market has started to develop its own big four – the GRI, the SASB, the UN's SDG and the IIRC. Unlike Kell, Kraten believes that these four can work very well together, noting that they produce complementary standards (Gaetano, 2019).

Climate change reporting and disclosure, which the author considers to be the most important part of sustainability reporting, has evolved significantly over the past year. The International Sustainability Standards Board (ISSB) of the International Financial Reporting Standards (IFRS) Foundation (in London), which aims to provide a global baseline for climate-related financial disclosures, has been consulting on its standard-setting priorities and Exposure Drafts (the ISSB EDs) for endorsement by various jurisdictions. In the European Union, the European Financial Reporting Advisory Group consulted on its European Sustainability Reporting Standards Exposure Drafts (the ESRS EDs), which incorporate the reporting requirements of the Corporate Sustainability Reporting Directive (CSRD). At a regional level, overseas, the US Securities and Exchange Commission (SEC) consulted on its proposed rule on mandatory climate change reporting for SEC registrants. As noted above, there are hundreds of frameworks focusing on sustainability and sustainable development issues, with each organization claiming to be motivated by the humane cause and mission to save people and the Planet. It seems that organizations, economies and regions are struggling to compete and dominate in the global race to achieve this goal, but each is motivated by its specific interests and pursues its particular objectives.

The proliferation of frameworks is a real cause for concern. Rather than providing guidance and real support as intended, the proliferation of frameworks tends to become a prerequisite for compromising or significantly reducing the comparability and usefulness of disclosed information. Hoogervorst, the former chair of the International Accounting Standards Board, has acknowledged this fact (London, 2019), highlighting that there are now at least 230 initiatives for corporate sustainability standards across more than 80 sectors. "There are simply too many standards and initiatives in the area of sustainability reporting," Hoogervorst (2019) warned, citing a telling example: "Tesla is the top-ranked company in [investment research firm] MSCI's sustainability index, while [the Financial Times Stock Exchange 100 Index] ranks it as the world's worst carmaker on ESG issues. Another agency puts it somewhere in the middle."

Due to identified problems with the quality and/or quantity of information in sustainability reporting and disclosure, investors and other stakeholders do not have a reliable picture of the sustainability risks faced by companies. Companies' impacts on people and the environment and their plans to reduce these impacts in the future, should increasingly be known to all stakeholders. The significantly improved quality of information would better support stakeholders in meeting their specific disclosure requirements under the Sustainable Finance Disclosure Regulation (SFDR). Stakeholders and investors in particular need relevant, consistent and comparable information on the sustainability impacts of the companies in which they invest, as the green investment market cannot be credible without such information. Companies' impacts on people and the environment, and their strategies to reduce these impacts in the future, should increasingly be known to all stakeholders.

Mackintosh, a former chair of the CRD and vice-chair of the IASB, acknowledges that the TCFD has been quite successful over the years and points out that a study of participants' frameworks against the TCFD recommendations was undertaken because the Task Force has

gained a lot of traction and many companies are interested in using the recommended metrics in their corporate reporting. The TCFD (2017) framework is based on four pillars:

- ***Governance*** *on climate-related risks and opportunities, board oversight and management's role in assessing and managing such risks for both investors and companies;*
- ***Strategy****, on the risks and opportunities posed by climate change, the implications for asset allocation and the processes investors use to assess performance;*
- ***Risk Management*** *on the processes investors use to measure, monitor and manage climate-related risks; and*
- ***Metrics and targets****, on the measures investors use to manage their climate-related risks and opportunities.*

Although significant international and global efforts have been made in recent decades, important issues remain to be addressed in the future. The author's research and a thorough review of EFRAG's recent publications on the topic central to this paper identify common problems (lack of consistency and transparency, lack of clarity about the links between information within and outside the financial statements, and others) encountered in practice that need to be addressed (EFRAG, 2023a).

- *In some cases, companies disclose climate-related risks in the front section (part) of the financial statements without any quantitative disclosure*[3];
- *Management reports and sustainability reports include disclosed information on commitments and investments that are not reflected in the financial statements;*
- *The carrying values/amounts, remaining useful lives and residual values of assets, impairment of assets and information within segment reporting are often not linked to the disclosures outside the financial statements relating to companies' investments and business model adaptations as a result of their transition.*
- *In practice, it is often unclear when failures to meet the relevant 'net zero' related commitments will be recognized by reporting entities as provisions or disclosed as contingent liabilities;*
- *The use of terms such as commitments, compensation, neutrality, etc. in sustainability reporting may not be consistent with the use of the same terms in financial reporting.*
- *It is difficult to reconcile the information on climate-related risks and opportunities in sustainability reports with the information provided in the financial statements*[4]*;*

4. FUTURE RESEARCH AND DEVELOPMENT

The directions for future research and development in sustainability reporting are outlined and predetermined by the nature and character of the problems identified. The global trend is likely to be towards a high degree of consistency, comparability, and transparency of information within and outside the financial statements, including sufficient clarity about their interrelationships. Further development of industry-specific requirements, building on the SASB standards, can be expected to address the wide range of sustainability issues. As noted by Kathryn Cearns (2015), chair of the ICAEW's Financial Reporting Advisory Board and Financial Reporting

[3] One insurance company's annual report, which included sustainability disclosures in the front section, referred to climate risk 330 times, but the financial statements did not provide (disclose) any quantitative information on this risk.

[4] For example, reconciliation of EU taxonomy-related investments to financial statements line items or segment information. Differences in the unit of account used for sustainability reporting and financial reporting may also cause difficulties. For instance, assets, vulnerable as exposed to climate-related physical risks, are disclosed at the site level in the sustainability disclosures but this is not reconcilable to the information in the financial statements line items or the segment disclosures.

Committee, the accountancy profession has a great heritage and legacy. To ensure future prosperity through successful and sustainable business practices, Kathryn Cearns argues that it is essential to consider new forms of corporate reporting. Recently, at the 45th Annual Congress of the European Accounting Association (EAA) in Finland, EFRAG hosted a symposium on the critical importance of the link between the information provided by (general purpose) financial statements and sustainability reporting information (EFRAG, 2023b).

Mackintosh recommends three key things to consider – whether a framework can be compared with other frameworks, what is material to the business, and what the business hopes to achieve with the framework, admitting that he does not believe there is a clear answer. "There is still a lot of overlap and potential for confusion," argues Mackintosh (2019). Undoubtedly, each company or organization's approach should be tailored to the nature and specifics of its activities and the particular risks faced by its activities and inherent assets, as well as the climate-related risks created by the activity itself (Oreshkova, 2022a).

Corporate reporting is an essential part of a company's accountability system. Corporate reporting is not only the system and process of collecting and recording the necessary data and transforming it into information using specific methodologies, technologies and procedures; it is also how companies communicate with stakeholders about their position and performance. The operation of the accountability system and the communication process have long-term implications for a wide range of external and internal stakeholders and societies, which is critical to corporate sustainability reporting. These considerations should be at the forefront of the minds of academics and researchers; politicians and policy makers; accounting, financial reporting and sustainability standard setters and regulators; company managers and stakeholders; and the accountancy profession.

5. CONCLUSION

Corporate boards and managers are increasingly aware of, and even openly acknowledge their growing concern about, the potential (likely) impact on their bottom line of worsening climate change and environmental factors other than social and governance issues. This has led to a growing need for clarity about where a company stands on these issues and how it is acting to improve these broader practices. In response, many regional and international organizations have emerged to develop and provide frameworks for assessing sustainable corporate behavior. However, many of these frameworks appear to be competing with each other, while others have different (single or broader) focuses and approaches, looking at different metrics for different audiences. As a result, companies around the world are adopting and applying different frameworks, which is the main reason for the reduced comparability and usefulness of the information disclosed and the reduced effectiveness due to the lack of information of sufficient quality for stakeholders.

It is equally important and fair to acknowledge that the proliferation of frameworks primarily affects those who are truly committed to sustainability reporting. The multiplicity and proliferation of frameworks are a major concern for practitioners involved in the sustainability reporting process. It creates complications, difficulties, and barriers that prevent practitioners from presenting the true picture and status of the organization in terms of sustainability and sustainable development, enhancing its reputation and achieving the proposed positive impacts from the organization's perspective, as well as positive ecological, environmental and social impacts.

The issue of the global need for sustainable business practices, once largely an afterthought in the corporate world, is gaining momentum as it proves to be of paramount social and human importance. The author's main concern remains whether humanity has reached the point where its inaction, unresponsiveness, or inability to respond adequately to the worsening problems of accelerating climate change, environmental degradation, loss of biodiversity, etc. has allowed such processes to become irreversible on a global scale.

The effectiveness and efficiency of disclosure will depend on the priorities, concerns and understanding of those at the highest levels of corporate governance and management. Climate change is emerging as a critical factor and key driver of investment decisions in the global allocation of financial capital. Investors are increasingly seeking to understand the potential and existing risks and benefits of the transition to a low-carbon economy. Not surprisingly, the innovative proposals from the US SEC, the EFRAG and the ISSB come at a time when climate-related disclosure requirements are flourishing around the world.

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Non-financial Disclosure of Large Portuguese Companies and Its Determinant Factors

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Abstract: *This paper aims to analyze the degree of disclosure of non-financial information (mandatory vs. voluntary) provided by large Portuguese companies and to identify its determinant factors. A content analysis was conducted on a total of 41 corporate reports published in 2020 by listed and unlisted companies with more than 500 employees. A multiple linear regression model was developed, with a non-financial disclosure index as the dependent variable and visible characteristics of the companies and report-related characteristics as independent variables.*

The results indicate that there are statistically significant differences in the level of non-financial information disclosure between listed and unlisted companies. Multiple linear regression model results showed that the variables of profitability and the use of the Global Reporting Initiative framework are statistically significant at a significance level of 5%, while the variable of the extent of the report is statistically significant at a significance level of 10%.

1. INTRODUCTION

Non-financial information provides information about the environment and social aspects, to cover all the needs of stakeholders (Malek-Yonan et al., 2016; Ştefănescu et al., 2020). There is no consensus in the literature on whether non-financial reporting should be mandatory or voluntary (Ribeiro & Monteiro, 2015). Nevertheless, non-financial reporting has moved from a voluntary basis to a standardized and mandatory practice (Osmanagić Bedenik & Barišić, 2019).

In recent years, countries such as India, Brazil, China, Denmark, South Africa, and Malaysia have disclosed non-financial information on Corporate Social Responsibility (CSR) (Hoffmann et al., 2018). The same scenario is currently experienced within the European Union (EU), by Directive 2014/95/EU, of the European Parliament and of the Council, of October 22, 2014, which establishes the obligation of non-financial reporting for some types of entities.

In Portugal, this was transposed into the Portuguese legal system by Decree-Law (DL) No. 89/2017, of 28 July. This law began to take effect in 2018 for the accounts for the year 2017, producing changes in Article 66B of the Commercial Companies Code (CSC). The disclosure of non-financial information must be made through a non-financial statement or through a report separate from the management report, which must be published together with the management report or made available to the public on the company's website.

DL 89/2017 applies to large companies considered entities of public interest and entities of public interest that are parent companies of a large group and that exceed the average number of 500

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employees[4]. The information contained in the companies' reports must refer to environmental issues, social aspects, measures relating to workers, respect for human rights and the fight against corruption and bribery attempts, and must include, in particular, the description of the business model adopted by the entity or group, the description of the policies followed by the entity, as well as their results, the main risks associated with these issues and the most relevant key performance indicators for the company's activity. The obligation of this information arises from the need to increase the comparability, transparency and coherence of non-financial information.

Over the years, several studies have focused on analyzing the information that is mandatorily required by the European Directive (or by the Decree-laws that transposed it into the different legal systems of the Member States). However, few studies have analyzed the disclosure of non-financial information in companies that are not obliged to apply the Directive, but that, voluntarily, choose to do so. In this sense, this work seeks to fill this gap, by analyzing the degree of disclosure of non-financial information (mandatory vs voluntary) carried out by listed companies and large Portuguese companies and identifying their explanatory factors.

Given the above, this paper is structured in six sections. In section 2 are defined the research hypotheses, in section 3 the research design is presented, followed by the presentation and discussion of results in section 4. Finally, future research suggestions are presented in section 5, and the conclusion is in section 6.

2. RESEARCH HYPOTHESES

To fulfill the objective of this paper, based on the literature, we have identified 8 variables as potential determinant factors for non-financial information disclosure. These variables have led to the formulation of research hypotheses, which will be presented below.

2.1. Company Size (SIZE_ Log of Total Assets)

Company size is considered one of the central variables in studies that aim to analyze and explain the extent of disclosure. Kiliç and Kusey (2017) found that larger companies are more likely to publish sustainability reports than smaller companies. For Baumann-Pauly et al. (2013), small and medium-sized companies tend not to disclose as much non-financial information compared to large companies, as they consider it too expensive to invest their resources in this type of action.

Larger companies tend to disclose more information than smaller companies since they are more vulnerable to pressure from stakeholders and the general public (Kansal et al., 2014). For Pereira et al. (2020), this can be explained by the constant concern of large companies to improve their image and reputation in society, as stipulated by the Theory of Legitimacy.

Given the above, there are several studies (Buitendag et al., 2017; Duran & Rodrigo, 2018; Dyduch & Krasodomska, 2017; Pereira et al., 2020; Szadziewska et al., 2018; Venturelli et al., 2017, 2019) that found that the degree of disclosure of non-financial information by companies is positively related to company size. In view of the above, we formulate the following research hypothesis:

[4] In Portugal, entities of public interest are those qualified by article 3 of the Legal Regime for Audit Supervision, approved under the terms of article 2 of Law no. 148/2015, of 9 September. Large companies are those that exceed at least two of the three limits defined in paragraph 3 of article 9, established in accordance with article 9-A, both of DL nº 158/2009, of July 13, as amended by DL nº 98/2015, of June 2nd.

H1: *Firm size has a positive relationship with the degree of disclosure of non-financial information.*

2.2. Activity Sector (SECT: Industry vs Not Industry)

For some authors (Buitendag et al., 2017; Dyduch & Krasodomska, 2017; Sierra-Garcia et al., 2018), the sector in which the company operates is a significant factor in terms of regulatory compliance, influencing the disclosure of non-financial information. Companies whose activity has a negative impact on the environment tend to disclose more and higher quality information compared to other companies (Dyduch & Krasodomska, 2017; Szadziewska et al., 2018). According to Garcia-Benau et al. (2022), companies operating in the oil and energy sector, consumer services, financial services and real estate are sectors more likely to publish non-financial information in a sustainability report. In turn, in the opinion of Gamerschlag et al. (2011), the companies belonging to the energy consumption and supply sector disclose more information of a non-financial nature.

In their study, Sierra-Garcia et al. (2018) found a positive and significant relationship between the activity sector where the company operates and the disclosure of non-financial information. On the contrary, research by Caputo et al. (2019) and Pereira et al. (2020) found a negative relationship. However, Venturelli et al. (2019), and Fuster and Ortiz (2019) found that the sector of activity has no influence on the level of disclosure of non-financial information. Also, Venturelli et al. (2019) did not find any relationship between the sector of activity and the quality of the non-financial report.

Nevertheless, with these contradictory results, it is expected that the largest companies that carry out industrial activities, tend to disclose non-financial information following legal requirements, as a tool to legitimize their activities. In this sense, we formulated the following research hypothesis:

H2: *Companies belonging to industrial activity sectors present a higher degree of disclosure of non-financial information.*

2.3. Internationalization (INT)

Over the years, several studies analyzed the effect of the level of internationalization of companies on the disclosure of non-financial information (Fuster & Ortiz, 2019; Pereira et al., 2020). In the research by Duran and Rodrigo (2018), no significant relationship was found between these variables. However, Fuster and Ortiz (2019) verified the existence of a positive relationship. Based on these results, the following research hypothesis was elaborated:

H3: *There is a relationship between the degree of internationalization of a company and the disclosure of non-financial information*

2.4. Profitability (PROF)

For Tagesson et al. (2013), managers with greater knowledge are better equipped to handle a company's resources effectively. In turn, understand what social responsibility entails and the importance of social and environmental disclosures. For these authors, companies with higher levels of profitability tend to disclose more non-financial information. Duran and Rodrigo (2018) found that

there is a negative and significant relationship between profitability and the disclosure of non-financial information. On the contrary, according to Buitendag et al. (2017) and Garcia-Benau et al. (2022), there is a positive and significant relationship between profitability and disclosure of non-financial information. In turn, some studies did not find any significant relationship between profitability and the disclosure of non-financial information (Dyduch & Krasodomska, 2017; Szadziewska et al., 2018) and the quality of sustainability reports (Mion & Loza Adaui, 2019). In view of the diversity of results, we elaborated the following investigation hypothesis:

H4: *There is a relationship between profitability and the degree of disclosure of non-financial information.*

2.5. Report Type (RepType)

According to Hoffmann et al. (2018), the disclosure of non-financial information is best disclosed in separate reports or sustainability reports. For the authors, companies will include more complete non-financial information in these independent reports, instead of attaching some of this information in non-financial statements. In the study by Fuster and Ortiz (2019) and Venturelli et al. (2019), there was a positive relationship between the type of report and the level/quality of non-financial information. Also, Balluchi et al. (2021), found a positive relationship between the disclosure of social and environmental information through the separate sustainability report and the credibility of the information. Considering these results, the following hypothesis was formulated:

H5: *There is a positive relationship between the use of separate non-financial reporting and the degree of disclosure of non-financial information.*

2.6. Framework (FRAM)

The use of different frameworks in the dissemination of non-financial information has been investigated in the literature (Fuster & Ortiz, 2019; Michelon et al., 2015; Schröder, 2022). For Schröder (2022), the framework is considered a necessary tool to identify gaps in the disclosure of non-financial information, consequently improving the quality of reports. Several authors (Fuster & Ortiz, 2019; Michelon et al., 2015; Venturelli et al., 2019) found a positive relationship between the level of disclosure of non-financial information and the framework used. In this sense, the following research hypothesis was formulated:

H6: *There is a positive relationship between the use of the GRI framework and the degree of disclosure of non-financial information.*

2.7. Length of the Report (No. of pages)

According to Wu and Pupovac (2019), to respond to coercive pressures, companies can use long reports to influence stakeholders' impressions of their social responsibility and performance. Pereira et al. (2020) observed that the average number of pages in reports based on the GRI framework is higher compared to reports in which there is no reference to the GRI. Furthermore, Pizzi et al. (2021) concluded that reporting length can positively influence the reporting of information on sustainable development**.** Given the above, it is expected that extensive reporting will lead to higher levels of disclosure of non-financial information:

H7: *There is a positive relationship between the length of the report and the degree of disclosure of non-financial information.*

2.8. Auditor Type (Big 4)

For Cunha et al. (2014) the audit reduces the asymmetry of information between stakeholders and managers, as it validates the disclosed information. Companies often use external assurance to validate the information disclosed in their non-financial reports, as a way of giving a sign of transparency and commitment to sustainability. According to Angonese et al. (2014), the larger the size of the audit firm, the greater the influence that the auditor has on the company being audited and, consequently, the greater the voluntary disclosure of information made by companies. In light of this thought, the following research hypothesis has been formulated:

H8: *There is a positive relationship between the type of external auditor (Big 4) and the degree of disclosure of non-financial information*

3. RESEARCH DESIGN

3.1. Sample selection

For sample selection, we have considered the following criteria: (a) Companies covered by DL 89/2017: companies listed on Euronext Lisbon as of December 31, 2021, which are classified as public interest companies and have more than 500 employees; (b) Companies not covered by DL 89/2017: we used the special edition of Exame magazine for the year 2021, which listed the "500 Largest & Best Portuguese Companies." From this list, companies with more than 500 employees have been selected. Applying these criteria resulted in a sample of 41 reports containing non-financial information, of which 18 (43.9%) belong to listed companies, and 23 reports (56.1%) belong to unlisted companies. Table 1 presents the results regarding the division of the sample into the 2 groups under analysis.

Table 1. Division of the sample by groups

Groups	Frequency	%
Group 1: Listed Companies – Mandatory non-financial reporting	18	43.9
Group 2: Unlisted Companies – Voluntary non-financial reporting	23	56.1
Total	41	100

Source: Own processing

3.2. Methodology adopted in data collection and processing

A qualitative methodology was adopted through content analysis of non-financial reports for the year 2020, from a sample of 41 reports. For this purpose, a disclosure index (DI) was built based on eight items corresponding to the information requirements of DL 89/2017, which allowed measuring the degree of disclosure of non-financial information. Each item of information present in the disclosure index was classified using a dichotomous scale, with a value of 0 being assigned whenever a given item was not disclosed and a value of 1 whenever an item was disclosed. In this sense, the value of the index results from the quotient between the total items disclosed by each company and the sum of the total items that make up the disclosure index.

In order to analyze the influence of independent variables on the degree of disclosure of non-financial information, a multivariate analysis will be carried out using a multiple linear regression model, which is calculated using the following formula (see Table 2):

Table 2. Multiple Linear Regression Model

$DI = \alpha_0 + \beta_1 Size + \beta_2 Sector + \beta_3 Inter. + \beta_4 Prof. + \beta_5 RepType + \beta_6 Fram + \beta_7 No. Pages + \beta_8 Big4 + \theta_i$

Source: Own processing

4. PRESENTATION AND DISCUSSION OF THE RESULTS

4.1. Descriptive analysis of results

As previously mentioned, a disclosure index was created, to measure the degree of non-financial disclosure. This index ranges from 0 to 1, with a value of 0 when no item is disclosed in the non-financial report and a value of 1 when the report contains disclosure on all items considered in the index. Table 3 presents the descriptive statistics obtained.

Table 3. Non-financial information disclosure index: descriptive statistics

	Average	Dev. error	Min.	Max.
Group 1: Listed Companies –Mandatory non-financial reporting	0.93056	0.115222	0.625	1
Group 2: Unlisted Companies – Voluntary non-financial reporting	0.80457	0.222491	0.250	1
Total sample	0.85988	0.192030	0.250	1

Source: Own processing

The disclosure index has a minimum value of 0.250 and a maximum of 1 and, an average value of 0.86. Unlisted companies have an average of 0.80. In turn, for listed companies, the minimum value of the index is 0.625 and the maximum value is 1, with an average of 0.93. In this sense, we observe that the degree of disclosure of non-financial information is higher in the group where reporting is mandatory. However, the companies that make up the voluntary non-financial reporting group also show a high degree of disclosure. The disclosure of non-financial information is an *accountability instrument*, allowing large companies to legitimize their performance and manage the perception of their stakeholders and, thus, preserve their image and legitimate status in society.

4.2. Multivariate analysis

Table 4 summarizes the results obtained in the regression model, associating the dependent variable (disclosure index) and the independent variables defined in the research hypothesis.

It is possible to conclude that the independent variables explain about 51.20% (R^2) of the value of the dependent variable (disclosure index). However, we can see that only 3 independent variables were statistically significant. The variables Profitability and Framework proved to be statistically significant at a significance level of 5%, while the variable Length of report (No. Pages) proved to be statistically significant at a significance level of 10%.

According to Duran and Rodrigo (2018), the higher the financial margin of companies, the more resources are made available for the practice of non-financial disclosure. In view of the above, the results show that the greater the profitability of a company, the more non-financial

information it tends to disclose. In this sense, H4 is validated. These results are in line with the results obtained by Buitendag et al. (2017) and Garcia-Benau et al. (2022). Additionally, the Framework variable was also positive and statistically significant, which means that companies that adopt GRI standards are more likely to disclose non-financial information. Thus, H6 is also validated. These results coincide with the results of Michelon et al. (2015), Venturelli et al. (2019), Fuster and Ortiz (2019), and Schröder (2022).

Table 4. Results of the multiple linear regression model

	Non-standard coefficients		**Standardized Coefficients**		
	B	Error	Beta	T	sig
(Constant)	0.600	0.501		1,200	0.244
Size	0.005	0.056	0.020	0.089	0.930
Prof.	0.002	0.001	0.456	2.136	0.045
Big 4	-0.036	0.097	-0.065	-0.377	0.710
Inter	-0.040	0.076	-0.121	-0.525	0.605
Sector	0.165	0.102	0.414	1.613	0.122
RepType	-0.056	0.091	-0.161	-0.614	0.546
Fram	0.189	0.085	0.557	2,216	0.038
No. Pages	0.001	0.001	0.472	1,894	0.072

R	**R^2**	**R^2 Adjusted**
0.716^{th}	0.512	0.280

a. Dependent Variable: Index
b. Predictors: (Constant), TipSetor, Rentab, NºPág, TipAuditor, Inter, LogAtivo, fram, Trelat

Source: Own processing

The variable Length of the report (No. Pages) proved to be statistically significant for a significance level of 10%, so H7 is validated. The number of pages in the report has a positive influence on the level of disclosure of non-financial information. This result is in line with that of Pizzi et al. (2021). Contrary to what was expected, the results for the remaining variables under study proved not to be statistically significant.

5. FUTURE RESEARCH DIRECTIONS

In future studies, we suggest expanding the sample (including medium-sized companies, as provided for the new European directive) as well as extending the time horizon. A broader longitudinal study will allow the collection of a greater number of observations and analyze the evolution of non-financial reporting practices. It would also be interesting to compare the non-financial information disclosure in the Iberian region and the broader EU context.

6. CONCLUSION

The main focus of this research was to analyze the degree of disclosure of non-financial information (mandatory vs voluntary) carried out by listed companies and large Portuguese companies and identify the determining factors of the degree of disclosure. The results allowed us to conclude that listed companies, where reporting is mandatory, have higher mean values of disclosure of non-financial information (mean index = 0.93) compared to unlisted companies, where non-financial reporting is voluntary (mean index = 0.80). The results obtained are consistent with the results of Hoffmann et al. (2018) and Tarquinio et al. (2020), who found a higher level of disclosure of non-financial information in companies from the moment they were

obliged to disclose this type of information. Coercive isomorphism comes from formal pressures that are exerted on organizations, resulting from DL 89/2017, and from the expectations created by stakeholders who expect a high degree of compliance with the law.

The results of the multiple linear regression showed that the profitability and framework variables are statistically significant at a significance level of 5%, and the report length variable (number of pages) was only statistically significant at a significance level of 10%. These results allowed us to validate hypothesis H6, as there was a positive association between the framework adopted by companies and the degree of disclosure of non-financial information, corroborating the results of Michelon et al. (2015), Venturelli et al. (2019), Fuster and Ortiz (2019) and Schröder (2022). In addition, it was also possible to validate hypothesis H4, since there is a positive and significant relationship between a company's profitability and the disclosure of non-financial information. Hypothesis H7 was also validated, proving the existence of a positive and significant relationship between the number of pages in the report and the degree of disclosure of non-financial information. For the remaining variables, we were unable to find any statistically significant relationship.

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Evidence-Based Policy Making Towards Social Sustainability

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Abstract: *Social sustainability is one of the key pillars of sustainable development. In our analysis, this concept refers to the need for the creation of a society that contains all the conditions for sustainable development in terms of equal opportunities for employment and social well-being.*

Currently, significant problems and dysfunctions exist as long as several European labor markets are fragmented with a strong insiders-outsiders divergence, job polarization, high labor market slack, and high in-work poverty rates, especially in precarious forms of employment. In Europe as well as globally, addressing these issues is of major importance to ensure social sustainability. This paper depicts the state of play of social sustainability in Europe and aims to identify specific policy responses that could offer viable solutions to old and emerging challenges in terms of social inclusion, within the framework of evidence-based policy making mainly related to social policy.

1. INTRODUCTION – PRELIMINARY REMARKS

The present paper aims to analyze the state of play regarding social sustainability and the relevant key challenges for the public policy complex. The key research questions are the following:

- *What was the evolution of the interrelation between sustainable development and social sustainability?*
- *What are the key determinants-dimensions of social sustainability?*
- *What are the factors that contribute to social sustainability?*
- *What are the key challenges for the Welfare State and the public policy complex towards evidence-based policy making?*

Social sustainability constitutes one of the main theoretical pillars of the sustainable development concept, although it is open to variations in its content and meaning, as there is no commonly accepted definition so far. In any case, this concept refers to the need to create a society that contains all the conditions for sustainable development in terms of equality, opportunities and social well-being.

The inclusion of social sustainability in the sustainable development conceptualization is first identified in the Brundtland Report (WCED, 1987) and the Rio reports of the United Nations (UN, 1992), in which a synthesis of the ecological, economic and social dimensions of social development takes place. Hence, these three areas were called dimensions or pillars of the concept of sustainability. At the same time, these pillars are not independent of each other but are

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interrelated and the existence of all three is a necessary condition for forming a comprehensive content to the concept of sustainability. In any case, the concept of social sustainability is related both to environmental issues and to issues of social well-being and cohesion, while considering the contribution of the private and public sectors to the processes of achieving these objectives, i.e. improving living conditions on equal terms.

2. SUSTAINABLE DEVELOPMENT AND SOCIAL SUSTAINABILITY

Sustainable development is based on three interrelated and equally important pillars; the environmental, the economic, and the social. The environmental refers to the preservation and respect of the natural ecosystem and its functions; the economic is related to the creation of stable economic systems that ensure social justice without hindering the functioning of the free market while respecting the environment; and the social involves building a framework that promotes the well-being of the whole population with the ultimate aim of preserving social cohesion (Ekins, 2000) while reducing social discrimination.

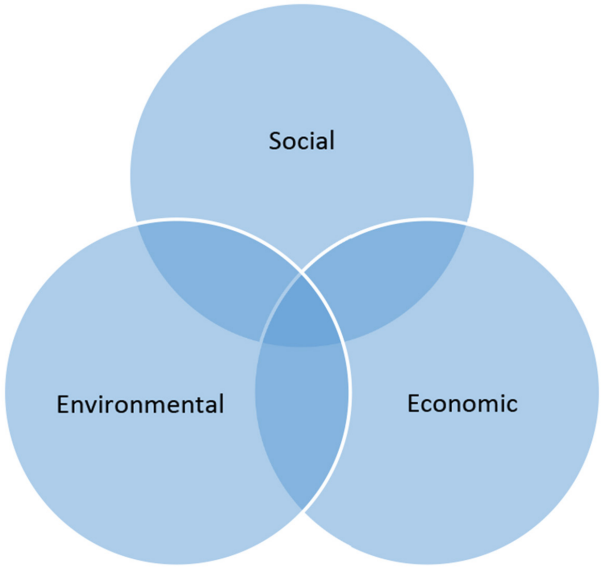

Figure 1. Sustainable Development Pillars

The academic debate on these issues started in the 1960s (UNEP, 2002), but the emphasis was initially on improving management, while the social and environmental pillars were not distinguished. The transfer of the concept of sustainable development from the theoretical to the practical-institutional level first took place in 1972 with the report "The Limits to Growth" by the Rome Group, which referred to the decline of natural resources due to industrial pollution, population growth and economic growth, and the Stockholm Declaration of the United Nations, which placed a substantial focus on the environmental orientation of development (UNEP, 2002; Baker et al., 2005). Both in the 1970s and even more intensively in the 1980s, the link between sustainable development and the environmental pillar was strengthened, to the point where the concept became synonymous with environmental sustainability (Evans & Thomas, 2004). However, the process of more closely linking and in some cases identifying the concept of sustainable development with environmental issues is seen by some scholars, such as Castro (2004), as a response to the growing radical environmental movement of the time that was putting obstacles to development. Therefore, it was necessary to find solutions that combined ecosystem protection while promoting economic and social progress. This was precisely the subject

of the UN's definition of sustainable development in the Brundtland Report, according to which sustainable development refers to the satisfaction of the present needs without compromising the ability of future generations to meet their own needs (WCED, 1987). This general definition provided the opportunity for the gradual development of a public debate around the content of the concept through the creation of several approaches, critical or supportive (Baker et al., 2005). Some of these approaches did not accept the link between the conventional concept of development and sustainable development but considered that these two concepts could work in parallel in order to prevail in the modern political-economic, globalized system (Rennen & Martens, 2003). In contrast, several international organizations developed the view that environmental sustainability should be part of neoclassical economic principles. However, the result of this inclusion has been the very low impact of environmental sustainability principles and the limited development of alternative effects that the concept of sustainable development can include, such as the social pillar, under the influence of the economic pillar. On the other hand, the view of the utmost importance of the concept of sustainable development was cultivated, as the protection of the environment must be the basic precondition for economic growth, so as not to undermine the well-being of future generations (Baker et al., 2005; Castro, 2004).

The debate on sustainable development and its content led to the creation of several different definitions, but the common element was the effort to deepen both the environmental issues and the socio-economic. Thus, the Rio Conference in 1992 brought together all these contributions to the public debate and several states signed Agenda 21 and the Rio Declaration on Environment and Development, committing themselves to implementing a sustainable development policy that respects the principles mentioned (UN, 1992). Sustainable development was also included in the 1996 UN Istanbul Conference, during which it was stated that sustainable development for settlements (the subject of the conference was human settlements) is necessary to combine economic development with social development and environmental protection (UN, 1996). The protection and respect of human rights and individual freedoms were set as a necessary condition for achieving this objective. There is a greater effort to link the three pillars mentioned above (environmental, economic, and social) as a prerequisite for achieving sustainability. Within a year (1997) the Third UN Conference was held, in which an international legal instrument was established for the first time to promote sustainable development, which would control its main pillars but would focus mainly on environmental protection, and was called the "Kyoto Protocol" (UN, 1998). Finally, the UN conference in Johannesburg in 2002 and, more importantly, the 2012 conference on sustainable development in Brazil, were characterized by the attempt to link the three pillars and consequently consolidate the coexistence of economic development, environmental protection and the safeguarding of social cohesion (UN, 2002). In Johannesburg issues were raised relating to a) the importance of civil society and the private sector in promoting inclusiveness and cooperation between different actors (with the ultimate aim of strengthening social entrepreneurship in order to promote sustainable development), b) the link between green growth and the battle against unemployment and poverty, and c) institutional reorganization at international, national and regional level in order to achieve sustainable development.

The United Nation's (UN) most recent "Agenda 2030" for Sustainable Development ("Transforming our world: the 2030 Agenda for Sustainable Development"), signed in August 2015, sets 17 global strategic goals that will balance social, economic and environmental needs and commit to the effective implementation of Sustainable Development (Figure 2). At the same time, in the European Union, the establishment of the European Pillar of Social Rights in 2017,

sets certain objectives in the course of satisfying social rights, thus making a crucial step towards social sustainability (ETUI, 2021). Although European integration in social issues has not taken a comprehensive dimension, the European Pillar of Social Rights is particularly important because it includes the principles and necessary values in order to achieve social prosperity and social cohesion, thus social sustainability.

Figure 2. The UN Sustainable Development Agenda 2030 priorities
Source: UN, 2015

2.1. Outline of the Social Sustainability Dimensions

Before delving into the analysis of the social sustainability dimensions, it should be mentioned that due to the lack of agreement on the content of the term, different approaches (Shirazi & Keivani, 2019) often appear, not driven by the theoretical thinking that leads to the research on specific domains but by practical issues in different circumstances and under different research methods. Hence, reformist approaches argue for a balance in the three pillars of sustainability (Peterson, 2016), revisionist focus on the addition of a cultural pillar (Soini & Birkeland, 2014) and others stress issues related to governance (Leal Filho et al., 2016), to the political bottom line (Bendell & Kearins, 2005) as well as to ethical values (Burford et al., 2013). In addition, the connection between the three pillars of sustainability, in some cases, continues to be unclear while different priorities are given to each of these directions and they are not integrated as a whole, giving the concept of sustainability an unclear and often "open" content, thus, highlighting the need for further study that leads to a clearer and more comprehensive definition. In this light, we will try to include in the term social sustainability all those dimensions that are necessary and should be included in relevant considerations of sustainability, thus contributing to the clarification of the role of individual actors in achieving social sustainability.

One of the key terms set out by the Brundtland report on sustainable development was that the concept of sustainability necessarily includes needs, highlighting a kind of development that meets the needs of the present without compromising those of future generations, thus indicating the interconnection between nature and society, giving a human-centered dimension to sustainability and highlighting intergenerational solidarity. Certainly, the concept of need must be seen in its broadest form, since on the one hand, it includes, in the context of the environment,

the satisfaction of nutritional energy and other needs in a way that does not compromise the ecological dimensions and the durability of resources, while, on the other hand, there are social needs, which include a wide range of sub-categories such as health, retirement, and education. Consequently, if the concept extends to meeting needs such as education, personal development and social relations, then a much greater activation in terms of interventions is required, leading to the achievement of social well-being.

Employment is one of the key development factors and at the same time, constitutes the basic precondition for achieving social sustainability, on the one hand, it plays a key role in meeting needs, and on the other, it improves living conditions by combining the satisfaction of social and environmental factors. Hence, a key component in achieving social sustainability is the creation of conditions and opportunities for the satisfaction of individual needs. Consequently, employment, which is one of the dominant factors for achieving individual autonomy, through the existence of appropriate norms, institutions and normative-protective frameworks, could achieve individual well-being if promoted in a socially just context. At this point we should bear in mind, the rising of the precarious work in Europe, as well as globally, that affects social inclusion. Further, the rising mega-trends affect employability. It should be noted that during the years 2010-2018, the risk of poverty in temporary employment increased considerably in the majority of EU28 countries (Eurostat, 2020a, 2020b), while the risk was almost three times higher for employees with temporary jobs than for those with permanent jobs (Eurostat, 2020c). Thus, there is a strong correlation between precarious employment, social vulnerability and the risk of poverty (Papadakis et al., 2021). Further, Mega-Trends that are taking place and seem to gradually prevail (e.g. globalization, digital economy, digitalization, demographic and social changes, climate change, etc.- Eurofound, 2020, pp. 3-4) have a clear impact on the structure of the economy and labour market, industrial relations systems, and business models, having, in turn, direct impact on work relations, forms of employment and contracts types and, consequently, on social welfare systems in Europe (Eurofound, 2020, pp. 3-4). Given all the abovementioned, we are not simply referring to the use of resources to meet needs but to the construction of a society that will organize individual life trajectories in an efficient and socially just manner (Senghaas-Knobloch, 1998).

In this context, the form of welfare provided by the state constitutes one of the primary characteristics of modern societies and shapes the conditions for their development within the ever-globalizing system (Pfau-Effinger, 2000). Socially sustainable development should include the reorganization and promotion of the social welfare concept (HBS, 2001; Brandl & Hildebrandt, 2002). Therefore, rights such as employment must be safeguarded not only in terms of ensuring adequate income but also concerning psychosocial dimensions such as working time, social integration and the importance of wage employment for social cohesion (Senghaas-Knobloch, 1998). At the same time, rights to education and health as well as equal access to goods and services, gender equality and tolerance, are aspects of primary importance for achieving social sustainability.

Different factors could be distinguished that contribute to the achievement of the social dimension of sustainability. A first category could include all those factors related to the satisfaction of basic needs and the improvement of life quality. Therefore, they are related to the level of individual income, poverty, income distribution, unemployment, education, training and lifelong learning, housing, health, insurance and employment that satisfies both material and psychosocial needs. The achievement of these goals-factors can only be realized if there is a level of

social justice that implies fairness in terms of opportunities for quality of life and participation in civil society (Löffler, 2004; Nussbaum & Sen, 2002). The next level for achieving social sustainability is social consistency, i.e. social integration through participation in social networks and voluntary actions where the concept of solidarity is realized outside formal institutional and normative frameworks as part of citizenship. These theoretical dimensions could be transferred to the level of political practice through the welfare state and the framework of social policies and social rights it promotes.

3. THE ROLE OF THE WELFARE STATE IN SOCIAL SUSTAINABILITY

In order to achieve social sustainability, it is necessary to implement social policy through the institutional framework of the welfare state. Social policy (in all different fields such as health, labor, cash benefits, pension, etc.) is a deliberate intervention by the state to redistribute resources among citizens as a way to achieve social welfare and sustainability. The concept of well-being is synonymous with that of welfare and meeting needs where there is a shortfall, thus creating a framework for reducing social inequalities and promoting equal access to social goods and services.

The concept of well-being involves two opposing perspectives that have had a major influence on ideological orientations of social policies and the scope of the welfare state: a) welfare is identified as well-being for all and therefore it includes the promotion of social protection as a right which implies the notion of universality and b) care is also offered to those most in need, by implementing selective welfare policies in areas, such as cash-benefits and care services, as a lever for reducing inequalities.

4. SOCIAL SUSTAINABILITY CHALLENGES IN SOUTHERN EUROPE: STATE OF PLAY

The economic crisis, the pandemic, and the current energy crisis highlight the necessity of the welfare state in protecting citizens from the multidimensional social risks that are being reproduced, multiplied, or readjusted. At the international level, the socio-economic context is becoming more complex, with more interdependence and a speed of events that is constantly increasing (Schwab & Malleret, 2021), creating new challenges for achieving social vulnerability. The permacrisis era (multiple crises) highlights that the respective public policies need to be more prepared for phenomena that one might mistakenly consider rare.

The Covid-19 pandemic, as well as all other crises, that occurred in the last decades (economic, energy, migration, etc.), are not "black swan" but "white swan" phenomena (Schwab & Malleret, 2021, p. 34), as humanity has experienced similar situations many times in the past if one takes into account the historical data of pandemics (Huremović, 2019) as well as economic (Sewell, 2012) and migratory crises (Hoerder, 2019). At the level of social policy, permacrisis legacy indicates the importance of an organized, effective and inclusive welfare state.

The labour market in Southern European countries is often considered to be fragmented and divided into the following sectors: central, regional and informal/underground. This fragmentation creates more strongly the problem of insiders-outsiders (Ferrera, 1996, 2010; Moreno, 2000; Papadakis et al., 2021) as well as increases precarity, in-work poverty, and social vulnerability in general (Jessoula et al., 2010; Mulé, 2016). Hence, over time, Southern European countries have had higher in-work poverty rates than the EU average, despite a downward trend in recent years, which follows the trend at the EU level, but does not reduce the existing gap between

South Europe and the EU average. The qualitative characteristics of this indicator show that older employees are more likely to be at risk of in-work poverty. Moreover, employees with low educational attainment, the self-employed (which underlies the case of freelancers), contract workers and part-time employees have over time been the groups most at risk of in-work poverty (Papadakis et al., 2022; Ziomas et al., 2019). At the same time, poverty and social exclusion indicators are higher than the EU average in southern European member states (Greece, Spain, Italy, Portugal) as well as in some eastern (Romania, Bulgaria, Lithuania, Estonia).

At the same time, the shift to teleworking, especially during and after the pandemic, is a crucial transformative factor of the labor market, as the economy is currently increasingly based on working through online platforms. In this form of employment, employees are often neither permanent nor part-time but offer work in pieces (gigs), which intensifies the deregulation of work and the risks for them (Bieber & Moggia, 2021). While promoting teleworking creates new opportunities for trade and innovation, inequalities could be further increased, especially for those in the peripheral and informal sector - rotational employment, freelance and non-formal employment (Nieuwenhuis & Yerkes, 2021). Furthermore, the phenomenon of family-work-life balance disruption occurs because the employee tends to be in a standby situation. The "right to disconnect" and the non-violation of working hours, if respected, can create positive effects. Therefore, there is a necessity to safeguard labor rights, enhance digital skills, strengthen small and medium entrepreneurship and provide incentives for new jobs in order to achieve social sustainability.

5. FUTURE RESEARCH DIRECTIONS

In the coming years, global employment supply is expected to increase jobs related to new technologies, artificial intelligence, digitization and automation, while it is expected to decrease traditional forms of employment such as secretarial support, accounting, administration and unskilled labor (World Economic Forum, 2020). Skills such as analytical thinking and innovation, critical thinking, leadership, creativity and flexibility (inherent in social sciences and humanities content), as well as knowledge of using new technologies, planning, design and digital marketing, will become necessities in the coming years (World Economic Forum, 2020). Due to the expansion of digital platforms and teleworking the phenomenon of lego flexibility occurs. Lego flexibility refers to the fact that the production of each product is divided into its parts. These components are produced in areas where costs are low, quality is high, sufficiency is excellent and the rate of innovation is above average and high (Garud et al., 2002; Sennett, 2006). Each of these four elements brings in different components from different parts of the world, but they eventually come together to make up the product, which may be a mobile phone, a car, a computer, etc. Lego's flexibility depends on having an organizational form in which multifunctional teams are the smaller units and global competence teams are the global units (Azmat et al., 2012). Furthermore, it is vital to assign a central role to knowledge development, knowledge transfer, feedback processes, co-creation, and social sentiment analysis (Meister & Mulcahy, 2017; Susskind & Susskind, 2015).

It turns out that there will be huge social consequences if this kind of Lego flexibility is enacted globally (Standing, 2011, 2014), and will represent the development of a new form of global distribution of labor and occupational specialization (Gaskarth, 2015). The above-mentioned impact should be further explored and analyzed, via relevant research. In this new landscape, skill development, careers, individual risk and wealth creation processes will all undergo inherent

changes. One outcome of this kind of Lego flexibility will be that sovereign states could easily lose control of wealth creation processes (Kessler, 2017; Stearns, 2013). In the 1980s and 1990s, a large part of the labor force moved from industrial production to jobs in the service sectors (Enderwick, 1989; Foster, 2016). This movement took place both through cuts in the number of traditional manufacturing jobs and an increase in service sector jobs (Thurow, 1999). On the threshold of the fourth industrial revolution, knowledge economy workers - the backbone of the middle class - are now under threat (Coates & Morrison, 2016), as well as service sector workers (Frey & Osborne, 2017). This transformation constitutes another future research field.

6. CONCLUSION

The key focus of the welfare states in order to achieve social sustainability during this transformative era should be given to public policies that prepare individuals and societies for fundamental adjustments such as those in labor market, in the environment, and the population (aging). An important strategy in order to achieve higher levels of social sustainability is social investment, which addresses the fundamental sources of the problems based on the concept of humanism but also on the protection of the environment and the achievement of economic sustainability. One of the main challenges is to broaden the tax base (special tax on higher incomes to reduce inequalities) and jointly increase productivity and the quality of employment, invest in human capital, which allows more and better jobs to be created and offer the opportunity for the development of social capital through enhancing participation, democratic dialogue and citizenship.

As social sustainability means an inclusive society and welfare for all there should be a focus on the knowledge society as well as on investments in education, training, reskilling innovation and new technologies. In times of permacrisis, the welfare state is more necessary than ever. It is therefore essential for the state to undertake systematic interventions to boost demand and thus create new jobs. Integration into the labor market and investment in innovation should guide the educational process from infancy through the phases of vocational training and university education. Thus, closer cooperation between employment services and employers, as well as social economy players, is essential.

Defining the concept of social sustainability is a major challenge. However, an attempt to emphasize also on the role of an inclusive and active welfare state is made in the present study. Hence, social sustainability is directly connected with equality of access to important services such as health and education, the concept of intergenerational solidarity combined with solidarity between members of the same generation, the acceptance of cultural diversity, the promotion of citizenship, the promotion of the idea of belonging to a society in order to enhance social participation and action, as well as the creation of incentives to strengthen the social economy and subsequently social inclusion.

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Understanding the Quality and Performance of Work from the Perspective of Sustainable Work

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Workers' well-being;
Performance

Abstract: *Many work contexts are now characterized by the adoption of digital technologies. As digital contexts become ubiquitous in both work and personal contexts the characteristics of workspaces change. This drives the call for understanding how they affect the quality of work and the well-being of individuals. This study examines the factors that determine the quality and sustainability of the workforce, channeling studies involving remote working. The paper is based on a systematic review of the literature addressing work quality and sustainability in remote working contexts. The study builds on recent research work conducted by Eurofound, the European Foundation for the Improvement of Living and Working Conditions, subscribing to the dimensions proposed to frame the work on sustainability and to categorize the findings from the literature. The paper aims to identify variables that affect the satisfaction, well-being and productivity of remote workers. The study builds on the Scopus database, for critical and exploratory analysis of the concepts addressed in the term "sustainable work", searching in abstract or title, between 2018 and 2023, leading to the identification of 243 publications. The study allows for the advancement of our perception regarding the impact and relevance of the theme addressed in the work, and that can be used as a basis for the continuation of the study, in the development of sustainable management strategies focused on facing the challenges of implementation of effective remote work systems.*

1. INTRODUCTION

With the evolution of technology in recent years, there has been a restructuring in working methods and workers' conditions. This includes changes in processes and physical work arrangements. Given this scenario, teleworking has been gaining more space in the market, as a new model of working and interaction between organizations and workers, thus providing greater flexibility in planning tasks, and managing time, environment, and method of execution (De Carlo et al., 2022). The working methods are constantly and dynamically changing, and adapting to the inevitable changes in the working methodologies, driven by various social, environmental, and technological factors (Bharti et al., 2022). The authors Sadłowska-Wrzesińska et al. (2022) conceptualize sustainable work as a job in which workers can perform their professional activities without endangering their physical and/or mental health. Teleworking is often advocated for its benefits concerning environmental and social sustainability, favoring the reduction of travel and work traffic, consequently increasing flexibility and reachability in the professional area. Throughout the COVID-19 pandemic, a significant increase in the number of teleworkers was noticeable, and there is a trend towards the permanence of this new working method in the post-pandemic period across organization and business sectors (Widar et al., 2022).

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2. CONCEPTUAL BACKGROUND OF THE STUDY

The change from conventional face-to-face work to models of remote work is associated with the digitization of processes. Recently, the restrictions caused by the COVID-19 pandemic, had an impact on working models, related to social sustainability, changing the work environment, organizational innovations, as well as the well-being, performance and conduct of employees with such changes (Babapour Chafi et al., 2022).

Against this background, it is crucial to understand the difference between the periods before, during, and after the COVID-19 pandemic. Before the pandemic, few employees worked from home (around 5% in the US), and most did so of their own volition. Likewise, the scenario in the European Union was one where only 3.2% of employees worked remotely. During the pandemic, due to lockdown restrictions, several workers were forced to work remotely – estimated as 39% in the EU and 50% in the US. After the pandemic situation, several studies were carried out highlighting the effects of the pandemic on the organization and working methods, notably addressing the persistence of hybrid working methods that include some extent of remote work (Babapour Chafi et al., 2022).

The concept of work sustainability encompasses environmental optimization, efficiency, and quality of life at work. Characteristics that provide greater organizational and worker resilience, with the ability to meet the different ways of working (Eriksson et al., 2022).

A viable method for assessing quantitative and qualitative trends in research activities over time is bibliometric analysis. In which, it utilizes databases and characteristics of literature metrology. This method has become common in academic studies. Given this, bibliometric studies have advanced considerably in scientific studies in recent years (Xie et al., 2020).

3. DATA AND METHODS

In the present study, a systematic literature review was conducted, to identify the most relevant research in the literature, focused on the quality and sustainability of the workforce, specifically focusing on the factors that affect the quality of work and the well-being of teleworkers. The study was based on the guidelines of research methodologies presented by Kitchenham, et al. (2009), which involve three stages, namely: (i) planning the review; (ii) conducting the selection of articles and the review; and (iii) reporting the review (Bastos et al., 2023).

3.1. Planning the Systematic Literature Review

Variables that affect the quality of work life and that play an important role in productivity and individual well-being have been studied for decades. The growth in the adoption of digital technologies in recent years, forcing many people to work remotely, has shed new interest in the topics since new variables might be at stake (Rasool et al., 2020). Given this scenario, the article aims to carry out a systematic review of the literature, concerning the most recent studies on this topic. The study addresses the following question: What are the most relevant studies in the literature focusing on the sustainability of work, and how do they align with the dimensions of sustainable work proposed by Eurofound?

3.2. Carrying Out Article Selection and Review

In this paper, we investigate the recent and significant studies on workforce quality and sustainability, to identify and analyze the academic works on this topic, comparing their contributions in the literature. During the study, a bibliometric analysis was carried out using the VOSviewer software tool, in order to compare the studies from different countries, regarding citations, correlating them with the keywords, titles, and abstracts used in the studies analyzed. To conclude the analysis of the article, these studies were analyzed towards the research carried out by Eurofound, a European Foundation for the Improvement of Living and Working Conditions, which proposes the aggregation of the determinants of quality and sustainable work in seven dimensions, namely: (i) physical environment; (ii) work intensity; (iii) quality of working time; (iv) social environment; (v) skills and description; (vi) perspective and (vii) income.

3.3. Report of the Review

The study analyzed publications between 2018 and 2023, indexed in the Scopus database. The search took place in May 2023, using the term "sustainable work" in the abstract or title, leading to the preliminary access of 243 journals. The refined search criteria were: (i) by document type (article), thus making 171 journals available; (ii) language (English), with 163 journals available and (iii) open access, making 113 journals available. The data collected covered the year of publication, authors, country, institution, journal, citation count, and abstract. When analyzing the research data, a trend was observed in the period of the COVID-19 pandemic in relation to the context of labor sustainability, due to the increase in the number of publications between the years 2020 and 2022, the years that followed the pandemic, as shown in Figure 1. In the year 2020, there were 50 publications (22%), the year 2021 with 57 publications (23%) and the year 2022 with 53 publications (21%).

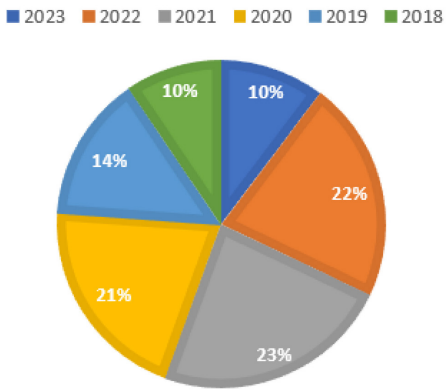
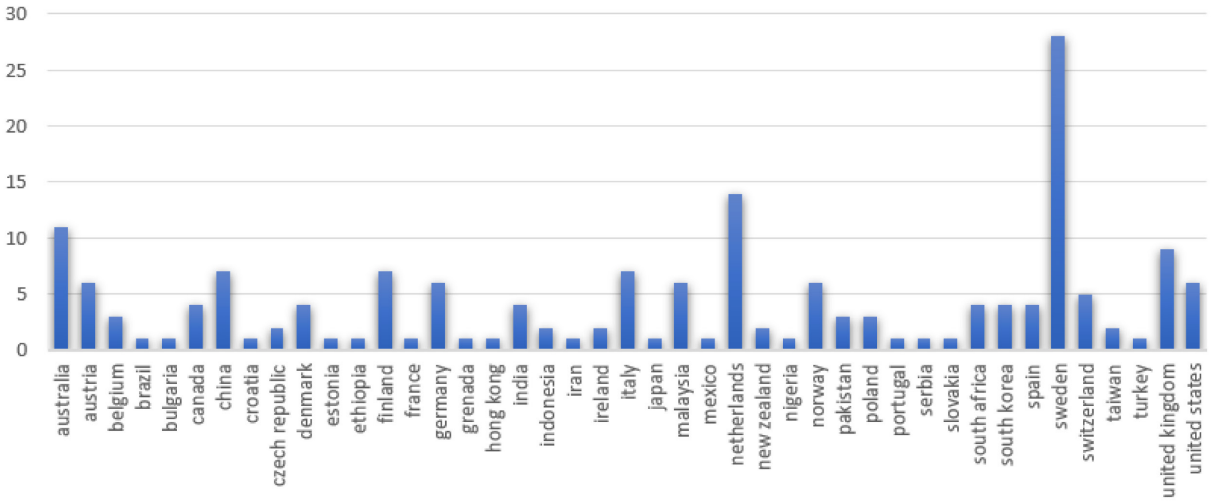


Figure 1. Publications using the term "sustainable work" from 2018 to 2023

Source: Own research

During the research, 43 different countries were identified, among these countries, Sweden was the country that published the most scientific articles in the area (28), followed by the Netherlands (14), then Australia (11), as shown in Graph 1.

The analysis of the selected articles used the VOSviewer software to analyze the co-authorship relationships existing in the countries under analysis. Sweden stands out due to its higher number of publications on the topic of labor sustainability. In the software filtering procedure, countries with at least 5 published articles were selected.



Graph 1. Distribution of the number of publications by country
Source: Own research

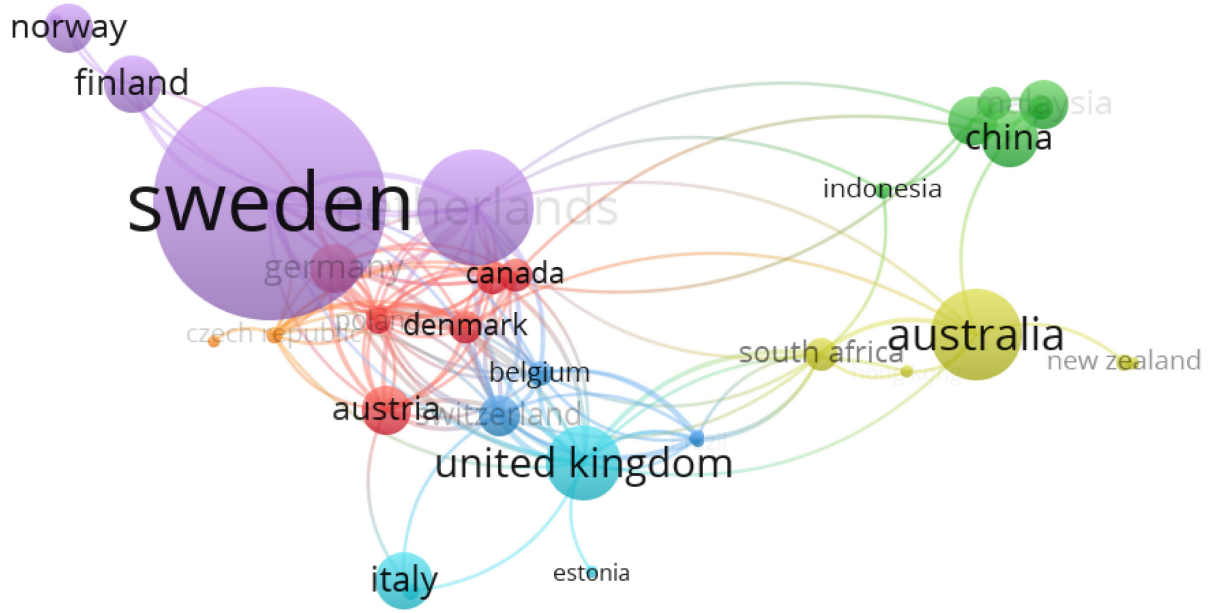


Figure 2. Network map between countries in the context of labour Sustainability
Source: Own research

According to Figure 2, of the 43 countries selected for the study, it is noteworthy that Sweden is the country with the most publications on the topic of labor sustainability and shows a close relationship with research carried out in the Netherlands, Finland, Austria, Denmark, Canada, Belgium, and the United Kingdom.

4. STUDY RESULTS AND CONTRIBUTIONS

In the analysis performed with the VOSviewer software, regarding the co-occurrence of keywords in the analyzed studies, the minimum number of occurrences, which was defined as 1, and the minimum number of clusters, 50, were taken into account. This resulted in a total of 1,201 keywords and 13 clusters. Among the 1,201 keywords, the software grouped the words that present similarity between them, classifying them into clusters. Thus, it grouped the 1,201 keywords into 13 clusters.

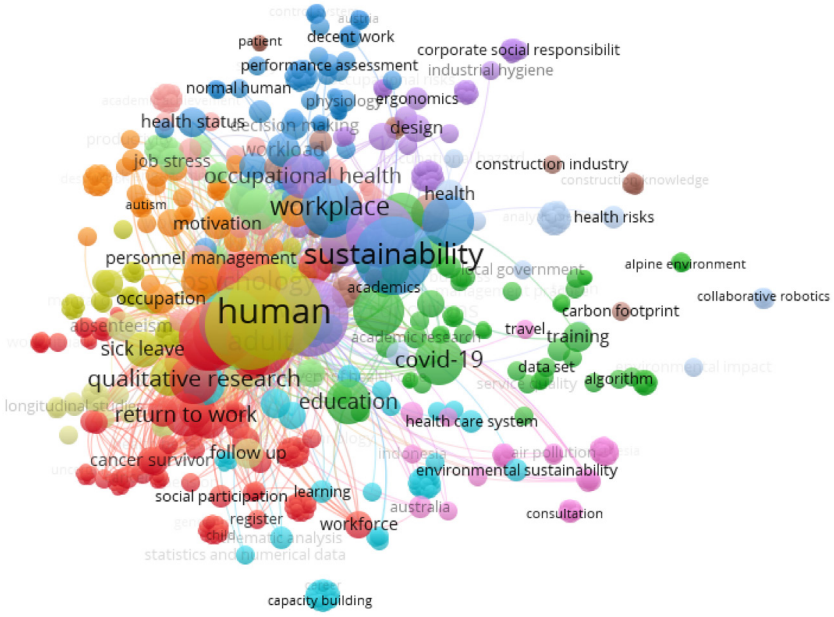


Figure 3. Analysis of the co-occurrence of keywords in the context of labor Sustainability

Source: Own research

Analyzing the 1,201 keywords found in the analysis study, we can see that the most used keywords were: Human (93), article (33), Sustainability (33), female (26), sustainable work (26), adult (25) and male (24). When analyzing the word cloud data, some terms similar to the Eurofound dimensions were identified, namely: physical workload, physical stress, working conditions, workforce, work situation, working time, decent work, work-life balance, employee satisfaction and occupational health.

The study analyzed the co-relationships of authors using VOSviewer software, which resulted in 477 authors, but only 29 of these authors showed co-relationships. These were divided into three groups based on their similarity, as shown in Figure 4, which is represented by three distinct colors.

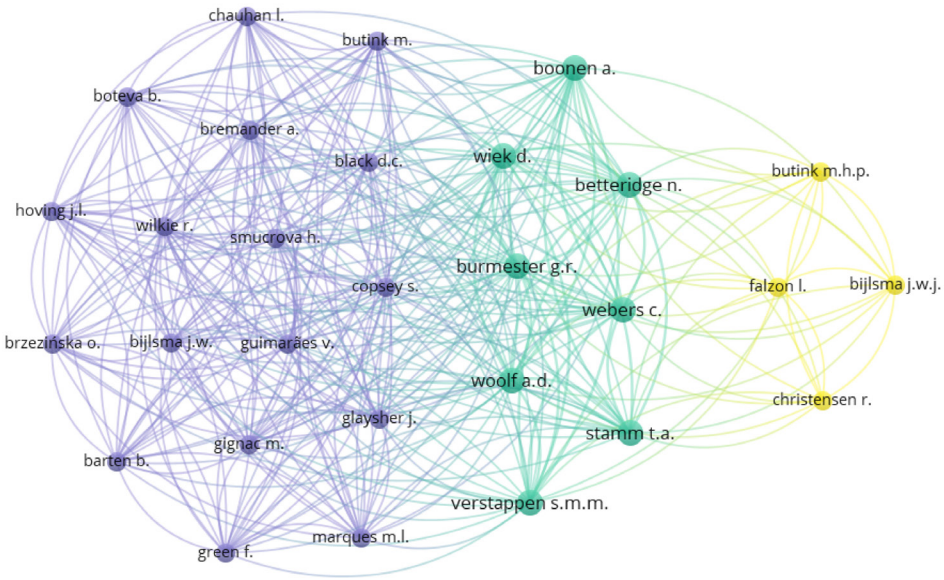


Figure 4. Authors' co-relationship analysis in the context of labor Sustainability

Source: Own research

Continuing the analysis of the co-relation between the authors, using the VOSviewer software, in the filtering process the option of non-co-relation between the authors was selected, to verify the "independence between the authors". This resulted in the cloud shown in Figure 5.

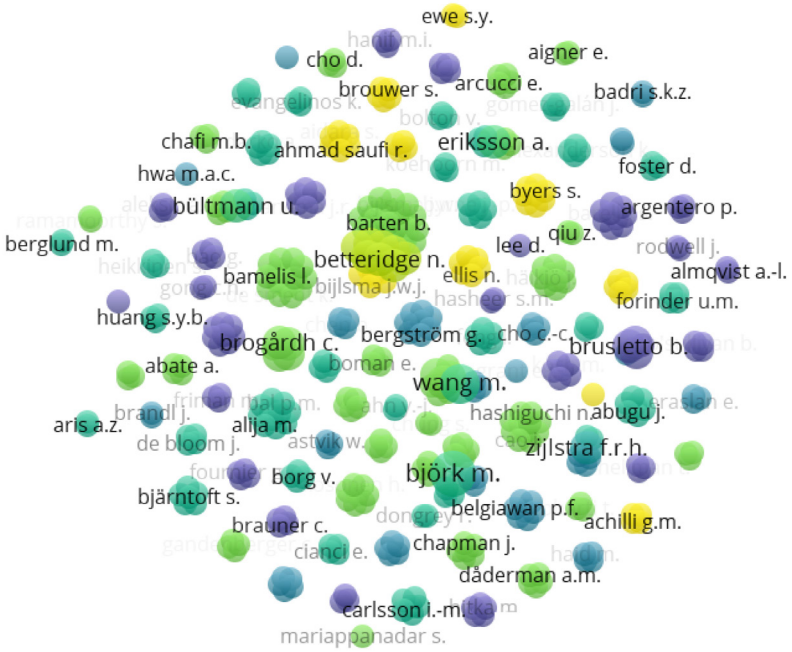


Figure 5. Analysis of authors' co-relationship in the context of sustainability of work independently

Source: Own research

According to Figure 5, each niche or cloud characterizes the authors who have used the same term in the literature, due to the diversity of subjects that have been addressed on the sustainability of work, it is noted that many authors do not cite each other in the literature. Thus, we can conclude that the field of "sustainable work" is dispersed across different topics. Among the 243 publications selected for the systematic literature review, after filtering, a result of 113 journals was obtained for the respective analysis. The ten most cited studies are listed in Table 1.

Table 1. Top ten most cited journals from the systematic literature review

Titles	Authors and Year	Cited by	Alignment with Eurofound	Citation
Sustainable work performance: the roles of workplace violence and occupational stress	Rasool et al., 2020	85	Social Environment; Competencies and Description; Perspectives	(10)
Post-pandemic office work: Perceived challenges and opportunities for a sustainable work environment	Babapour Chafi et al., 2022	37	Physical environment; Social environment; Work intensity; Quality of working time; Skills and description	(3)
The impacts of COVID-19 on the environmental sustainability: a perspective from the Southeast Asian region	Praveena and Aris, 2021	34	Physical environment; Quality of working time; Earnings	(11)
Intention for car use reduction: Applying a stage-based model	Olsson et al., 2018	31	Physical environment; Quality of working time; Social environment	(12)

Unshrouding the sphere from the clouds: Towards a comprehensive conceptual framework for sustainable employability	Fleuren et al., 2020	29	Social environment; Physical environment	(13)
Employee motivation as a tool to achieve sustainability of business processes	Lorincová et al., 2019	29	Quality of working time; Intensity of work; Social environment	(14)
Health and work-life balance across types of work schedules: A latent class analysis	Brauner et al., 2019	26	Work intensity; Quality of working time; Social environment; Skills and description	(15)
Physical capacity, occupational physical demands, and relative physical strain of older employees in construction and healthcare	Merkus et al., 2019	26	Physical environment; Intensity of work; Quality of working time	(16)
The role of service providers' resilience in buffering the negative impact of customer incivility on service recovery performance	Sommovigo et al., 2019	25	Social environment; Work intensity; Quality of working time	(17)
Burnout among direct-care workers in nursing homes during the COVID-19 pandemic in Spain: A preventive and educational focus for sustainable workplaces	Martínez-López et al., 2021	24	Social environment; Work intensity; Physical environment; Work time quality; Skills and description; Perspectives	(18)

Source: Own research

The studies that received the highest number of citations in the literature and made significant contributions to the scientific community are presented in Table 1. These studies were examined and compared with the research carried out by Eurofound to identify which of the seven dimensions are present in the article under analysis.

According to Table 1, we can see that the dimensions of the Eurofound survey that were most cited were "Quality of Working Time" and "Social Environment", both with eight occurrences. Next, the dimensions that were most cited were "Physical environment" and "Work intensity", both with six occurrences. Next was the dimension "Skills and description", with four occurrences, then the dimension "Perspectives", with two occurrences, and finally "Gains" with one occurrence.

5. CONCLUSION

The study allowed the identification of gaps in the literature on the quality and sustainability of work, addressing several variables associated with the Eurofound dimensions, and comparing them with variables found in the systematic literature review, related to satisfaction, well-being and productivity in the context of remote work. The research has implications for organizational human resource management, contributing to HR managers' practices. Thus, the study suggests that employers should be aware of the importance of quality of work-life and work-life balance to achieve organizational and personal effectiveness. It is hoped that the present study will contribute to the well-being of society by helping to implement a work-life balance. However, the study opens space for further research in the area and sets the stage for future research on the topic.

Acknowledgment

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Unveiling the Impact of the Gig Economy on Sustainable Development

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Keywords:
Gig economy;
Sustainable development;
Economic impact;
Environmental benefits;
Work-life balance;
Social protection

Abstract: *This paper examines the opportunities and challenges of the gig economy within the framework of the Sustainable Development Goals (SDGs), focusing on some environmental, economic, and social dimensions. It emphasizes the need for fair working conditions, income stability, and ethical considerations to foster an inclusive and sustainable gig economy benefiting workers and society. The gig economy offers environmental benefits through optimized resource utilization, and economic sustainability by generating income opportunities and supporting work-life balance. However, challenges in labor rights, social protection, and income stability persist. The study utilizes both global secondary data and primary data from a survey of 200 gig workers (freelancers) in Slovenia. Through analyzing gig economy data within the context of sustainable development, this study contributes to the ongoing discourse on sustainable practices and inclusivity in the gig economy, urging policymakers and stakeholders to implement measures that promote fairness and sustainability, benefiting both workers and society as a whole.*

1. INTRODUCTION

Emerging from technological advancements and shifts in work preferences, the gig economy has transformed conventional employment systems. Through digital platforms, gig workers—often freelancers—offer specialized services to a diverse clientele (Roy & Shrivastava, 2020; Woodcock & Graham, 2019).

One notable benefit of the gig economy is the flexibility it offers to workers in determining their schedules and work locations (Anwar & Graham, 2021). This adaptability appeals to various groups, such as students, part-time workers, and those seeking supplemental income, allowing them to achieve a better work-life balance (Kelliher et al., 2019). Employers, too, find value in this model, gaining swift access to a skilled and diverse workforce, thereby efficiently meeting fluctuating business demands (Burke & Cowling, 2015).

This paper aims to analyze the gig economy within the context of the Sustainable Development Goals (SDGs). We pose the central research question:

> *How does the gig economy influence sustainable development, specifically addressing its economic, environmental, and social ramifications within the framework of the SDGs?*

Understanding the diverse facets of the gig economy—including resource optimization, income generation, and work-life balance—is crucial for evaluating its impact on both contemporary labor markets and future work trends. Such insights also indicate how the gig economy

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contributes to the SDGs, which serve as a roadmap to address global challenges and strive for a more sustainable future by 2030 (Taylor, 2022; United Nations, 2015).

Figure 1 below visually illustrates the interconnectedness of the 17 SDGs, as favored by academic audiences (Folke et al., 2016).

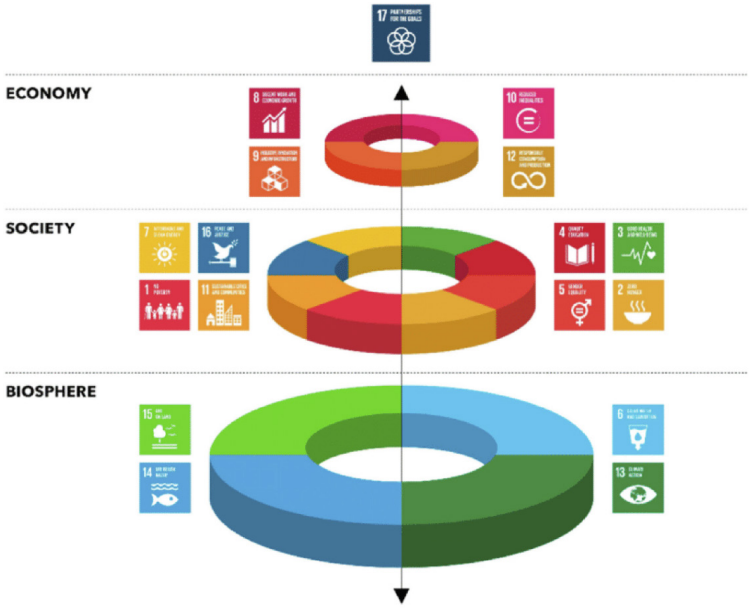

Figure 1. Grouping of the SDGs
Source: Folke et al., 2016

This study particularly delves into:

- **Economic Implications:** The impact of the gig economy on SDGs like Goal 1 (No Poverty) by generating supplemental income, Goal 8 (Decent Work and Economic Growth) by offering flexible employment, and Goal 9 (Industry, Innovation, and Infrastructure) by leveraging digital platforms.
- **Environmental Aspects:** The alignment with Goal 12 (Responsible Consumption and Production) by optimizing resource usage, thereby potentially reducing waste.
- **Societal Perspective:** The contribution to Goal 3 (Good Health and Well-being) through work-life balance, Goal 5 (Gender Equality) by offering equitable opportunities, and Goal 10 (Reduced Inequality) by making employment accessible to various demographics.

Our methodology includes analysis of both secondary literature and primary data from a 2020 survey among Slovenian freelancers. The paper is systematically structured into economic, environmental, and social implications sections, followed by suggestions for future research and conclusions.

2. ECONOMIC AND ENVIRONMENTAL IMPLICATIONS

2.1. Economic Impact and Inclusive Growth

The gig economy has significantly contributed to job creation and income generation by offering individuals various earning opportunities (Farrell et al., 2018). Its adaptable nature aligns jobs with personal skills, schedules, and aspirations. Simultaneously, companies benefit from

access to specialized skills among gig workers, leading to reduced operational costs (ILO, 2020). This operational model transcends geographical constraints, broadening customer bases for individuals, enhancing earnings, and reducing poverty. As such, it advances goals like poverty eradication, decent work, economic growth, and advancements in industry, innovation, and infrastructure.

2.2. Inclusivity and Sustainable Economic Growth

The gig economy's potential to address inclusivity and poverty reduction aligns with Sustainable Development Goals 1 and 8. It offers supplementary income opportunities, particularly aiding those with lower incomes and contributing to poverty alleviation and financial stability. For instance, in 2020, around 36% of the U.S. workforce engaged in gig work, contributing 5.7% to the total GDP (Fennell, 2021). The Freelance Forward survey by Upwork (2022) revealed U.S. freelancers added $1.35 trillion to the economy, a result of the shift from traditional employment. The growth of gig work could absorb labor, reduce unemployment, and increase overall workforce participation, indirectly reducing poverty rates. Key motivations for gig work include *earning extra income* (83%) and *time flexibility* (73%). A 2020 study of 200 Slovenian freelancers echoed these findings, emphasizing the possibility of choosing their project and realizing their ideas (Huđek & Širec, 2023, p. 71). The gig economy empowers individuals to be microentrepreneurs, using their skills for business ventures and potentially breaking the cycle of poverty. In regions with limited job opportunities, the gig economy provides global participation, ultimately improving living conditions. As it expands, diverse skills are required, driving continuous learning, improved employability, and poverty reduction.

2.3. Accessibility and Empowerment for Individuals with Disabilities

The gig economy's appeal to individuals with disabilities aligns with Sustainable Development Goal 8, promoting inclusive and sustainable economic growth. It addresses discriminatory triggers prevalent in physical employment, such as biases related to disability, accent, attire, and age (De Stefano, 2015; Graham et al., 2017; Huđek, 2022). Additionally, it mitigates accessibility challenges linked to transportation and disability-related obstacles (Zyskowski et al., 2015). Gig work empowers disabled workers, fostering self-reliance, self-esteem, skill development, and practical experience. It also offers an opportunity for individuals facing communication challenges due to disabilities to work without the customary social expectations of traditional workplaces, making it a viable alternative (Harpur & Blanck, 2020). Thus, it contributes to promoting decent work and comprehensive economic growth.

2.4. Entrepreneurship, Innovation, and Infrastructure

The gig economy's influence on entrepreneurship aligns with SDG 9, enabling individuals to initiate businesses, bolster economic growth, and drive innovation. Self-employment demands flexibility, creativity, and problem-solving skills. Independent workers are accountable for generating income and excelling in their chosen field, necessitating innovative ideas, approaches, and solutions (Romero & Martínez-Román, 2012). Gig workers, leveraging digital tools and online platforms, expand and utilize digital infrastructure (Schwellnus et al., 2019), enhancing technology access and connectivity. Moreover, the gig economy fosters global collaboration (Jackson, 2022) among individuals worldwide, enabling project collaboration and expertise exchange. This cross-border knowledge sharing is pivotal for fostering innovation and advancing industry practices.

2.5. Responsible Consumption and Production

Furthermore, the gig economy's potential to promote SDG 12 lies in efficient resource utilization, sustainable work arrangements, innovation, and local economy contribution. Online labor platforms, remote work, and telecommuting could reduce carbon dioxide emissions (Kuzior et al., 2022). Gig work often involves remote and digital-based services, leading to reduced physical resource consumption compared to traditional employment. The gig economy's adaptability empowers individuals to customize work schedules and locations, potentially curbing commuting and carbon emissions and thus supporting sustainable consumption patterns. Gig workers offering localized, on-demand services reduce the need for long-distance transportation, aligning to minimize the environmental impact of production and distribution. Additionally, gig economy platforms can collect and analyze consumption data, enabling informed decisions for more sustainable production and consumption strategies.

2.6. Addressing Challenges

Despite its potential to advance Sustainable Development Goals 1, 8, and 12, the gig economy must tackle challenges. Thriving as a gig economy entrepreneur faces obstacles. Notably, the employment status of gig workers poses a challenge (PwC, 2021). Gig economy workers operate on temporary and contractual terms, lacking various employment rights (such as additional financial benefits and pension contributions) (Berg et al., 2018) and social security. Consequently, gig workers must manage these aspects themselves, including tax payments and self-insurance (Aloisi, 2016). Unpredictable incomes and a lack of conventional support systems can hinder long-term sustainability. Intense competition among diverse gig workers necessitates innovative strategies to differentiate oneself and secure consistent opportunities (Roy & Shrivastava, 2020). Continuous skill enhancement poses a challenge, as gig workers must adapt to rapid industry changes, encountering obstacles such as limited access to formal training, and hindering skill acquisition. Addressing these challenges will be critical to maximizing the potential benefits of the gig economy while mitigating its drawbacks.

3. SOCIAL IMPLICATIONS

The gig economy significantly impacts the social sphere, aligning with SDG 3 (Good Health and Well-being), SDG 5 (Gender Equality), and SDG 10 (Reduced Inequalities). This influence is particularly beneficial for vulnerable groups such as people with disabilities, women, the elderly, and young individuals (OECD & European Union, 2019).

An examination of the Slovenian context reveals diverse profiles of gig workers, with higher male (59%) than female (41%) involvement. The 35-44 age group comprises the largest share (30%) of gig workers in Slovenia, with a notable 42.2% having completed a second level of tertiary education (Huđek & Širec, 2023, p. 65). This data underscores the varied participation in gig work across demographics and educational backgrounds.

Additionally, Upwork's (2019) *Freelancing in America* study establishes a correlation between age and gig work engagement, with younger individuals being more active participants. Similarly, the RSA's extensive survey on Britain's gig economy highlights the allure of gig work among young people (aged 16-30), with a quarter expressing future interest. In light of this expansive growth potential, the RSA envisions platforms as catalysts for equitable and rewarding work in the current labor landscape (Balaram et al., 2017).

3.1. Gender Equality and Flexibility

The gig economy's flexible work arrangements are particularly advantageous for women seeking to balance work and caregiving responsibilities. This flexibility empowers women to participate in the workforce on their terms, enhancing work-life equilibrium. Churchill and Craig (2019) find that the gender divide present in the broader economy is mirrored in the gig economy. Men predominate in platforms for traditionally male tasks like transportation, while women dominate those focusing on traditionally female tasks like caregiving. This suggests the gig economy is a potential alternative for women in creative industries. A survey of 504 participants reveals that both genders are motivated by income enhancement when joining the gig economy, even while holding traditional jobs. Flexibility emerges as a critical incentive for both, yet women cite compatibility with their schedules as a more significant factor, indicating their greater constraint by non-work commitments like family responsibilities. More men than women report effective income generation through gig work.

3.2. Work-Life Balance and Well-being

The gig economy offers new avenues for improved work-life balance. Allowing individuals to set their work hours and locations, facilitates equilibrium. This flexibility can lead to lower stress levels and improved mental well-being, in line with SDG 3's promotion of mental health. Slovenian case results show gig workers to be satisfied with the financial aspect of their subjective well-being, as indicated by income satisfaction. However, satisfaction with non-financial aspects, such as job and career satisfaction and life satisfaction, is even higher. This supports prior findings that gig workers are content with the non-financial dimensions of their work and overall well-being. Notably, life satisfaction receives the highest mean score on a 7-point Likert scale, followed closely by job and career satisfaction.

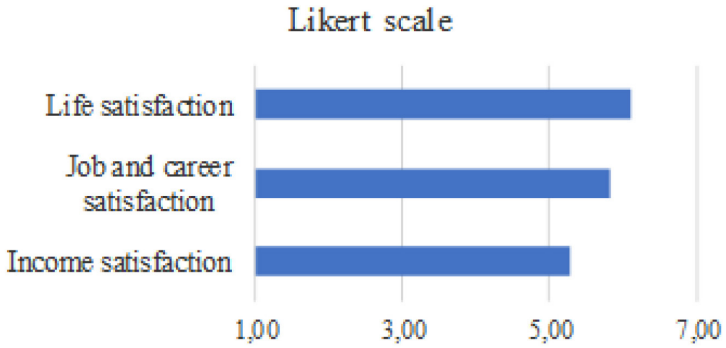

Figure 2. Subjective well-being dimensions of the Slovenia respondents

Source: Own processing

3.3. Social Challenges and Ethical Concerns

Despite these positive aspects, the gig economy presents various social challenges, including ethical concerns, psychosocial risks, and regulatory complexities. Tan et al. (2021) categorizes ethical challenges into three areas: the new work organization, the new nature of work, and the new worker status. Algorithmic systems and price discrimination raise control and exclusion concerns for gig workers. Bérastégui (2021) highlights psychosocial risks due to the organization and management of gig work, while De Ruyter et al. (2018) note regulatory challenges in identifying employers, tax collection, and social protection.

3.4. Job Insecurity and Worker Classification

The gig economy raises apprehensions about job insecurity, worker classification, and international outsourcing. While flexibility is portrayed positively, worker preferences and well-being are sometimes overlooked. The pandemic exacerbated gig labor oversupply in certain sectors, potentially deepening inequality due to a lack of protections. Government intervention to enhance labor safeguards is necessary. While traditional employees enjoy comprehensive rights including healthcare, leave, overtime, and education, modern platform work often lacks such protections, leading to heterogeneous employment. Policymakers need to strike a balance between flexibility, innovation incentives, and worker security. Tailored policies are crucial to address the unique challenges posed by new forms of work.

Stam (2020) emphasizes that fostering innovative entrepreneurship is essential for future prosperity. Governments can support gig workers with financial planning and tax compliance, encouraging legitimate gig work and proper tax contributions. Local governments can collaborate with gig workers and employers to formulate policies benefiting both parties, fostering positive outcomes and potential revenue streams.

4. FUTURE RESEARCH DIRECTIONS

Based on the presented content, we propose several promising directions for future research that can enhance our understanding of the gig economy's implications and potential within the context of sustainable development.

Firstly, an innovative avenue involves the development of novel metrics and assessment frameworks. These tools could facilitate a holistic assessment of the gig economy's role in promoting inclusive and sustainable economic development. Secondly, a comparative exploration spanning diverse countries is essential. Analyzing how regulatory frameworks, cultural dynamics, and economic landscapes influence the gig economy's impact on sustainable development can yield valuable insights and guide the creation of effective policies. Thirdly, a longitudinal investigation is recommended to delve into the lasting economic, social, and environmental effects of gig work over extended timeframes. This comprehensive analysis would significantly contribute to our understanding of its viability as a sustainable livelihood option.

5. CONCLUSION

This study delves into the gig economy's role in furthering Sustainable Development Goals (SDGs) and its potential impact. While it has the potential to alleviate employment barriers and inequalities, challenges like precarious work conditions and social security gaps exist. Addressing these necessitates robust legal frameworks. Fostering an environment that supports fairness can enable the gig economy to contribute positively to sustainable development and equity.

Economically, the gig economy can generate income, create jobs, and alleviate poverty, especially for marginalized groups. Its flexibility empowers microentrepreneurship, breaking the poverty cycle and aligning with SDGs 8 and 9.

Additionally, it promotes responsible consumption (Goal 12) through efficient resource use, emission reduction, and localized services, supporting sustainable consumption patterns and reducing production's impact.

Socially, the gig economy enhances well-being (Goal 3) by enabling work-life balance and challenging gender norms (Goal 5) with equitable opportunities.

While addressing inequalities (Goal 10) with flexible work options, including for those with disabilities, regulatory frameworks must balance gig workers' rights.

In conclusion, the gig economy's transformative impact on labor markets can drive SDG progress. Leveraging its positives, addressing challenges, and fostering responsible growth can align the gig economy with sustainable development. Continued research and cooperation are pivotal for realizing this alignment with the SDG vision.

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Female Education and Entrepreneurship in the Service of Sustainable Development in Serbia

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Abstract: *The business world is rapidly changing adopting new technologies and business models. It affects entrepreneurship, which is one of the most important factors of sustainable development. In recent years, the importance of female entrepreneurship has increased, because more and more women have started to get involved in entrepreneurial activities. Among the main factors influencing female entrepreneurship are education, which gives women the knowledge to succeed as entrepreneurs, and finance, which enables women to start their businesses. In order for entrepreneurship to be successful, it is of great importance to constantly improve business, which implies constant investment in education and training, and stable income as the source of further investment in business growth. This paper aims to investigate the importance of female education for successful female entrepreneurship and sustainable development in Serbia, by examining the correlation between the education level and: the annual income, and the investment in lifelong learning.*

1. INTRODUCTION

Throughout various studies, it has been demonstrated that "women view entrepreneurship differently than men" (Pruett, 2023, p. 2). Female entrepreneurship can be observed as a distinctive area of entrepreneurship in general since it is characterized by specific features. Most of the enterprises run and managed by women are micro and small enterprises, and this implies the specific scope and methods of investment in innovation and business growth. Unlike male entrepreneurs, who are predominantly run by external motives such as income or recognizing business opportunities on the market, female entrepreneurs are usually run by internal motives, which are related to the quality of everyday life and work-life balance, "especially if they have family responsibilities" (Cesaroni & Paoloni, 2016, p. 4). These determine the goals of entrepreneurship and influence the way male and female entrepreneurs run their businesses. Education has proven to be very important in this context, especially in the fields that can improve entrepreneurial skills. When it comes to female education, although the gender gap has been decreasing in recent years, men are still prevalent in technical sciences and IT, while women prevail in arts, humanities, education and healthcare. This division reflects on the future choice of occupation, and regarding entrepreneurship, the activity of their business.

The lack of a generally accepted definition for entrepreneurship has resulted in "problems with defining female entrepreneurship" (Gawel, 2013, p. 115). A unique definition of female entrepreneurship did not exist until recently. According to one, the female entrepreneur is a "woman who owns at least 1% of the company, holds at least one managerial position, and is employed in

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the company" (Popović-Pantić, 2014, p. 64). The other definition refers to "an enterprise owned and operated by a woman with a minimum financial interest of 51% of the capital and at least 51% of the jobs of women in the enterprise" (Deshpande, 2021, p. 93). Finally, UN Women issued a Toolkit for Gender-Responsive Public Procurement 3 in 2017, in which a definition of a female entrepreneur was given concerning the minimum requirements, such as ownership, control and independence, regarding the enterprise: "(1) at least 51% owned by one or more women; (2) actual management of the company's business operations on a daily basis and long-term business decision-making by women; (3) independence from non-women owned businesses" (Keric, 2017, p. 41).

Taking into account the significance of entrepreneurship for sustainable economic growth, it would be important to investigate female entrepreneurship as an increasing area of entrepreneurship in general, in relation to education among other factors, in order to determine the methods and guidelines for its further development.

2. LITERATURE REVIEW

Female entrepreneurship has been recognized as an important factor for sustainable development since it contributes to the overall economic growth of a country (Popović-Pantić et al., 2023). This is particularly important for developing countries, and it has been demonstrated that "there are great benefits to supporting female entrepreneurs" since it "stimulates economic growth and household welfare" (Babović & Kočović De Santo, 2023, p. 115). "The role of education in contributing to the creation of female human capital" has been shown throughout history (Bühler et al., 2023, p. 65), and education has proven to be very important for entrepreneurship. "Various strategies for promoting female entrepreneurship emphasize the importance of formal education for women" (Tovmasyan, 2022, p. 1795) since it provides women with knowledge, enables access to networks and resources, which are necessary for starting and leading a business, and "increases the ability to develop business skills and perceive business opportunities" (Khyareh, 2018, p. 112). Empirical research on women's empowerment in rural areas demonstrates that "vocational training and education play a significant role in fostering women's empowerment" (Ebrahimi et al., 2022, p. 9). There is the assumption that "female entrepreneurship is explained by different levels of education (primary, secondary and tertiary), which impact their decisions to enter entrepreneurship" (Gawel, 2021, p. 403). According to the results of the previous research, "women with a high level of education are more likely to engage in entrepreneurship" (Mashapure et al., 2021, p. 65), and "less likely to fail than low-educated entrepreneurs" (Khyareh, 2018, p. 112). It is suggested that "the education process encourages the entrepreneurial activity, since before and during entrepreneurship, education and training are seen as the key determinants of maintaining the entrepreneurial spirit and business management" (Stanković et al., 2023, p. 171). It is important, as well, to "provide an educational environment for employees so that they can continuously develop their potential and contribute to the overall success of the organization" (Radović Marković et al., 2022, p. 158). Even though "women might have increased their enrolment in colleges compared to men, women may still differ in terms of the types of subjects in which they are enrolled" (Radović Marković et al., 2012).

In 2019, "nearly 231 million women were creating or running new ventures across the world" (Deng et al., 2021, p. 3). However, it has been shown that the state of female entrepreneurship "varies significantly across different economies" (Raman et al., 2022, p. 2), and that it is influenced by different factors such as social, economic, legal, political, technological, etc. Although

female entrepreneurship "has gained acceptance in all sectors" (Mukhtar, 2022, p. 1794), "women usually take opportunities in the service sectors and sales to start an enterprise" (Martinez Cerda & Sanchez Macias, 2022, p. 65). The reason for this could be that these sectors do not require big investments, since "women encounter obstacles to raise finance from formal financial institutions" (Allahar, 2015, p. 12741), especially in developing countries, where they are supported mainly through "microfinance and cooperativism" (Coronel-Pangol et al., 2023). "Women in the middle-income and lower-income groups are usually engaged in micro-entrepreneurship, mostly in service sectors" (Kannappan, 2022, p. 1795).

Even though female entrepreneurship is "increasing in the economies of almost all countries" (Khajuria, 2021, p. 206), "in developed, developing, and even less developed nations" (Tovmasyan, 2022, p. 19), "a gender gap in entrepreneurship is still observed" (Gawel, 2021, p. 404). The previous findings have illustrated "how females receive and perceive different messages about their attitudes and abilities from those of males, which has implications for their place in the labor market" (Skelton, 1993, p. 324), as well as that in post-socialist countries "men are more likely to perceive and exploit business opportunities than women", and "women are on average also less likely to start with entrepreneurship" (Tominc & Rebernik, 2006, p. 426). The situation has been improved in recent years. In Serbia, progress in terms of gender equality was made "in formal education", although the great majority of women are still concentrated in social sciences, humanities, and art, which influences their prevailing job determination in the fields of services, and "when it comes to the economic position of women and participation in the labor market, in the entrepreneurship, as well" (Ferigra Stefanovic, 2021, p. 29). "The share of female businesses in the total number of SMEs in Serbia is 31.7%, which is similar to the EU average, in the traditional low-income and low-growth sectors" (Popović-Pantić et al., 2020, p. 54). The latest data indicates that this share changed slightly in 2021, to 31,2% (Babović et al., 2022, p. 10). It should be also taken into account that certain improvements have been made in terms of a "gender-sensitive system of regular monitoring of entrepreneurship", which, according to official documents, did not exist in Serbia until recent years (Stošić, 2016, p. 124).

The inclusion of female entrepreneurs into the economic mainstream could be measured through different indicators. "Women's entrepreneurship indicators, the so-called Istanbul indicators, were approved by IPA countries, National Small Business Act (SBA) coordinators and DG Enterprise and Industry in Madrid on the 1st June 2010 and they were used in SBA Assessment aimed to allow measurement and, even more, to predict next steps to improve performance in women's entrepreneurship in the South-East European countries (SEECEL 2014). This so-called 2nd generation of five indicators for women's entrepreneurship included: 1) policy support framework for the promotion of women's entrepreneurship, 2) training for women's entrepreneurship, 3) financing for women's entrepreneurship, 4) networking for women's entrepreneurship." It can be seen that training has been among the top three indicators for female entrepreneurship (Popović-Pantić et al., 2022, p. 249).

The hypothetical framework is given through two hypotheses:

Hypothesis One: The more educated female entrepreneurs are more aware of the importance of learning, and therefore they invest more in continuous improvement of their companies.

Hypothesis Two: The annual income depends on the education level of the female entrepreneur.

3. RESEARCH METHODOLOGY

3.1. Research Setting and Participants

The research was conducted during the first half of 2023 in Serbia. The research sample consisted of 105 enterprises owned and managed by women and included different types of enterprises by size, of which prevail micro enterprises (69%), followed by small and medium enterprises, belonging to various sectors: arts and crafts (17%), education (11%), industry (10%), media and communications (8.5%), trade (7.5%), construction (7.5%), legal services (7%), IT industry (6%), healthcare (5%), etc. The respondents come from all the regions of the country, with a great majority of them living and working in urban areas (94%). The demographic structure of respondents, regarding the education level, is as follows: Bachelor's degree 35%, Master's degree 22%, college vocational studies 19%, secondary school vocational studies 13%, PhD 7,5%, and gymnasium 3%.

3.2. Instruments

For the purpose of the research, a specialized questionnaire was designed. It was distributed through e-mail and different online platforms, and the answers were collected using Google Questionnaire. The questionnaire was divided into three sections. The first section consisted of questions regarding the demographics of respondents, including the education level. The second section included questions about the respondents' entrepreneurial experience, and general information about the enterprise, such as number of employees, annual income and activity. The third section consisted of 21 questions regarding the innovation management of the enterprise, as the general approach to business of female entrepreneurs.

Using the ANOVA method, the influence of the education of female entrepreneurs on the characteristics of their approach to business was tested, in relation to the education level. The approach to business was observed through 21 variables previously defined by the INNOVATE tool, created with the support of the ICIP and SECEP projects funded by the European Union, in order to measure the innovation capacity of companies. These variables include different aspects of business improvements, based on the introduction of innovative business principles and constant learning (Vučetić & Kirin, 2022). ANOVA (Analysis of Variance) is a statistical test used to analyze the differences between three or more groups. The test compares the means of the groups to determine if there is a statistically significant difference between them. ANOVA test uses the F-statistic, which is the ratio of the between-group variance to the within-group variance. It measures the degree to which the group means differ from each other compared to the variability within each group. A higher F-value indicates a greater difference between the groups. The p-value is the probability of obtaining the observed F-statistic (or a more extreme value) if the null hypothesis is true. If the p-value is less than the significance level (usually 0.05), we can reject the null hypothesis and conclude that there is a statistically significant difference between at least two of the groups. There are two sets of degrees of freedom in an ANOVA test: the degrees of freedom between groups and the degrees of freedom within groups. The between-groups degrees of freedom measures the number of independent groups being compared, while the within-groups degrees of freedom measure the number of observations within each group. If the ANOVA test is statistically significant ($p < 0.05$), we can conclude that at least two of the groups have significantly different means. To determine which groups differ, post-hoc tests (such as Tukey's HSD) can be conducted. It is important to note that ANOVA assumes

that the data is normally distributed and that the variances are equal across groups. In order to meet the statistical assumption of normality, skewness and kurtosis statistics should be below an absolute value of 0.5, which is satisfied.

4. RESULTS AND DISCUSSION

The test for homogeneity of variance was performed, in Table 1, and since in the case of business networking impairment, for that variable robust test of equality of means was applied, Table 4.

Table 1. Test of homogeneity of variances

		Levene Statistic	df1	df2	Sig.
Attitude towards changes	Based on Mean	1,975	3	100	0,123
Decision-making process	Based on Mean	1,322	3	100	0,271
Employee training	Based on Mean	1,772	3	100	0,157
Business networking	Based on Mean	16,029	3	100	0,000
Reputation	Based on Mean	0,995	3	100	0,399

Source: Own research

The description of the observed variables is given in Table 2.

Table 2. Descriptive statistics

		N	Mean	Std. Deviation	Std. Error	95% Confidence interval for mean		Min	Max
						Lower Bound	Upper Bound		
Attitude towards change	Vocational high school/ gymnasium	17	1,59	0,939	0,228	1,11	2,07	1	3
	College or vocational studies	19	2,84	1,119	0,257	2,30	3,38	1	4
	Faculty	36	2,03	1,028	0,171	1,68	2,38	1	4
	Postgraduate studies	32	2,03	1,177	0,208	1,61	2,46	1	4
	Total	104	2,11	1,131	0,111	1,89	2,33	1	4
Decision-making process	Vocational high school/ gymnasium	17	1,59	0,618	0,150	1,27	1,91	1	3
	College or vocational studies	19	2,21	0,918	0,211	1,77	2,65	1	4
	Faculty	36	1,97	0,736	0,123	1,72	2,22	1	3
	Postgraduate studies	32	2,44	0,878	0,155	2,12	2,75	1	4
	Total	104	2,10	0,842	0,083	1,93	2,26	1	4
Employee training	Vocational high school/ gymnasium	17	2,12	1,111	0,270	1,55	2,69	1	4
	College or vocational studies	19	2,74	1,147	0,263	2,18	3,29	1	4
	Faculty	36	3,17	0,845	0,141	2,88	3,45	2	4
	Postgraduate studies	32	3,47	0,879	0,155	3,15	3,79	1	4
	Total	104	3,01	1,057	0,104	2,80	3,22	1	4
Business networks	Vocational high school/ gymnasium	17	1,24	0,562	0,136	0,95	1,52	1	4
	College or vocational studies	19	2,37	1,383	0,317	1,70	3,03	1	4
	Faculty	36	2,22	1,245	0,207	1,80	2,64	1	4
	Postgraduate studies	32	2,34	1,310	0,232	1,87	2,82	1	4
	Total	104	2,13	1,259	0,123	1,88	2,37	1	4

Reputation	Vocational high school/ gymnasium	17	1,53	0,717	0,174	1,16	1,90	1	3
	College or vocational studies	19	2,21	0,976	0,224	1,74	2,68	1	4
	Faculty	36	2,36	0,798	0,133	2,09	2,63	1	4
	Postgraduate studies	32	2,00	0,803	0,142	1,71	2,29	1	4

Source: Own research

The results of the ANOVA method showed that there is a statistically significant difference in relation to the level of education of female entrepreneurs for the variables Attitude towards changes, Decision-making process, Employee training, Business networking and Reputation, Table 3.

Table 3. ANOVA

		Sum of Squares	df	Mean Square	F	Sig.
Attitude towards changes	Between Groups	15,252	3	5,084	4,361	0,006
	Within Groups	116,585	100	1,166		
	Total	131,837	103			
Decision-making process	Between Groups	8,916	3	2,972	4,635	0,004
	Within Groups	64,123	100	0,641		
	Total	73,038	103			
Employee training	Between Groups	22,573	3	7,524	8,142	0,000
	Within Groups	92,418	100	0,924		
	Total	114,990	103			
Business networking	Between Groups	16,454	3	5,485	3,733	0,014
	Within Groups	146,921	100	1,469		
	Total	163,375	103			
Reputation	Between Groups	8,522	3	2,841	4,196	0,008
	Within Groups	67,699	100	0,677		
	Total	76,221	103			

Source: Own research

Table 4. Robust test of equality of means

		Statistic[i]	df1	df2	Sig.
Business networking	Brown-Forsythe	4,084	3	75,510	0,010

i. Asymptotically F distributed.

Source: Own research

The nature of the differences is explained below. When observing the attitude toward changes, a statistically significant difference in results was obtained between female entrepreneurs with the lowest education level and other levels of education, Figure 1. The female entrepreneurs with the lowest education level have the lowest propensity to change, and it can be expressed with the statements "We hesitate to change something in case it goes bad" and "We know we need to change, but we don't know how". Female entrepreneurs with a college or vocational studies education level are the most inclined to change, and their attitude can be expressed by the statement "We actively strive for changes in the way we work". Female entrepreneurs with the highest education level are cautious when it comes to changes and opt for the attitude "We know we need to change, but we don't know how".

There is also a statistically significant difference in the decision-making process between the least educated female entrepreneurs and the most educated. The least educated female entrepreneurs tend to make decisions themselves or possibly ask for opinions, while the most educated female entrepreneurs seek professional opinions.

A medium-strong positive correlation was obtained between the education level and employee training, which leads to the conclusion that more educated female entrepreneurs are more aware of the importance of employee training. Employee training is the variable where the positive correlation (r=0.437) between the education level and the awareness of the necessity of employee training is most clearly shown.

As far as business networking is concerned, the difference between the level of connection of female entrepreneurs with the lowest education level and all the others was obtained. Female entrepreneurs with the lowest education level hardly network. And that difference is statistically significant.

Similar results were obtained in the case of reputation. Female entrepreneurs with the lowest education level do not invest in the promotion of their business. Other entrepreneurs try very hard to promote the activities of their company.

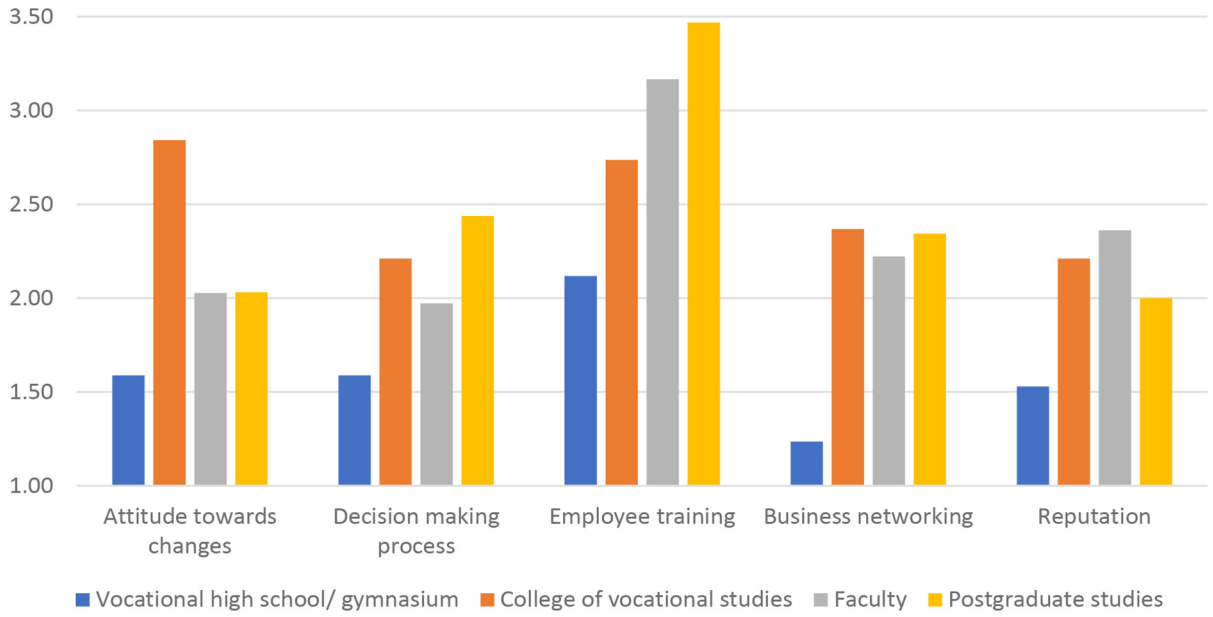

Figure 1. Influence of the women's education on the characteristics of their approach to business

Source: Own research

This proves the first hypothesis that more educated female entrepreneurs are more aware of the importance of learning, and therefore they invest more in continuous improvement of their companies, from different aspects and in different areas.

The range of income of female entrepreneurs as well as the grouping by their level of education are shown in Table 5 and Table 6.

The question of whether there is a statistically significant difference in the annual income of the company and the level of education of female entrepreneurs was analyzed using the ANOVA method, Table 7.

Table 5. Frequency of the annual income of female entrepreneurs

	Frequency	Percent	Cumulative percent
Less than 2 million EUR	71	67,0	68,3
2-10 million EUR	24	22,6	91,3
11-50million EUR	9	8,5	100,0
Total	104	98,1	

Source: Own research

Table 6. The annual income of female entrepreneurs grouped by education level

	N	Mean	Std. Deviation	Std. Error	For Mean		Min	Max
					Lower Bound	Upper Bound		
Vocational high school/ gymnasium	17	1,35	,493	,119	1,10	1,61	1	2
College or vocational studies	19	1,47	,697	,160	1,14	1,81	1	3
Faculty	36	1,47	,696	,116	1,24	1,71	1	3
Postgraduate studies	32	1,31	,644	,114	1,08	1,54	1	3
Total	104	1,40	,646	,063	1,28	1,53	1	3

Source: Own research

Table 7. ANOVA-education and income of female entrepreneurs

	Sum of Squares	df	Mean Square	F	Sig.
Between groups	,572	3	,191	,449	,719
Within groups	42,466	100	,425		
Total	43,038	103			

Source: Own research

Since the p-value is greater than 0.05 (Sig=0.719>0.05), it can be concluded that the differences in the annual income of the company in relation to the education level of female entrepreneurs are not statistically significant. In this way, the second hypothesis that the annual income depends on the education level of the female entrepreneur was disproved.

5. FUTURE RESEARCH DIRECTIONS

Taking into account that only a small percentage of respondents comes from rural areas, 6% of the sample, shifting the research focus to female entrepreneurs in urban areas, the future research endeavors should include to a greater extent the experiences of women entrepreneurs in rural areas, placing a particular emphasis on addressing the distinctive challenges associated with empowering women in these regions. Acknowledging this as a growing global concern, future research should contribute to a more profound understanding of the difficulties in fostering women's empowerment in rural areas. Further, future research should investigate more profoundly which fields of education have the biggest positive influence on successful entrepreneurial activity, in order to create particular education programs for those women who are interested in engaging the entrepreneurship.

6. CONCLUSION

In order for entrepreneurship to be successful, and to contribute to sustainable development, it is of great importance to constantly improve business. Education has been proven one of the main factors influencing female entrepreneurship in Serbia, in terms of continuous improvement.

The female entrepreneurs with the lowest education level have the lowest propensity to change, they tend to make decisions themselves or possibly ask for opinions, they hardly network, and don't invest much in the promotion of their business. The more educated female entrepreneurs are more ready for changes, they seek professional opinions, and invest more in employee training and the promotion of the activities of their company. The more educated female entrepreneurs are more aware of the constantly changing market and the need for continuous learning and improvement implementation, in order to adapt to the new conditions and market requirements. Therefore, they are more ready for changes, they improve the way they make decisions, invest in employee training, establish and preserve business relationships, and promote their business building the company's reputation.

To date, scholarly inquiries into the realm of entrepreneurship have predominantly focused on male motivations and drivers. However, with the increasing participation of women in entrepreneurship and the noticeable distinctions in their motivations compared to those of men, the more profound investigation of female entrepreneurship emerges as a significant and compelling subject for scientific research. Education has a significant influence on female entrepreneurship, not only in terms of the choice of business activity and the necessary knowledge and skills but in terms of running a business, as well, especially regarding investment in education and training. Since the importance of female entrepreneurship has increased in recent years, the research results suggest that female education should be encouraged in Serbia, especially in the fields where the gender gaps still exist, like technical sciences and IT, in order to encourage more women to engage in entrepreneurship and contribute to the overall economic development of the country.

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Algorithmic Human Resource Management: Characteristics, Possibilities and Challenges

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Abstract: *In the field of human resources, algorithmic management refers to the utilization of digital technology, artificial intelligence, and big data to develop rules and procedures that enable the automated management of human resources. Algorithmic human resource management can potentially replace human resource managers in all stages and activities of staffing, thereby significantly expediting the management process and enhancing cost-effectiveness. Through the use of artificial intelligence, algorithms develop patterns and models from which they can autonomously learn and improve the quality of decision-making in employee management. However, relying exclusively on algorithmic human resource management can lead to the emergence of discriminatory management practices, particularly when the algorithms are based on unrepresentative or biased data. Considering these factors, this paper aims to examine the fundamental characteristics, principles, application possibilities, and challenges of algorithmic human resource management.*

1. INTRODUCTION

Making business decisions has always occupied the attention of numerous authors. While the decision-making process is well-elaborated and clear, the same cannot be said for the decision-making process supported by modern digital technologies. Artificial intelligence, supported by a set of large volumes of data and machine learning, has led to a new way of making decisions, which is known as algorithmic decision-making. This approach to decision-making can be implemented in different business areas, thereby providing numerous advantages, but also challenges (Newell & Marabelli, 2015; Shrestha et al., 2019). An algorithm represents a decision-making process, or process of solving a problem, which is based on a set of certain rules and instructions for transforming inputs into outputs (Cheng et al., 2019; European Parliament, 2019). Algorithmic decision-making is usually based on the application of ICT and digital technology. Therefore, the entire decision-making process becomes automated and precise, since decisions are based on the results of the previous processing of a large volume of data (Köchling & Wehner, 2020; Lepri et al., 2018). Algorithmic decision-making, which in the context of the Fourth Industrial Revolution is integrated with artificial intelligence and machine learning, provides numerous opportunities for managers, certainly those who deal with human resources management. It is about the digital transformation of the human resources management function, where decisions are made based on extensive data and software solutions through complete or partial automation of the human resources management function (Meijerink et al., 2021). Thanks to the large volume of data and machine learning, a completely new form of knowledge is created, which is the intellectual capital of the organization. Based on such knowledge, HR managers can make effective decisions based on objective information, but can also predict future employee-related decisions and their effects. However, algorithmic decision-making has certain challenges and problems that should be taken into account (de Laat, 2018).

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Considering these factors, this paper aims to examine the fundamental characteristics, principles, application possibilities, and challenges of algorithmic human resource management. The work is divided into several relevant units. It is a theoretical analysis of a still limited number of works in the field of algorithmic human resource management (Jarrahi et al., 2021; Sienkiewicz, 2021). The initial section of the paper introduced the fundamental principles surrounding algorithmic human resource management. The subsequent segment delved into a comprehensive analysis of the core attributes inherent to this approach. Moving forward to the third section, the paper explored the viability of implementing algorithmic human resource management across various stages of the staffing process. Following this, a comprehensive overview of the benefits, challenges, and issues associated with the application of algorithmic human resource management was provided. This sequential structure has allowed for a systematic examination of the subject matter, facilitating a holistic understanding of the potentials and challenges posed by algorithmic human resource management in contemporary organizational contexts.

2. ALGORITHMIC HUMAN RESOURCE MANAGEMENT - BASIC CONCEPTS

Algorithmic decision-making and the application of information technology in human resource management (HRIS) are not new. However, their integrative application when managing human resources in the context of the Fourth Industrial Revolution is new. The fact that we live and work in the so-called "Information Era" creates opportunities to analyze and apply a large amount of data in order to improve decisions. Algorithms based on artificial intelligence scan and analyze millions of different data every day, turning them first into information and then into knowledge that can be used to make decisions (Cappelli & Rogovsky, 2023; Ranjbar, 2023; Shrestha et al., 2019). However, before delving into a more intricate examination of algorithmic human resource management, it is imperative to establish certain differentiations, primarily concerning HRIS. Both HRIS and e-HRM operate on the foundation of employing information and communication technology alongside data furnished by human resource managers. These systems are under the stewardship of managers and frequently lack autonomous learning capabilities or the capacity to generate novel insights. The complete spectrum of employee management remains within the purview of human resource managers who operate within the confines of existing data encapsulated within HRIS. This distinction lays the groundwork for comprehending the subsequent exploration into algorithmic human resource management, which signifies a departure from the conventional managerial landscape by introducing a level of autonomous decision-making and adaptability driven by algorithmic intelligence (Sienkiewicz, 2021). Concerning HRIS, algorithmic human resource management has the possibility of independent learning based on the provided data, which creates new information and an innovative form of organizational knowledge. Algorithms are often interconnected and use large and unstructured data, which ensures a special contribution to knowledge and decisions made. In particular, it should be emphasized that algorithmic human resource management can be fully automated. Unlike HRIS, the algorithm can completely replace human resource managers in certain activities (Parent–Rocheleau & Parker, 2022). This automation is particularly useful in the domain of administrative HR activities, as it gives HR managers enough space and time to deal with the complex strategic issues of employee management. Strategic human resource management is further powered by machine learning. Specifically, algorithmic human resource management entails the manipulation and application of information derived from the scrutiny of extensive quantities of unstructured data. Machine learning systems autonomously pinpoint a collection of attributes that are postulated to influence decision-making processes. Through supplementary analysis, combination, and assessment of these attributes, algorithms scrutinize

their effect on performance and decision quality. Consequently, these algorithms proffer optimal solutions to human resource managers. This paradigm reflects a dynamic cycle wherein these algorithms leverage evolving insights to continually refine their proposals, bridging the gap between data-driven insights and human managerial judgment. The crux of algorithmic human resource management rests on its capacity to navigate the intricacies of vast and unstructured data realms, ultimately fostering more informed, effective, and adaptive decision-making within human resource contexts (Shrestha et al., 2019).

Concerning HRIS, algorithmic human resource management uses data contained in various other systems and media of the organization, as well as outside it. This ensures the cross-functional connection of information, which significantly improves the comprehensiveness and quality of the decisions made (Leicht-Deobald et al., 2019). Human resource managers can access not only data related to employees' records or performance, but also information related to their interaction with customers, computer activities (search history, social media activity), GPS information, and so on (Bernhardt et al., 2021). If these data are collected and used ethically, following national and international ethical standards, an information base can be created that will significantly improve the quality of decisions made. Given the above, it can be noted that algorithmic human resource management is more than simple analysis in the use of employee data. Algorithmic human resources management is a system where algorithms that can learn independently make decisions based on statistical models and decision rules, with the explicit intervention of human resources managers (Sienkiewicz, 2021). Thanks to computer systems, the decision-making process becomes automated and capable of very quickly processing millions of different data and making large-scale decisions (Bucher et al., 2021).

Algorithmic human resource management is the effect of digital transformation and the integration of artificial intelligence and machine learning in human resource management. As such, algorithmic human resource management has three essential attributes. First, it is based on the use of digital data. Second, this data is analyzed within modern software and digital solutions. Third, the HR decision-making process can be fully or partially automated (Meijerink et al., 2021). The decision-making logic of the algorithm in human resource management is identical to any other algorithmic decision-making, i.e. it can be deterministic or probabilistic. In mathematics and computer science, most studies are based on the deterministic nature of decision-making, which is based on the assumption that if input A creates output B, then A will always be followed by B. The probabilistic relationship between input and output is based on the idea that the occurrence of A increases the probability of B. Because it is applied in conditions of imperfect knowledge of the relationship between inputs and outputs, human resource managers are often more interested in problems of a probabilistic nature. But, precisely because of limited knowledge, probabilistic algorithms will not always offer the correct solution. That is why human resource managers use a large volume of data, statistical models, and numerous software solutions when applying algorithmic human resource management (Cheng & Hackett, 2021).

3. CHARACTERISTICS OF ALGORITHMIC HUMAN RESOURCE MANAGEMENT

The digital transformation of business has created numerous changes in the field of human resource management. Among these changes, algorithmic human resource management stands out for its role in simplifying the process of talent identification within organizations. This particular capability has significantly contributed to the adoption of algorithmic human resource management by prominent enterprises such as Google, IBM, Microsoft, and others.

These industry leaders have embraced algorithmic approaches to human resources as a means to streamline and enhance their talent identification endeavors. By leveraging algorithms and data-driven insights, these organizations can discern and nurture potential talents more efficiently, aligning with their broader strategies for growth and innovation. This trend underscores the pivotal role that algorithmic human resource management plays in reshaping traditional talent management paradigms to suit the demands of the contemporary digital business landscape (Alvarez-Gutierez et al., 2022; Köchling & Wehner, 2020).

There are three essential elements at the basis of algorithmic human resources management, as shown in Figure 1. These are artificial intelligence, predictive and prescriptive HR analytics, and evidence-based decision-making.

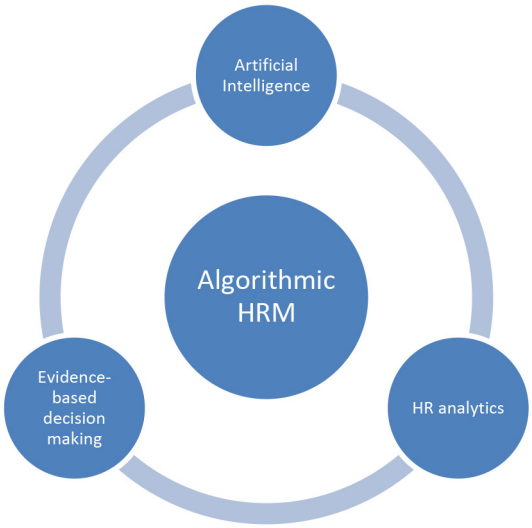

Figure 1. Basic foundations of algorithmic human resource management
Source: Sienkiewicz, 2021

The information used in algorithmic decision-making is provided by human resource managers. This information may be descriptive; but bearing in mind the fact that evidence-based decision-making models and artificial intelligence are based on a large volume of data, they must be both semi-structured and unstructured. Decision models based on artificial intelligence predict future activities and outcomes, while models of prescriptive analytics, based on a large volume of data, go a step further and provide additional information about the probability of certain events and their characteristics. Therefore, algorithmic human resource management requires machine learning and data mining in order to create patterns that will help in making HR decisions (Meijerink et al., 2021).

According to the above, it is possible to identify three types of algorithms in human resource management (Leicht-Deobald et al., 2019):

1. Descriptive algorithms: provide information about previously made decisions and their effects. Being based on historical data, descriptive algorithms are based on the application of simple statistics and provide information to human resource managers about the current motivation, satisfaction of employees, their performance, etc.
2. Predictive algorithms: they are based on the use of data on previously made decisions and achieved results, in order to predict them in the future. These algorithms use regression techniques, data mining, and machine learning.

3. Prescriptive algorithms: their task is to show different possible scenarios of decisions made. These algorithms transcend the realm of mere predictability because they provide information about the potential effects and characteristics of the decisions made. As such, prescriptive algorithms use the same models and techniques as predictive algorithms but add simulation techniques and scenario analysis.

Prescriptive algorithms are often used to improve the efficiency of employees since they predict the effects and different scenarios to make decisions on the behavior and productivity of employees (Parent-Rocheleau & Parker, 2022). For example, by employing prescriptive algorithms it is possible to monitor how different employee reward systems can affect their motivation, satisfaction, performance, and the like. An additional advantage is that these models operate with unstructured data, so it is possible to monitor the additional influence of socio-demographic and other characteristics of employees on the decisions made.

4. APPLICATION OF ALGORITHMIC HUMAN RESOURCE MANAGEMENT IN EMPLOYEE STAFFING

The basic application of algorithmic human resource management was first present in the domain of HR analytics, performance measurement and recruitment (eg resume parsing software). Over time, algorithmic models began to be used in order to improve the efficiency of employees, and today their automated application is noticeable in the process of employee recruitment, selection and development (Bernhardt et al., 2021). Based on the information contained in the systems and databases, which for example can relate to the level of demand and customer preferences, human resource managers can predict the required number of employees in the future with high precision, thus improving the human resources planning process. HR analytics helps employees predict their future behavior through clearer insights into employee information, primarily when it comes to motivation, retention and engagement. In addition, through HR analytics, it became much easier for managers to make decisions about the employees' career development (Jarrahi et al., 2021).

Algorithmic human resource management proves particularly advantageous in the realm of employee recruitment and selection. In the contemporary landscape, enterprises increasingly harness innovative recruitment approaches, prominently through online platforms and social networks. These digital avenues offer a distinct advantage through their utilization of referral systems. Employing a blend of inputted referral requests, historical search data, behavioral patterns, and candidate preferences, these digital platforms autonomously present candidates deemed suitable for organizational needs. This process mirrors marketing methodologies, enabling a finer level of precision in targeting desired candidates. By leveraging algorithmic insights, organizations can efficiently navigate the intricate realm of modern recruitment, swiftly connecting with potential talents that align with their specific requirements. This synergy between technology and human resource management underscores the transformative potential of algorithmic approaches in refining and optimizing the recruitment process to ensure the best possible candidate matches (Köchling & Wehner, 2020). Special systems and software solutions can analyze a large number of incoming applications and candidate resumes in a very short period and automatically reject those who do not meet any of the defined conditions. In addition to shortening the recruitment time, this also reduces recruitment costs (Cheng & Hackett, 2021). Efficiency and cost reduction are also evident in the selection process. Resume parsing systems and algorithmic evaluation of conducted interviews with candidates, as well as text mining, facilitate the selection of those candidates who meet the requirements according to various

criteria. Additionally, certain artificial intelligence systems can track verbal and non-verbal communication symbols (changes in voice tone and dynamics, facial expressions, body posture, and the like). It is Natural language processing, which represents a set of syntactic and semantic rules of algorithmic decision-making, i.e. comparison, extraction, analysis and use of information (Köchling & Wehner, 2020).

Algorithmic human resource management is also used for employee development. Thanks to HR analytics and a large volume of data, algorithms can easily present deficient employee knowledge that needs to be improved, with clearly defined and customized education programs. Algorithms can also predict the knowledge and skills that will be needed in the future based on the prediction of future demand (Cheng & Hackett, 2021). The information used in decision-making is not only based on personal files and previous performance of employees but also includes a benchmark with talents on the labor market. In addition, when planning employee development, algorithms often take into account the potential effect on motivation, retention and engagement, which is in line with the principles of prescriptive analytics (Köchling & Wehner, 2020).

A big advantage when managing human resources is that algorithms can use a large volume of different data about employees, especially when it comes to performance. Namely, algorithms do not only monitor the quantitative results achieved by employees, but also their emotions, social contacts, stress, and psycho-physical burnout, and then bring these variables into mutual relations in order to identify patterns and trends. Thanks to the large volume of data, algorithms can predict the future performance of employees much more easily and more precisely, while providing information to human resource managers on how to improve them (Parent-Rocheleau & Parker, 2022).

When it comes to the reward system, this area of algorithmic human resource management has been the least explored so far. If the reward system is linked to the performance and behavior of the employees, the algorithms can show when the rewards given to the employees led to specific positive or negative changes. Following such information, it is possible to design a reward system that is flexible and adapted to the needs of employees, which has a positive impact on performance, but also on employee motivation and engagement. For example, Google uses predictive algorithms to reduce employee attrition by analyzing when rewards should be given and how flexible the reward system must be (Cheng & Hackett, 2021).

5. POSSIBILITIES AND CHALLENGES OF ALGORITHMIC HUMAN RESOURCE MANAGEMENT

Algorithmic human resource management simultaneously provides various advantages, but also numerous challenges. In addition to shortening decision-making time and improving the decisions, algorithmic human resource management allows companies to more easily identify potential talent. Decisions made based on numerous information enable the minimization of risks, the increase of employee productivity, as well as an increase in the certainty of the outcome. In other words, the algorithmic management of human resources can provide a competitive advantage (Köchling & Wehner, 2020). Also, algorithmic human resource management significantly facilitates the monitoring of employees, which is especially useful for remote work (Jarrahi et al., 2021).

However, algorithmic human resource management also has certain challenges, which can potentially threaten its effectiveness. Namely, it is often stated that decisions made in this way are not transparent enough. In certain circumstances, algorithmic human resource management can lead

to discriminatory practices, certainly in the process of recruitment and career development (Meijerink et al., 2021). This happens in circumstances where there is low-quality input data. Algorithms work based on previously provided information. Therefore, if there is biased data, future decisions will not be objective. For example, if the manager entered data characterized by stereotype, incompleteness, or any other bad assessment, there is a risk that the decisions made will have the same character (Bujold et al., 2023; Köchling & Wehner, 2020; Rodgers et al., 2023). When managing human resources, these problems can lead to discrimination on any basis (race, gender, age, education, etc) (de Laat, 2018). Since the algorithms are based on data extrapolation, if the manager, for example, hires more men in the recruitment process, there is a risk that the system will recommend only male candidates in the future. One study shows that job vacancies on Facebook are primarily viewed by women (more than 85%), while ads for taxi drivers are predominantly viewed by men. The Uber tracking application, as part of the algorithmic human resource management, monitors the driver's GPS position, speed, stopping time, and heavy braking. The algorithm calculated lower earnings for women since they drove more slowly than men on the same route. The Amazon CV screening tool often decides to hire men, since the algorithm is based on historical data in which more decisions in the recruitment process were made to hire male engineers than female ones (Köchling & Wehner, 2020). Therefore, in order for algorithmic human resource management to give good results, it must be based on objective information. If you take Uber as an example, women may have driven more slowly than men, but the system did not take into account that there may have been fewer traffic accidents or damage to transported goods.

In addition to the problem of discrimination, the problem of privacy and data integrity often arises, since algorithms use a large volume of data to make decisions, many of which may be of a personal nature (European Parliament, 2019). A typical example is the use of Internet searching information, viewing profiles and activities on social networks, and the like. The problem of privacy also arises due to the continuous and facilitated monitoring of employees' devices (mobile phones and computers), since the system can monitor the employee's work, as well as his activities outside of working hours (Leicht-Deobald et al., 2019). This can consequently lead to information asymmetry, and a decrease in autonomy, motivation, and job satisfaction (Parent-Rocheleau & Parker, 2022).

Ultimately, it's crucial to recognize that the implementation of algorithmic human resource management, even when upholding ethical principles, is not without complexity. Given its nature as a digital transformation, HR managers must possess specialized knowledge and competencies that extend beyond conventional HR expertise. Additionally, addressing this requirement is challenging due to the scarcity of educators available for such training. Compounding this issue is the resource constraint, as implementing algorithmic human resource management can entail substantial costs. The adoption of algorithmic management introduces a paradigm shift that demands a new skill set among HR professionals, but limitations in both educational opportunities and financial resources pose obstacles to its seamless implementation. Navigating these challenges necessitates a concerted effort to bridge the knowledge gap, develop pertinent competencies, and secure the necessary resources to successfully harness the benefits of algorithmic human resource management while ensuring its ethical and effective application (Jarrahi et al., 2021).

6. CONCLUSION

Digital transformation has led to numerous advantages in the business of organizations, certainly when it comes to human resource management. The traditional approach to employee management must be replaced by an innovative one, in which artificial intelligence and machine

learning provide the basis for quality decision-making. Thanks to the large volume of data and HR analytics, artificial intelligence and machine learning systems create the basis of algorithmic human resources management.

The concept of algorithmic management has emerged as a transformative force in the realm of human resources. By leveraging digital technology, artificial intelligence, and big data, organizations can streamline and automate various aspects of human resource management. This holds the potential to revolutionize the traditional staffing processes, offering greater efficiency and cost-effectiveness. The utilization of algorithms, driven by artificial intelligence, empowers these systems to evolve and enhance decision-making in personnel management through continuous learning from patterns and models.

However, it is essential to acknowledge the potential pitfalls of overreliance on algorithmic human resource management. The risk of discriminatory practices looms when algorithms are founded on biased or inadequate data, underscoring the significance of maintaining human oversight to ensure fairness and ethical treatment. Striking a balance between the benefits of algorithmic efficiency and the necessity of human judgment remains a pivotal challenge. In navigating these complexities, organizations must prioritize a holistic approach that harnesses the power of algorithmic management while upholding values of inclusivity and fairness in the treatment of employees.

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Project Management Skills for Non-management Students from the Perspective of Education for Sustainable Development

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Abstract: *Project management skills (PM skills) play an essential role in advancing sustainable development (SD) objectives. Project management as a goal-oriented approach aligns with the SD framework. They provide a structured framework for planning, implementing, and monitoring projects, making them invaluable for advancing Sustainable Development Goals. They support effective stakeholder engagement, risk management, and adaptive approaches, while also fostering cross-cutting competencies that are vital for addressing sustainability challenges in diverse contexts.*

Project management is crucial in the workplace nowadays, and possessing these skills can significantly enhance students' employability prospects.

This research aims to analyze the coverage of project management skills and competencies in the Ukrainian academic standards and generalize the recommendations for effectively embedding these skills into the curriculum.

Methodology. Qualitative content analysis of Ukrainian academic standards developed by the Ministry of Education and Science of Ukraine. 38 academic standards for master's contain project management skills. There are challenges with the implementation of the standards in terms of alignment between the standards and the academic programmes, including teaching-learning-assessment practices.

Project-based learning and interdisciplinary projects are essential for ESD and PM skills development. Interdisciplinarity is a pillar of ESD and this will open project management concepts and practices for non-management students as they navigate the complexities of team dynamics, task delegation, and project coordination. Mentoring and peer-to-peer learning could be effective tools for ESD and for PM-skills development. Peer learning groups where senior students can guide non-management students in developing project management skills. The mentorship can provide valuable guidance, feedforward, and feedback throughout project-based learning.

1. PROJECT MANAGEMENT SKILLS AND SDG 4: EMPLOYABILITY PERSPECTIVE

According to the reports "The Future of Jobs", which have been published by the World Economic Forum since 2016 WEF (2016), WEF (2018), WEF (2020), WEF (2023), the labour market in all sectors of the economy is experiencing significant changes globally. These reports showed that many traditional skills have not been relevant nowadays. Experts are increasingly declaring that the skills that machines cannot replace will be in demand, at least in the near future WEF (2023), provided they develop in combination with technological skills.

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According to QAA and Advance HE (2021), students expect sustainable development to be implemented into their institutional practices and curricula. "In the 2020 National Union of Students Skills Survey, 91% of respondents agreed their place of study should actively incorporate sustainable development – up from 88% in 2014; while 83% would like to see sustainable development actively incorporated and promoted across all courses – up from 71% in 2014." (p. 5).

Based on Project Management Institute (PMI) analysis in 11 countries on five continents it is expected the opportunity for project-related job growth to be 33 percent collectively. Moreover, the set of the most popular skills for project managers includes leadership, technical management, as well as strategic and business management PMI (2017). As noted by PMI, this situation strengthens the role of project managers in stimulating changes and innovations in the organizations where they work. In this regard, PMI predicts that by 2027, employers will need 87.7 million people who will work in positions focused on project management. China and India will represent more than 75% of the total project management-oriented employment. So, we can also talk about the growing demand for project management professionals and professionals in sustainable development. According to PMI (2017), the latest PMI-commissioned talent gap analysis by Anderson Economic Group (AEG) points to outstanding opportunities in jobs and career growth for project managers within the 11 countries studied. Through 2027, the project management-oriented labour force in seven project-oriented sectors is expected to grow by 33 % or nearly 22 million new jobs. PMI (2017) shows that project managers are important contributors to productivity. Talent shortages in the profession can potentially create risks of nearly US$ 208 billion in GDP over the 10 years in the 11 countries examined. Project management skills are not only valuable in project management roles but are also demanded by employers in a wide range of industries and job positions. Therefore project-management skills can enhance students' employability and thus, should be recognised as essential and highly relevant to sustainability, particularly SDG 4 Quality Education. These skills are highly relevant to target 4.4 which implies "by 2030, substantially increase the number of youth and adults who have relevant skills, including technical and vocational skills, for employment, decent jobs, and entrepreneurship". According to PMI (2017) the trend of a deficit of professionals with project-oriented skills, identified in 2008, has increased and even exceeded forecasts, which was shown by the analysis conducted in 2012. The main reasons for this are a significant increase in the number of jobs that require project-oriented skills, an attrition rate, including retiring professionals, and significant growth in demand for professionals with project management skills, especially in fast-growing economies such as China and India.

2. SUSTAINABILITY IN PROJECT MANAGEMENT

Connecting project management with sustainability is a process that has begun with the adoption of sustainability principles by practitioners. Proposals have been defined in a global context since 2008 – the World Congress of the International Project Management Association (IPMA) put forward a statement about the need for project management professionals to "take responsibility for sustainability" McKinlay (2008). This statement was preceded by several studies related to the need to implement sustainability principles in the project management approach to overcome globally recognized threats to the planet, people, and further prosperity. Nowadays the link between project management and sustainability has been thoroughly explored. Brent and Labuschagne (2006), Labuschagne and Brent (2008, 2011), and Pade et al. (2008) acknowledge the insufficiency of efforts in this direction (Gareis et al., 2010). Since then, there has been a constant development of project management towards sustainability.

Progress in promoting sustainability is substantial (Gareis et al., 2011, 2013). However, researchers have identified problems that prevent the implementation of sustainability in project management. Among them, Silvius and Schipper (2014a) argue that the lack of sustainability which is considered in the context of project management prevents sustainability from being operationalized.

Another important aspect of sustainability implementation in project management is the qualification of managers. What knowledge and skills should project managers have to successfully implement the concept of sustainability in practice?

Silvius and Schipper (2014b) investigated how sustainability competencies are covered by the most important standards of project management competencies. Emphasizing the important role of a project manager in implementing sustainability, they insist on developing an appropriate set of competencies that allow them to carry out this role. Even though the concept of competencies is not new to project management, standards for project management competencies are available from PMI and IPMA (two of the world's leading professional organizations). Ndubuka and Rey-Marmonier (2019) investigated how Responsible Management Education contributes to the achievement of SDGs. The experience of SDGs implementation in curricula is widely presented as well by Fiselier et al. (2018), and Giangrande et al. (2019).

So, we have posed the research questions such as:
1) How are competencies for sustainable development close to project management skills?
2) How are project management skills represented in the Ukrainian landscape of higher education and how are these competencies constructively aligned with the programme learning outcomes?

Methodology. Qualitative content analysis of Ukrainian academic standards developed by the Ministry of Education and Science of Ukraine.

The data selection involved a search for programme learning outcomes and subject-specific competencies or/and generic competencies related to project management. As search strings, we used the terms 'project management' in Ukrainian academic standards or simultaneously with 'project' or 'project management'. To compare the content of academic standards in terms of representation of managerial skills we included also "strategic management", "technology management", "time management" and "team management" in the search.

3. THE LINK BETWEEN UNESCO'S KEY COMPETENCIES FOR SUSTAINABILITY AND PROJECT-MANAGEMENT SKILLS

The question of to what extent project management skills related to UNESCO's key competencies for sustainability does not have an agreed answer. Oyalowo et al. (2010) considered project management education can be used as a catalyst for sustainable development. Silvius and Schipper (2014b, 2015) analyzed publications related to education for sustainable development, including the five key competencies for sustainable development in management education programmes, as well as the level of inclusion of sustainability competencies in the ICB Project Management Competency Standard version 3. They came to the conclusion that intended competencies are partly covered by ICB3 project management competencies. In particular, strategic thinking competency and interpersonal skills are well covered: strategic thinking competency

is covered in ICB3 technical competencies, and interpersonal skills in ICB3 behavioral skills. Whereas systems thinking and normative competencies are partially covered by ICB3 project management competencies. Guraziu (2023) analyzed the model of project management as a sustainable pedagogical device in higher education. Guraziu (2023) considered project management as a concept different from project-based learning and gave the argument that project management methodology is more closely aligned with problem-based and inquiry-based learning methodologies.

It is essential to consider competencies for sustainability as a dynamic concept. As Leicht et al. (2018) noticed sustainable development will need to continue to evolve. The process of exploration and defining the future of ESD is continuing to engage different stakeholders nationally and globally. "Among other things, ESD will have to be responsive to changing contexts and emerging trends such as the recognition of sustainable development as a chosen lifestyle among the young generation rather than a series of environmental or related challenges" Leicht et al. (2018, p. 15).

Embedding a sustainability component in the teaching and learning professional component of academic programmes can be very useful for developing both cohorts of skills (Avelar et al., 2019; Cebrián et al., 2020; European Commission, 2020; Fia et al., 2023; Giangrande et al., 2019; Hammer & Lewis, 2023; Jones et al., 2008; Lemarchand et al., 2022).

Some research emphasized a strong connection between project management and sustainability implementation (McCarthy & Eagle, 2021). ESDConsulting (n.d.) considered projects to be effective for encouraging interdisciplinarity, teaching, and learning methodology as a recognized approach to bringing sustainable learning to the curriculum and extra-curricular activity.

According to the European Commission (2020), "The jobs of tomorrow require skills for the twin transitions. The green transition requires investments in the skills of people to increase the number of professionals who build and master green technologies, including digital, develop green products, services and business models, create innovative nature-based solutions and help minimize the environmental footprint of activities" (p. 12). Both concepts ESD and project management involve the development of students' ability to make non-standard decisions and innovate, as well as the ability to work in a team, cooperating with various stakeholders to achieve specific goals.

Several directions of connection between project management skills and Education for Sustainable Development can be distinguished, based on the competencies for sustainable development that UNESCO has identified as necessary for the training of specialists regardless of the field of study and/or specialty (Figure 1).

Strategic competence. The long-term vision that is immanent in the ESD aims to contribute to the long-term perspective of sustainable development, taking into consideration the well-being of current and future generations. The strategic focus of ESD is reflected in one of the competencies for sustainable development – strategic competence. However, implementing a long-term vision can be enabled through the development of project management skills.

Project management is based on planning and goal setting. The latter is fundamental in project management. That is, strategic competence as one of the competencies for sustainable

development can be developed through the development of project management skills if the programme is constructively aligned. Tuononen et al. (2022) confirm that well-organized and coordinated teaching, learning and assessment, which involves active learning methods, in particular, project-based learning, improves student learning of generic skills. That is, the embedding of such skills in disciplinary courses takes place primarily through methods of learning, teaching and assessment. According to QAA and Advance HE (2021) developing strategic competence confirms enabling the strategic achievement of goals globally and locally. This involves planning and assessment tools to identify and address sustainable development challenges, demonstrate flexibility and resourcefulness and adapt a problem-solving mindset to fit changing or unforeseen circumstances. Meanwhile, project management is highly effective for developing students' planning and assessment skills.

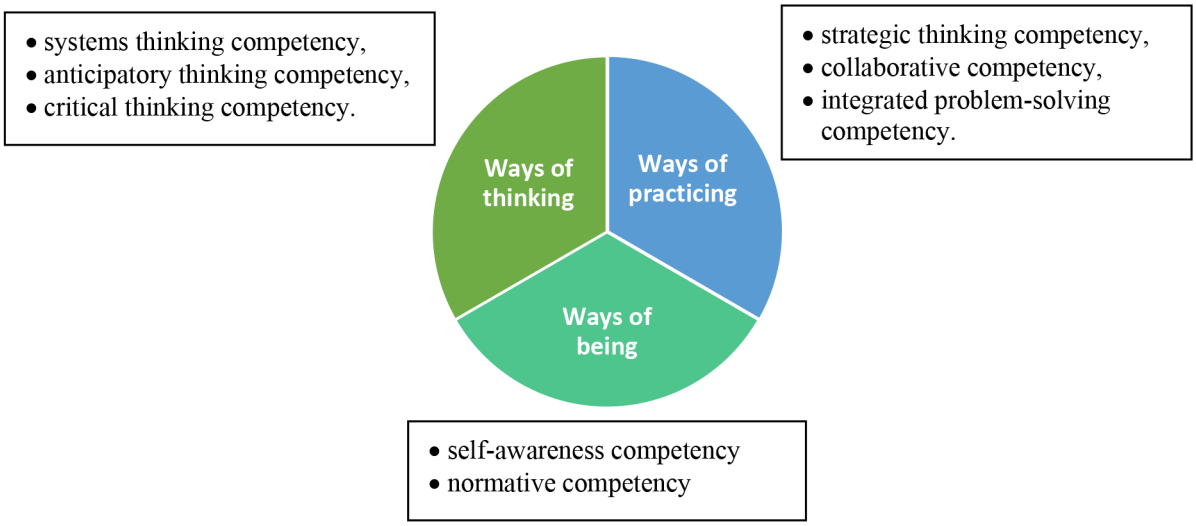

Figure 1. Key competencies for sustainability
Source: UNESCO, 2017

Interdisciplinarity. In the context of students' learning not only in management, but also in other majors, both for project management and for education for sustainable development, an interdisciplinary approach is important, since sustainability as a concept that integrates environmental, economic, and social aspects is interdisciplinary in nature essence "ESD requires a learning environment in which interdisciplinary or transdisciplinary learning approaches are facilitated" (QAA and Advance HE, 2021, p. 32). Interdisciplinarity refers to many competencies for sustainable development, in particular, integrated problem-solving competency involves the ability to work effectively in multidisciplinary and interdisciplinary groups. And as one of the teaching practices, collaborative learning is recommended – which involves an "interdisciplinary, international project to create dementia-friendly communities". So, project management skills such as stakeholder engagement, resource allocation, and risk management are essential to coordinate efforts across disciplines and ensure that diverse perspectives are integrated into sustainable solutions.

Collaborative competency. Another link between project management skills and Education for Sustainable Development is the ability to work in a team. Cooperation and teamwork are the pillars of project management. Among the key competencies for sustainability is a collaborative competency, which involves engaging in interdisciplinary discussion to inform their thinking about sustainable futures and seek holistic, creative solutions to problems and facilitate

collaborative and participatory problem solving. Similarly, project management emphasizes effective teamwork and cooperation between different stakeholders, and employees with different skills and experience. The project-oriented learning itself is actively encouraged within ESD, as it allows students to work together on sustainable development projects, reflecting real situations and developing collaborative competence. Besides, the methodology of project management is quite effective for developing the ability of students to recognize the goals, skills and needs of others which is crucial for successful collaboration.

Problem-solving competence. An obvious connection between ESD and project management skills is integrated problem-solving competence. This competence predicts that the student will be able to "combine different sources and types of evidence, drawing from different disciplines, to view and address a problem" (QAA and Advance HE, 2021, p. 29). A project manager also requires good problem-solving skills, which provide tools and techniques to facilitate the implementation of these solutions.

Project management involves continuous monitoring and evaluation to track progress and make necessary adjustments. Evaluation skills are important for ESD, which encourages a reflective process where students can assess the impact of their actions on the goals of sustainable development and accordingly adjust behavioral, consumption, and lifestyle strategies in general. Ethical aspects, which are taken into account when making decisions, are important for ESD and project management as well. Ethical decisions are important in project management to ensure that projects are executed with integrity and respect for stakeholders. ESD promotes ethical behavior by encouraging students to consider the social, environmental and economic consequences of their actions.

In essence, project management skills provide a structured approach to implementing the principles of ESD. It helps ensure that sustainable development initiatives are effectively planned, executed, monitored, and evaluated, ultimately contributing to the achievement of sustainable goals and positive societal outcomes.

4. HOW ARE PROJECT MANAGEMENT SKILLS REPRESENTED IN THE UKRAINIAN LANDSCAPE OF HIGHER EDUCATION

An analysis of the Ukrainian academic standards of higher education for the master's level (Ministry of Education and Science of Ukraine, n.d.) was carried out to understand to what extent project management competencies are represented in the programmes implemented in Ukrainian higher education. This approach was chosen due to two key reasons, such as 1) Academic standards of higher education in Ukraine are mandatory for higher education institutions to develop their study programmes, and 2) higher education institutions very rarely change the programme learning outcomes, although they have such a right. The Ministry's academic standards for higher education in Ukraine include generic competencies, and subject-specific competencies, based on which programme learning outcomes are defined. Following the regulations of the Ukrainian Ministry of Education and Science, higher education institutions may add and change the wording of subject-specific skills and/or program learning outcomes but ensure that students have acquired the competencies defined in the Ministry's academic standard.

Therefore, the content analysis of the Ministry's academic standards is representative of generalization and understanding of what extent these competencies are displayed in the landscape

of Ukrainian higher education. The overall result confirms the Ministry of Education and Science recognizes the importance of project management skills for various specialties, including health care, military sciences, and law.

We compared the project management skills and other management competencies, as shown in Figure 2, time-management, strategic management, technological management and team management. The project management skills are the most in demand. In general, 38% of the entire cohort of standards contain project management skills (38 from 101 academic standards). While the other ones are represented very poorly. Strategic management skills are included in just 8 % of academic standards, and team management skills are only represented in 3 academic standards. An important aspect of the Ukrainian academic standards' analysis is the fact that project management skills are represented mostly in the fields of study that are traditionally associated with arts and humanities. Three out of five academic standards in the Humanities contain project management skills, one contains the ability to manage work or learning processes in the field.

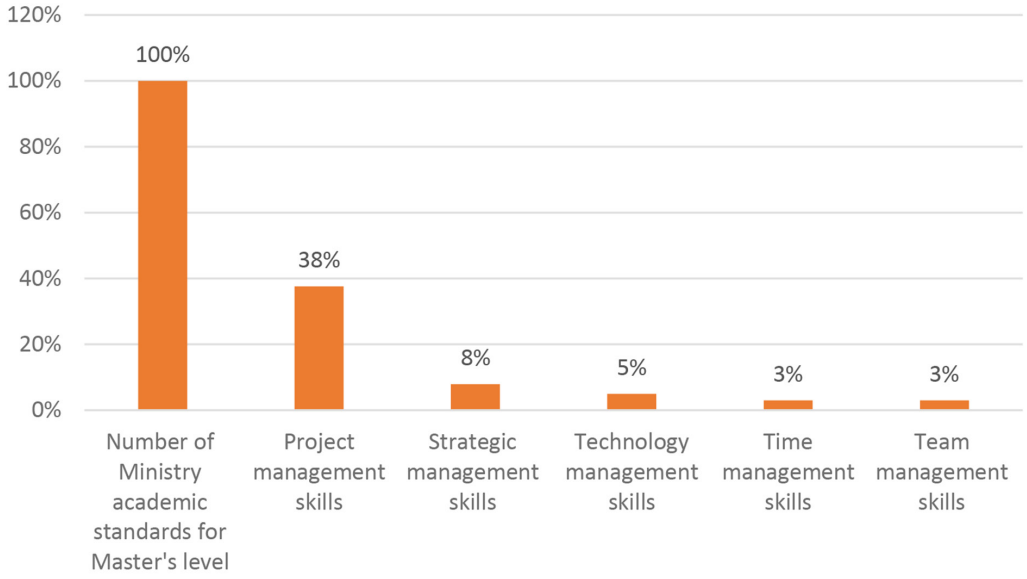

Figure 2. The project management skills and other management competencies in the academic standards of the Ministry of Education and Science

Source: Own calculations

A similar case is the in social and behavioral sciences. In this field of study 3 out of 5 academic standards contain management competencies, particularly project management skills. The field of study Agricultural Sciences and Food represents 5 out of 8 academic standards which contain project management skills. So, we see that project management skills are recognized as relevant for non-management majors. However, implementing project management skills in non-managerial academic programmes is quite complicated. Analysis of the academic standards revealed some inconsistencies, namely, most of the standards contain relevant generic competencies (23 out of 38) but have not been reflected in relevant programme learning outcomes, which depict project management skills. Just 8 academic standards contain programme learning outcomes related to project management. Since program learning outcomes in ministerial academic programmes under the specialty, there are significant risks that the principle of the constructive agreement will not be met. That is, the learning, teaching and assessment methods do not take into account the presence of project management competencies, as they are lost in the programme learning outcomes.

5. FUTURE RESEARCH DIRECTIONS

Despite plenty of research on sustainability implementation in the principles and practice of project management, the issue of how project management competencies correlate with key competencies for sustainability is still discursive. How does the development of project management competencies among students contribute to the development of their knowledge and skills about SD?

The limitation of this study is that the conclusions regarding the representation of competencies and programme learning outcomes in the landscape of higher education in Ukraine are developed based on the standards of the Ministry of Education and Science of Ukraine (n.d.). The next stage of research on this issue should be an analysis of the content of educational programs, as well as a survey of students about their learning experience and development. An important aspect is the development of an internal institutional vision regarding ESD.

The issue of how teaching, learning and assessment of components in academic programmes should be developed and delivered to make it possible to align these competencies with sustainability competencies needs to be researched. Guraziu (2023) concluded that the project-based approach promotes critical thinking and critical reflection, develops students' ability to recontextualize practice in the educational environment as well as enhances collaboration and teamwork. It would be highly beneficial for HEIs to integrate project management as an integral module in academic programmes given the importance of project management skills. Teaching project management goes beyond all disciplines and is not limited to specific subject areas.

6. CONCLUSION

Although the project management competencies in the academic standards of the master's level in Ukraine are broadly represented (mostly as general competencies), programme learning outcomes limit the implementation of this element in academic programs of a non-managerial profile. Such a situation creates path dependence when the lack of practice and experience in embedding project management elements into non-managerial and institutional policy programs in this regard limits the implementation of an effective approach.

We believe that it would be highly beneficial in terms of students' experiences for institutions to review the programme learning outcomes, as well as the formation of an institutional strategy for the development of sustainability competencies, and involvement of the stakeholders as actors. Mentoring and peer-to-peer learning could be effective tools for ESD and PM skills development. Peer learning groups where senior students can guide non-management students in developing project management skills. The mentorship can provide valuable guidance, feedforward, and feedback throughout project-based learning.

Therefore, higher education must find a combination of approaches and methodologies to teaching, learning and assessment to enable the development of key sustainability competencies.

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Customer Genetic Data for Sustainability and Innovation Management

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Abstract: *The availability of affordable genetic testing has enabled the collection of vast amounts of genetic data, creating new opportunities for marketing management. The use of genetic data empowers companies to develop personalized products and services and enhance customer relationship management. This, in turn, creates a competitive advantage for boosting companies' strategic market positioning by enhancing their sustainability and innovation policies. This review paper aims to explore how businesses can leverage genetic data for sustainability and innovation management. The framework presented outlines the integration of genetic data into different stages of sustainable product development thus allowing for precision targeting through responsible innovation management. The paper also examines the potential ethical and legal implications of using genetic data in marketing management.*

1. INTRODUCTION

The integration of genetic insights with business strategy is transforming marketing landscapes (Hoffman et al., 2022), leading to personalized engagement (Kotler et al., 2021) and sustainable innovation (Sachs, 2015; Schaltegger & Wagner, 2011). In an era marked by heightened environmental consciousness and rapid technological progress, businesses must adopt innovative strategies aligned with sustainability goals (SDGs). Simultaneously, the field of genomics has revolutionized, democratizing access to genetic data. This paper investigates the convergence of these trends, exploring how customer genetic data can fuel sustainability and innovation in product development. The intricate interplay between genetic insights, sustainable practices, and innovation lays the foundation for this exploration. By leveraging technology to propel sustainability-driven innovation, marketing based on DNA data - genetic marketing -enables precision targeting (Daviet et al., 2022) and gene-based segmentation to promote sustainable development through smart consumption (Ivanova-Kadiri, 2023), and facilitate innovation management. This paper aims to provide a comprehensive synthesis of the current state of knowledge on leveraging genetic data for business, identifying research gaps, and proposing future directions. The methodology includes analyzing existing business models in implementing genetic data for business purposes. The study's implications provide a basis for further research and practical implementation in leveraging genetic data for sustainable business practices and innovation management.

2. PRECISION MEDICINE: MARKETING KPIS

The integration of genetic insights into innovation management is reshaping traditional business models. Genetic data once limited to healthcare applications, now fuels innovation across sectors as diverse as consumer goods, entertainment, interior design and tourism. This paradigm

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shift is exemplified by the rise of direct-to-consumer genetic testing (DTC-GT), which empowers individuals to uncover their genetic makeup. Beyond satisfying curiosity, DTC-GT enables businesses to tailor products and services to individual genetic profiles, fostering hyper-personalization. Direct-to-consumer genetic testing has emerged, providing individuals with ancestry and health risk identification. The traditional biotechnology business model has expanded to include direct-to-consumer supply. While businesses recognize the transformative potential of genomics, the accumulation of genetic databases expands the scope of genomic products and services.

Vanhala et al. (2013) have identified five DTC genetic testing business models based on consumers' motivations for purchase, such as curiosity, medical needs, or lifestyle factors. These models include comprehensive genomic tests, genomics as part of individual health planning, services based on comprehensive genomic tests, medical precision tests, and restricted trait tests. Table 1 outlines the marketing KPIs for each business model.

Table 1. Marketing KPIs of DTC genetic testing

	Genome as data bank material	**Genome as a tool for health planning**	**Genome-as-a-service**	**Medical precision tests**	**Restricted trait tests**
Value proposition	Comprehending health risks and genomics through entertainment and familiarity.	Genome-informed health plan with lifestyle support.	Outsourced genetic testing for an easy and fast individualised lifestyle service.	Trusted and precise response to customer's medical inquiry.	Entertaining and informative details about a person's unique characteristics.
Target groups	Early adopters, genomics enthusiasts, and specific niche groups based on service.	Individuals pursuing lifestyle change, tech-savvy individuals, and those with lifestyle-related health issues.	Lifestyle and fitness enthusiasts, quantified self-followers.	Affluent persons interested in their own risk of disease.	Early adopters, genomics enthusiasts, and specific niche groups based on service.
Key resources	Genome data is a valuable revenue source due to its critical nature and significant value.	Genome data contributes to service offering alongside professionals and software, as key resources.	Genome data and software expertise are essential for service offerings.	Genome data crucial for product development.	Genome data crucial for product development, but the resale value of customer data is low.
Assessment of business model	Strong market position is essential. Some players evolved into healthcare testing providers.	Incomplete understanding of genome data interpretation makes this model risky to use.	Great potential once genetic data interpretation improves. Quick launch for software-based service.	Growing demand for functional models. Whole genome sequencing may revolutionize the business model.	A challenging model with price competition difficulties against genome-wide tests.

Source: Vanhala et al., 2013

Another emerging paradigm capitalizes on the individual's genetic code as a foundational element to create personalized physical products and services. Panasonic's Genome House initiative makes genetic composition central to product innovation and leverages the human genome as an essential and irreplaceable asset within its business model (Ivanova-Kadiri, 2023).

3. BUILDING CUSTOMER GENOMIC PERSONA THROUGH BEHAVIOURAL GENETICS

In the fascinating world of behavior genetics, the idea of individuals having unique genomic personas is uncovered (Carey, 2013; Kuechle, 2019), shaped by a combination of their genetic makeup and external influences, which impact their consumer behavior (Conway & Slavich, 2017; Daviet et al., 2022). This concept sheds light on how specific genes can influence behaviors like risk-taking, seeking novelty (Kuechle, 2019; Li et al., 2017), and embracing sustainability. Understanding these genomic personas opens new avenues for businesses to customize their products and services to match customers' genetic inclinations and external influences.

The concept of genomic personas has significant implications, especially in the realm of sustainability and eco-design. As businesses increasingly focus on eco-friendly product development (Schäfer & Löwer, 2021) valuable insights into consumers' inherent tendencies toward sustainable choices are provided by behavior genetics. Armed with this knowledge, products that align with customers' genetic predispositions for eco-consciousness can be created (Ivanova-Kadiri, 2023), leading to more appealing and sustainable offerings. Moreover, the idea of genomic personas also connects with the notion of smart consumption, emphasizing informed and responsible choices. Tailoring product recommendations based on customers' genomic profiles can facilitate the development of personalized and relevant suggestions, enabling consumers to make smarter, more sustainable decisions that align with their preferences and values. Ultimately, the application of customer genomic personas can build a more environmentally responsible consumer culture.

4. DATA PRIVACY AND ETHICAL CONSIDERATIONS

The utilization of customer genetic data poses substantial ethical and legal quandaries, demanding businesses to navigate these complexities with heightened responsibility. The intricate nature of personalized genetic insights underscores the need for unwavering commitment to data protection, informed consent, and transparency. This dual focus ensures that genetic data is employed for constructive purposes while zealously safeguarding the autonomy and rights of individuals. The integration of customer DNA data into business strategies remains a contentious subject, largely due to apprehensions concerning data privacy and ethical ramifications.

The DNA testing surge has enriched databases of key players like 23andMe, Ancestry, and others. A 2018 poll revealed that 50.5% of Americans would share DNA for $95, 11.7% altruistically, while 37.8% hesitated. Erasing DNA (72.2%), non-disclosure (69.8%), and consent (67.9%) were key considerations (Briscoe et al., 2020). Concerns included insurance exploitation, job discrimination, identity theft, cloning, and data misuse. Ethical issues of genetic marketing intertwine with secure data sharing. Notably, 23andMe shared data from five million customers with GlaxoSmithKline (GSK), raising ethics debates (The New York Times, 2019). Likewise, FamilyTreeDNA shared data with the FBI for crime-solving, questioning privacy ethics in genealogy (TIME, 2018). Amidst precision medicine's growth, genetic data's role in drug development and investigations is critical.

Globally, legal frameworks treat genetic data diversely, with the EU's GDPR notably safeguarding genetic data under personal data regulations (Ivanova-Kadiri, 2022). Correspondingly, the European Genomic Data Infrastructure (EGDI, n.d.) initiative facilitates secure genomic data

sharing within Europe. Recognizing genetic data's rising importance, EGDI establishes a cohesive ethical and privacy framework. This domain poses significant challenges, recognized within big data realms (Reali et al., 2018). Secure storage necessitates regulatory and software tools. Robust ethical guidelines are pivotal in governing genetic data's business use, ensuring privacy and enabling sustainable product development. Adherence to GDPR assures data security and consent. EGDI not only propels genetic research but also preserves privacy and builds public trust.

The integration of emerging technologies not only amplifies the potential for success (Muriithi, 2020) but also aligns with the demonstrated positive correlation between innovation, customer engagement, and marketing outcomes (Fidel et al., 2015). As consumers increasingly embrace circular consumption practices with a distinct sustainability focus, persistent barriers such as cost implications, limited sustainability interest, and information gaps (Deloitte-UK, 2022) underscore the necessity for businesses to seamlessly incorporate sustainability into product development strategies. Moreover, the imperative to address gaps in scientific evidence within the realm of direct-to-consumer genetic testing remains. This imperative not only upholds consumer trust within the broader healthcare context but also ensures the reliability and consistency of genetic insights (Delfanti, 2011). A holistic consideration of ethical, legal, and scientific facets serves as the foundation for an ethically responsible and comprehensive framework for the sustainable management of DNA-based products and services, further elucidating the intricate interplay between innovation, sustainability, and responsible genetic data utilization.

5. FRAMEWORK FOR SUSTAINABILITY AND INNOVATION MANAGEMENT OF DNA-BASED PRODUCTS AND SERVICES

Understanding customer genetic data for sustainability and innovation involves exploring the fusion of sustainable entrepreneurship and innovation (Schaltegger & Wagner, 2011). This synergy integrates environmental and social aspects into entrepreneurial ventures, aligning with sustainable consumption tailored to unique genetic personas. Sustainability innovation propels eco-friendly product and process development, aligning with economic success and broader sustainability goals (Schäfer & Löwer, 2021). By embracing customer genetic data, businesses customize offerings to individual genetic inclinations, ensuring alignment with sustainable preferences. Considering the "triple bottom line" of social, environmental, and economic factors (Elkington, 1998) reinforces businesses' commitment to practices harmonizing with customer genetic data. Categorizing sustainability practices and interactions (Schaltegger & Wagner, 2011) offers insights into catering to unique genetic personas. Integrating sustainability principles into daily operations (Hopkins, 2016) aligns businesses with customer preferences for sustainable choices. A long-term perspective (World Commission on Environment and Development, 1987) is vital for precise sustainable consumption. "Natural capitalism" (Hawken et al., 2013) aids businesses catering to sustainability-minded customers. Strategic sustainability management (Stead & Stead, 2014) guides precision in consumption. Successful sustainability integration examples (Elkington, 1998) inspire embracing customer genetic data.

The proposed framework for sustainability and innovation management of DNA-based products and services (figure 1) seamlessly integrates genetic data into sustainable innovation, emphasizing ethics and engagement. It aligns with environmental and social goals, creating personalized offerings that resonate with values. This approach drives value, advantage, and societal betterment, ensuring DNA-based products contribute to a sustainable and ethical future.

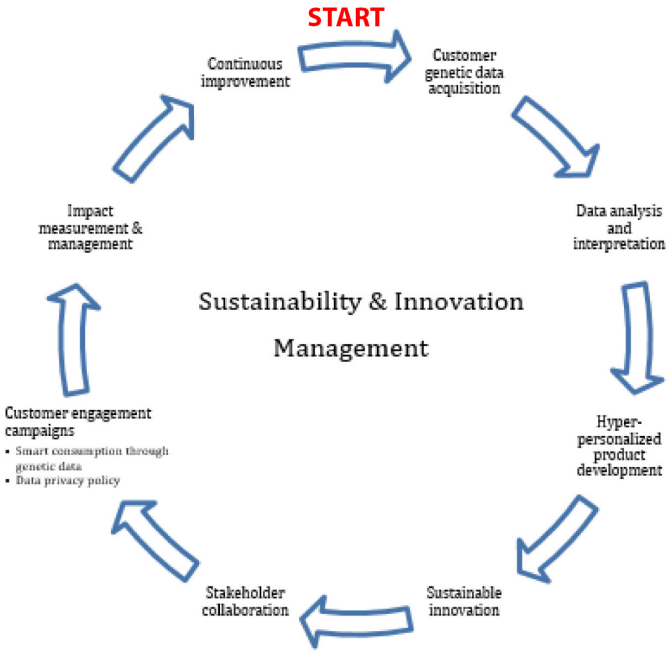

Figure 1. Framework for sustainability and innovation management of DNA-based products and services

Source: Own processing

The framework consists of eight steps, which integrate customer genetic data into the key principles of innovation management:

Step 1. Customer genetic data acquisition. Obtaining genetic information from customers through consented means, employing state-of-the-art genetic testing technologies. Upholding data security, privacy, and strict adherence to ethical and legal standards.

Step 2. Data analysis and interpretation. Utilization of bioinformatics and data analytics to delve into the genetic data. Identify patterns, variations, and potential health indicators, gaining valuable insights into each customer's unique genetic profile.

Step 3. Personalized product development. Harnessing genetic insights to tailor DNA-based products and services to individual preferences, health needs, and sustainable consumption practices. Pioneering innovations in areas such as personalized nutrition, skincare, and fitness.

Step 4. Sustainable innovation. Integration of genetic data into the product design process, facilitating the creation of environmentally friendly and socially responsible offerings. Embracing a life cycle perspective, considering the product's entire journey from sourcing to disposal.

Step 5. Stakeholder collaboration. Cultivating collaboration with genetic researchers, healthcare professionals, and regulatory bodies to ensure the accuracy, safety, and compliance of DNA-based products.

Step 6. Customer engagement campaigns. Developing targeted marketing campaigns that resonate with customers' genetic predispositions and values. Educate customers about the benefits of DNA-based products in promoting sustainable lifestyles.

Step 7. Impact measurement and management. Monitoring and assessing the broader effects of DNA-based products and services on consumers, the environment, and the overarching landscape of sustainability.

Step 8. Continuous improvement. Continuously refining product offerings and engagement strategies based on evolving genetic insights.

While precision in sustainable consumption remains paramount, it's equally crucial to comprehend the ripple effects that DNA-based products can generate. This entails carefully observing how these offerings resonate within the fabric of society and whether they genuinely contribute to the culture of sustainable consumption and responsible innovation. In this vein, businesses venture beyond the confines of product design and marketing to embrace their role as contributors to a more sustainable and ethically sound future.

6. FUTURE RESEARCH DIRECTIONS

The realm of genetic data business holds intriguing avenues for future scholars to explore. This involves refining the ethical aspects of using genetic information, especially concerning personalized product offerings while safeguarding data privacy. The convergence of technologies like AI and blockchain presents opportunities to balance these concerns. The study of decentralized data sharing's potential impact is another important direction. Investigating data ownership in relation to genetic information is crucial. Additionally, understanding how DNA-based products affect consumer behavior and contribute to sustainability goals on a societal level is a key focus.

Future research could delve into integrating genetic data into healthcare systems and promoting genetic literacy. Thus, scholars can significantly shape the ethical and innovative landscape of the genetic data business. Their insights can navigate complexities and establish responsible practices that balance innovation with ethics.

7. CONCLUSION

Utilization of genetic data for sustainable innovation management enables ecologically friendly and socially responsible product creation. Employing a comprehensive life cycle approach, businesses can ensure positive environmental impacts from sourcing to disposal. Yet, integrating customer genetic data into strategies necessitates addressing ethical concerns around data privacy and consent. Robust data protection and transparent communication are vital to uphold customer confidentiality. Moreover, the potential biases and stigmatization tied to genetic data must be carefully managed to ensure inclusivity. Despite challenges, this integration has the potential to build strong customer engagement and trust.

Behavior genetics and genomic personas offer a potent tool for businesses to enhance sustainability efforts. Understanding the link between genetics and consumer behavior aids in crafting precise strategies for eco-design and sustainable product development. This innovative approach can reshape customer interactions, promoting eco-conscious choices in the market. The framework introduced in this paper plays a pivotal role in bridging the realms of genetics, sustainability, and business innovation. Its primary objective is to guide businesses in effectively incorporating customer genetic data into their sustainable product development strategies. Through the framework's systematic approach, businesses can navigate the challenges of data privacy, ethical use, and potential biases associated with genetic information. The framework's emphasis on societal impact measurement ensures that DNA-based products contribute to a culture of sustainable consumption and responsible innovation, advancing both environmental preservation and economic prosperity.

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Consequences of the Pandemic: Consumer Behavior Changes

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Online orders;
Stockpiling;
Sustainable consumption

Abstract: *The COVID-19 pandemic significantly impacted the business environment worldwide. Some of the most significant changes occurred due to consumers altering their habits. This paper explores some of the most significant of these changes and draws their conclusions. The main aim of this research was to examine the consumer behavior changes that occurred during the COVID-19 pandemic and their impacts on the Slovak business environment. The findings were also used to describe the major consequences that the pandemic had on society in terms of its effects. A survey was used to collect data from consumers. The research sample file consisted of 587 Slovak consumers. It was discovered that some consumers experienced panic buying and significantly increased their tendency towards stockpiling goods during the initial stages of the pandemic. The trend towards shopping unaccompanied did not survive the end of the pandemic years. The increase in online shopping has remained strong even after the pandemic concluded and still represents a new challenge for business owners, but also an opportunity.*

1. INTRODUCTION

The world around us is a constantly evolving dynamic system. Any change that occurs in the system will affect its elements. By developing human knowledge, it is possible to prepare for changes and thereby eliminate their negative effects. However, sometimes the change is so fundamental and unexpected that societies cannot foresee its consequences. Such an unexpected major event was the COVID-19 pandemic, which caught the world unprepared and its effects were manifested significantly in the years 2021 - 2023. The COVID-19 pandemic negatively affected all aspects of the process in modern societies and researchers all around the world focused on documenting its immediate effects, including consumer behavior changes. Wells et al. (2023) stressed that the interpretation of consumer behavior is more relevant in situations where supply is uncertain. The COVID-19 pandemic created disruptions even in this area of supply chain management. Such risks created both temporal and social challenges during the pandemic that needed to be addressed by businesses providing products and services. However, for them to correctly address these newly emerged needs, they first must have enough evidence on how the consumer behavior changed.

Many consumers immediately shifted their shopping habits towards safer ways. Various evidences show how consumers reacted during the pandemic years (Eger et al., 2021; Moreira et al., 2023; Wells et al., 2023). However, the reactions varied based on the severity of the pandemic impacts and the strictness of governmental response. Therefore, it is important to look at consumer behavior changes through its elements as well as throughout different pandemic years.

Even though the immediate consequences of the COVID-19 pandemic have been sufficiently mapped, its long-term effects remain still unknown. This paper aims to draw conclusions from

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the pandemic and uncover the trends of changes that enable predictions of the future direction of consumer behavior evolvement. The findings of this research can also serve as guidelines for any members of society by predicting the changes that consumer behavior would go through if such a negative major event occurred again in the future. Such data is necessary to develop marketing strategies that consider changes to meet actual consumers' needs and feelings.

2. LITERATURE REVIEW

Consumer behavior is widely recognized as a broad term that encompasses many variables. This is the behavior of a person when buying and consuming products, which means external manifestations of behavior - coming to a store, choosing a product, using it and consuming it, and then getting rid of the product; as well as internal manifestations – motivation, perception, the influence of various variables, opinions and their dissemination, satisfaction. It is a complex concept that is the result between the consumer and his environment (Cazacu, 2022; Morrison, 2009). Therefore, it is possible to observe changes in consumer behavior by mapping their external manifestations or through a more demanding understanding of consumers' motivations that lead them to act or, on the contrary, stimulate them not to act.

One of the most significant changes that was observed almost immediately after the outbreak was the consumer behavior changes in terms of frequency of shop visits and changes in goods amount bought. While research all around the world points towards a decrease in the first-mentioned aspect of consumer behavior (Harantová et al., 2022; Moharana & Pattanaik, 2022), the evidence varies on the latter. Cai et al. (2023) described that even though consumers did not visit shops as often as before the outbreak, not all of them decreased the amount of products they bought.

The sudden nature of the outbreak of the COVID-19 virus also caused frequent incidents of large-scale material panic buying, resulting in an imbalance in the supply and demand of goods and threatening social stability (Chen et al., 2022). Moreover, Yin et al. (2021) described a newly formed trend related to consumers' preferred form of shopping and newly emerged factors influencing their behavior such as the feeling of safety in stores and the accessibility of shops (Al-Tarrah et al., 2021; Güngördü Belbağ, 2022; Khanna et al., 2023). The early stages of the pandemic were accompanied by uncertainty which led people to seek safety. Several cases of stockpiling were reported in the early days of the pandemic (Chen, 2020; Wang et al., 2020). However, the media coverage of this phenomenon decreased during the later years of the pandemic (Pan et al., 2022; Stanca et al., 2023). This decrease may not be a relevant indicator of the real situation. However, credible evidence in this area is currently lacking. Likewise, there are some scarce reports on how consumers may have shifted their preference towards shopping unaccompanied (Cai et al., 2023).

Furthermore, Di Crosta et al. (2021) described that the pandemic has also heavily impacted individuals' spending levels. The economic crisis that emerged as a reaction to the pandemic and a slowdown in economic activity causing a rise in unemployment often also resulted in decreased incomes for many households. Some evidence exists on the linkage between these alterations in household incomes and changes in consumer behavior (Veselovská et al., 2022). When household incomes decline, consumers typically adjust their spending patterns and priorities. These changes may include reduced spending on non-essential items, such as dining out, entertainment, or travel, and a shift towards essential goods and services like groceries, healthcare, and

housing. Consumer confidence can also play a crucial role in shaping behavior during an economic crisis. When people are uncertain about the future, they may reduce their spending to build a financial safety net. On a positive note, these changes may indicate a long-term shift towards more sustainable consumption.

Another interesting trend that occurred during the pandemic was the change in brands that consumers had used before the pandemic due to perceived value based on expectations and experience (Veselovská, 2023; Wang et al., 2023). Migliore et al. (2021) as early as 2021 described a trend toward ethnocentrism that has become abundant during the pandemic. These findings were later confirmed by Čvirik et al. (2023). According to Prymon-Ryś and Galarowicz (2021), the most important phenomena that have been observed include the growing importance of e-commerce and technologies supporting distance communication and online exchange. Many governments introduced lockdowns to stop the spread of the virus. Therefore, consumers were forced to limit their visits to classic brick-and-mortar shops. Other researchers also provided evidence of this phenomenon (Lemes Bausch et al., 2021; Phang et al., 2021; Yin et al., 2021).

The provided evidence is extensive at first glance. However, these studies provide only limited views of various elements of consumer behavior that focus mostly on their external manifestations, often lacking deeper context. Therefore, this research study focused on describing the most complex consumer behavior changes in one selected country taking into consideration its political and economic development as well as the development of the pandemic situations from the beginning of the year 2021 to the end of March 2023.

3. METHODOLOGY

This research was part of an ongoing project designed to map the effects of the pandemic on consumer behavior. A nationwide survey took place in the Slovak Republic. Data was collected from consumers almost since the outbreak of the COVID-19 pandemic. The target group was consumers who were at the time of the survey the main shopper for their household. So the goal was to build a representative sample of all people in the selected country, but to create a pool of data from consumers who possessed the relevant information. The sample file consisted of 587 consumers as presented in Figure 1.

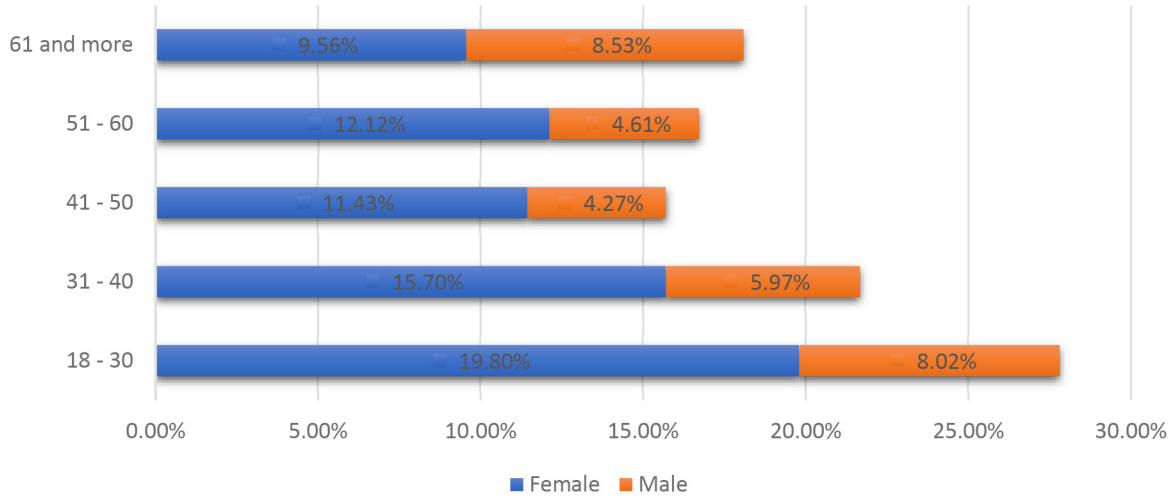

Figure 1. Sample file structure

Source: Own processing

This paper aims to explore the major consumer behavior changes that occurred during the COVID-19 pandemic. Several methods were used to collect, process, and analyze the data enabling the authors to elaborate a clear image of not only the changes that occurred but also of how different segments of consumers reacted and altered their behavior. This research uses segmentation of consumers by age, gender, and levels of education to uncover such differences.

4. RESULTS

Consumers experienced various significant changes during the pandemic. Based on its implication for sustainable consumption it would be beneficial to explore firstly the changes in the amount of products bought during the pandemic. Figure 2 and Figure 3 present the corresponding information. According to the data, the majority of consumers regardless of their level of education decreased the amount of products they bought during the years of the pandemic in comparison to amounts they had used to buy before the outbreak. However, some variation can be observed when examining this issue by segmenting the consumers based on this socioeconomic criterion. According to the findings consumers who completed just the elementary education were more prone to increasing the amount of products they bought during the pandemic. Furthermore, consumers with university degrees were least likely to change anything in their buying habits.

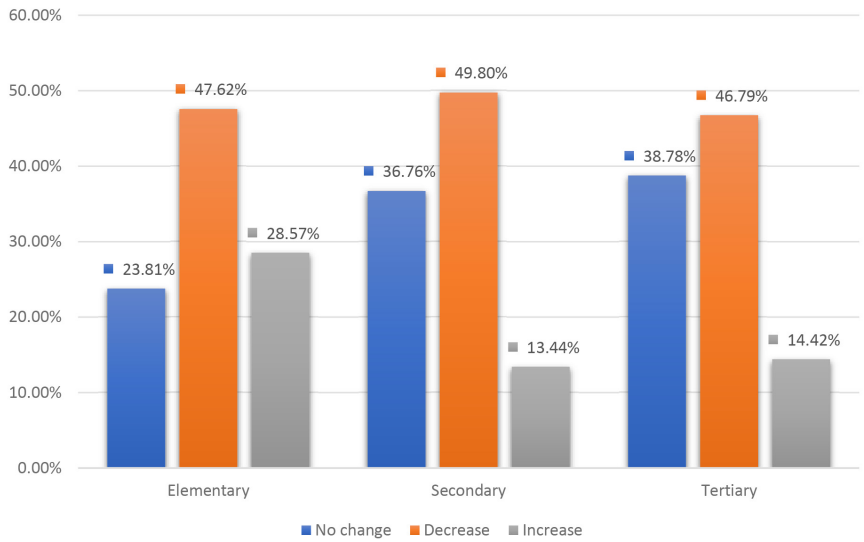

Figure 2. Changes in the amount of products bought during the pandemic

Source: Own processing

The COVID-19 pandemic significantly affected lives in societies during the years 2021 and 2023. However, its immediate effects were not consistent during this period. Therefore, it is necessary to explore any changes that occurred in consumer behavior in each year individually. According to the data presented in Figure 3, the second year of the pandemic was the time when the majority of changes occurred. On the other hand, in 2021 the majority of consumers did not alter the amount of products bought. However, this was the year when the highest share in the increase in the purchased quantity was recorded (18.18% of consumers). This year up to 36.8% of consumers experienced panic buying. This share was significantly lower during the other examined years. Given that panic buying is caused by fear, it is logical that the uncertainty at the beginning of the pandemic caused this phenomenon to an increased extent. In 2022 and 2023, more than half of all consumers reduced the amount of products they purchased. The mentioned findings indicate an increase in the caution of consumers, either by getting used to the pandemic situation or by learning

to be cautious concerning the creation of savings. In this context, this research also examined the changes that occurred among consumers in terms of their household income. Higher fluctuations occurred in 2022, which may result in lower purchase quantities.

Concerning achieving the sustainability of world consumption, it is appropriate to draw attention to the positives that the COVID-19 pandemic has brought. It is the reduction of the amount purchased, practiced by more than half of consumers since 2022, that can contribute positively to the sustainable use of resources on our planet, which is also one of the important strategic goals of sustainable development. The situation remained favorable in 2023 and hopefully, this trend will continue and prevail in the future.

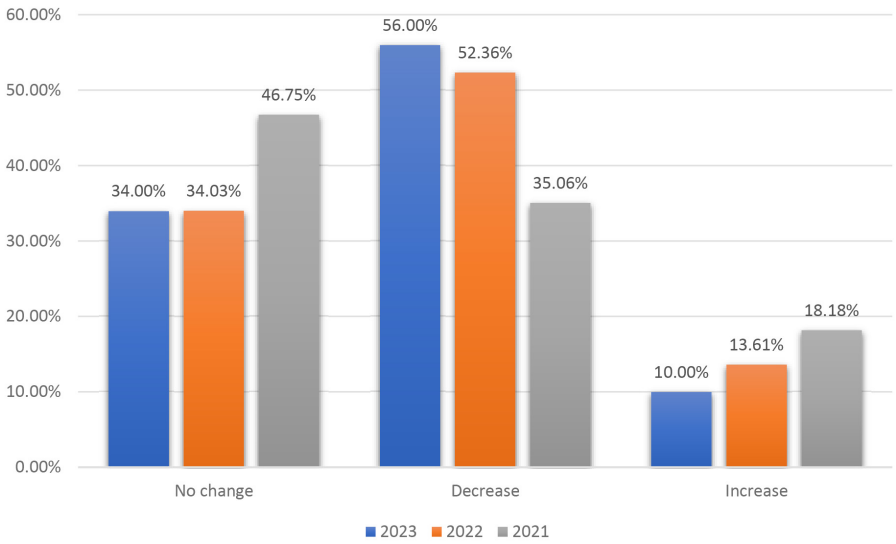

Figure 3. Changes in the amount of products bought during the pandemics according to income changes of households based on year

Source: Own processing

An accompanying sign of any sudden and unfavorable event is a rise in fear. Such negative feelings can also cause panic buying in consumers. Therefore, this research explored the preference of consumers to stockpile goods. Again, it is necessary to look at this information in the context of individual years, which also makes it possible to map the development of this phenomenon. Figure 4 shows the trend of a slight decrease in stockpiling of goods.

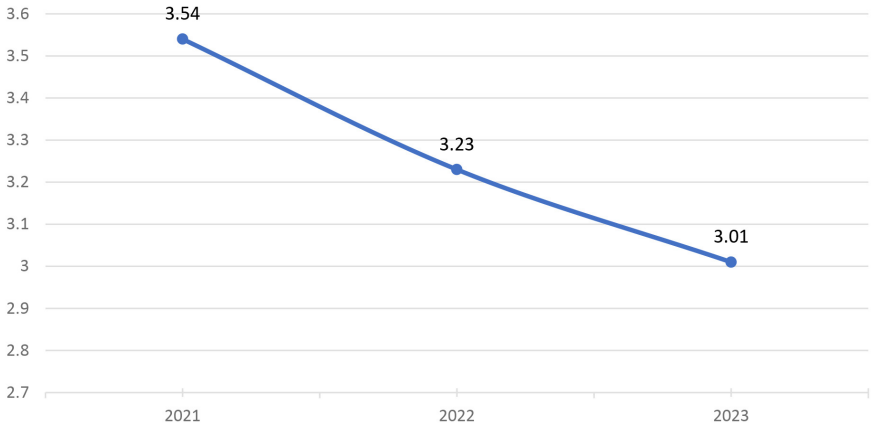

Figure 4. Changes in preference to stockpile goods based on year

Source: Own processing

Shopping in classic stores has always been a social activity when social contact is created. In the pre-pandemic period, consumers often used shopping as a leisure activity to meet friends or family members. However, the measures implemented during the pandemic led to exactly the opposite result, as they intended to limit social contact. Figure 5 shows the trend of how much consumers preferred unaccompanied shopping during the pandemic. The data suggests that this trend persists in 2023 and the situation is only slowly returning to the pre-pandemic state and consumers are still being cautious.

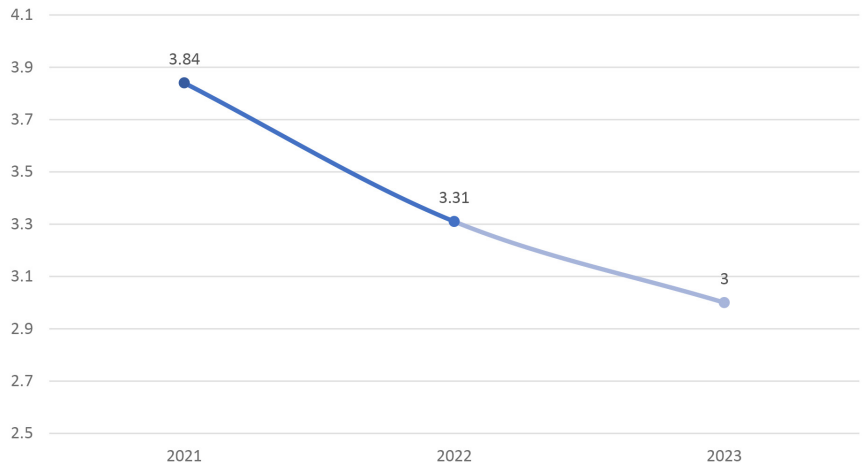

Figure 5. Changes in preference to shop unaccompanied based on year

Source: Own processing

Due to the measures implemented by the government to prevent the spread of the virus and protect people, it was necessary to move shopping to the online space. Before the COVID-19 pandemic, Slovak consumers had already been used to buying fashion items, cosmetics and electronics online. However, before the pandemic, only a very low proportion of consumers (8.72%) had bought daily products online. This share increased significantly during the pandemic, especially in 2022 and 2023. However, the changes were not equally large across the entire spectrum of consumers. Figure 6 shows how these changes were manifested during the pandemic in individual segments of consumers broken down by age. The highest increase occurred in the group of consumers in the 31-40 age group. Conversely, the lowest increase was recorded among the oldest consumers. On the figure, it is possible to also observe a downward trend in the growth of online shopping for daily consumption products as the age of consumers increases except for the youngest consumers under 30 years old.

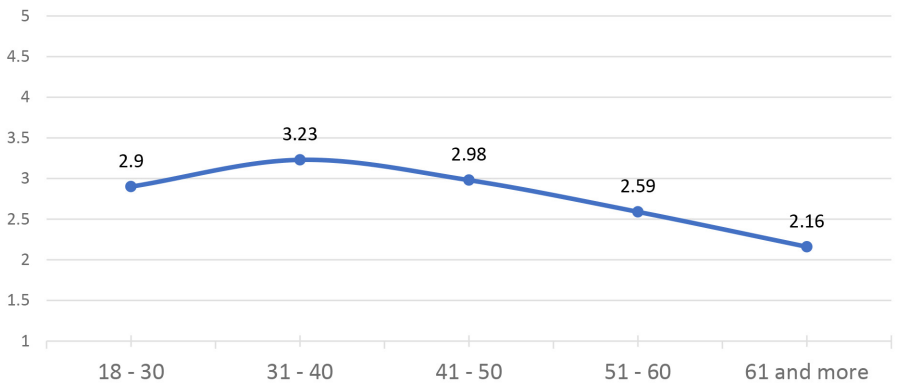

Figure 6. Changes in preference for online shopping according to the age of consumers

Source: Own processing

These findings indicate high rates of fluctuations between individual years of the pandemic. However, the majority of changes seemed to stabilize in 2023. Even though the future duration of these changes is not yet known, the immediate effects seem to indicate that consumer behavior is returning to its pre-pandemic factors of influence. However, some changes seemed to endure.

5. FUTURE RESEARCH DIRECTIONS

The findings of this research indicate that the long-term impacts of the COVID-19 pandemic have not yet been explored in sufficient detail. Therefore, future research needs to focus on consumers´ preference for online shopping and delivery of products ordered online to their homes. One of the other emerging trends reflects new ways of product distribution that had not yet been sufficiently explored.

One of the obvious, but necessary directions for future research should be the exploration of consumer behavior changes during the pandemic and its impacts on sustainable development on the planet. The preliminary findings show contradictory trends of development. Current research shows that people are becoming more responsible and more conscious of their communities. Consumers have significantly started to prefer locally produced goods, especially food items. On the other hand, the evidence clearly shows major increases in waste production. A preliminary report published by the United Nations points towards deterioration in meeting the strategies designed to meet the sustainable development goals. Our research shed some light on the development of sustainable consumption and the results are not positive. However, further explorations are needed to discover the exact nature of deterioration.

6. CONCLUSION

This research focused on discovering the major changes in consumer behavior that occurred during the COVID-19 pandemic. Even though it is not possible to prove that all the changes that were observed were caused by the pandemic itself, research can show how the situation affected consumers and their buying habits. Therefore, a representative sample of consumers was used to map these changes.

It was discovered that 36.8% of consumers experienced panic buying during the pandemic. The majority of such negative feelings and their consequences were observed during the early stages of the pandemic in 2021. Another interesting finding was the observed decrease in using shopping as a method of social enjoyment. During the pandemic, the majority of consumers preferred to visit shops alone. However, this trend towards shopping unaccompanied did not survive the end of the pandemic years. Already in the second half of 2023, consumers are returning to their previous habits of shopping with family members or friends. On the other hand, there is a trend that increased severely during the pandemic. The increase in online shopping has remained strong even after the pandemic concluded and still represents a new challenge for business owners, but also an opportunity. This finding was supported by research conducted in other countries as described by Yin et al. (2021). Therefore, the proposed solution would be paying attention to the combination of online and offline development of marketing activities.

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From Content Creators to Business Innovators: The Entrepreneurial Impact of YouTube Influencer Channels

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Online communication;
Marketing;
Sustainable development

Abstract: *Social media's transformative impact has led YouTube influencers to assume roles as content creators and entrepreneurs. This study delves into their innovative strategies encompassing revenue models, brand collaborations, and audience engagement. Ad revenue, sponsorships, subscriptions, merchandise sales, and crowdfunding form the diverse income streams. Affiliate marketing and product placements foster new business avenues. Niche content and data insights elevate audience interaction. Supported by platforms like Patreon, varied revenue channels drive sustainable financial growth. Collaboration strategies, such as endorsements, invigorate the digital economy. Entrepreneurial impact resonates through job creation, small business support, and innovation. Ethical considerations ensure sustainable growth. This study guides aspiring entrepreneurs and marketers by accentuating diverse revenue streams, strategic partnerships, and audience engagement. Future exploration may assess the endurance of influencer entrepreneurship, its effects on traditional media, and emerging platforms' nurturing of entrepreneurial endeavors.*

1. INTRODUCTION

The rise of social media platforms has led to a significant transformation in media consumption patterns (Ercegovac, 2022; Villi & Picard, 2019). With the advent of platforms like Facebook, Twitter, and YouTube, etc., have shifted from passive to active consumption, engaging in content creation, sharing, and curation (Ercegovac, 2022). The shift towards democratization of media has enabled user-generated content and the rise of social media influencers, who have utilized social media to amass large followings, influence audiences, and become key opinion leaders and trendsetters. As a result, they have created new sustainable entrepreneurial opportunities (Küng, 2017) and marketing strategies for businesses and content creators alike. In other words, the emergence of social media platforms has revolutionized media consumption (Chohan & D'Souza, 2020), fostering a more interactive and diverse media environment and leading to the rise of influential content creators, who continue to shape the digital landscape through their innovative strategies and sustainable entrepreneurial ventures.

YouTube's dominance as a platform for content creators and influencers is due to its user-friendly interface and diverse content, which have attracted both creators and audiences since its launch in 2005. YouTube's powerful search and recommendation algorithms facilitate content discovery, enabling creators to reach wider audiences. Monetization options (Ciampa et al., 2020), such as the YouTube Partner Program, provide income opportunities for creators through advertising, sponsorships, and viewer-supported features. YouTube's community-building features

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foster strong connections between content creators and audiences, promoting loyalty and engagement. This, along with its accessibility, content discovery, and monetization capabilities, has cemented YouTube as a leading platform for content creators and influencers, spurring innovation and entrepreneurship in the digital landscape.

This paper endeavors to scrutinize entrepreneurial opportunities and monetization strategies within YouTube influencer channels. The focus rests on the analysis of revenue models, encompassing ad revenue, sponsorships, and merchandise sales; exploration of brand collaboration strategies, encompassing affiliate marketing and co-creation; and examination of audience engagement techniques, including niche content and community building. Guided by these objectives, the study seeks to uncover the pivotal entrepreneurial opportunities and strategies adopted by YouTube influencers to monetize their channels and influence digital entrepreneurship. This investigation also seeks to provide valuable insights for aspiring entrepreneurs, marketers, and content creators, while also laying a foundation for prospective research within this domain and contributing to the development of a sustainable digital economy.

2. LITERATURE REVIEW

Influencer marketing has become a popular strategy (Abell & Biswas, 2023), leveraging social media influencers to promote products and brands. Key aspects of the landscape include: Platforms (sustainable influencer marketing occurs across various platforms (Borchers, 2019) like Instagram, YouTube, TikTok, Twitter, and Facebook, each with unique characteristics and audiences); Influencer tiers (influencers are categorized based on follower count and engagement rates (Park et al., 2021; Singh et al., 2023), including nano-, micro-, macro-, and mega-influencers); Content niches (influencers specialize in specific niches, such as fashion, beauty, or technology, allowing for authentic and relevant collaborations (Singh et al., 2023)); Types of collaborations (influencer campaigns can include sponsored posts, product reviews, affiliate marketing, ambassador programs, and co-created content); Measurement and analytics (success is measured using key performance indicators (KPIs) such as engagement rates, reach, impressions, conversions, and ROI (Singh et al., 2023)); Ethical considerations: (transparency and authenticity are crucial, with influencers and brands required to disclose paid partnerships and sponsored content (Ercegovac & Tankosic, 2023)).

The influencer marketing landscape offers unique opportunities for brands and influencers to connect with their target audience (Rosário & Morais da Silva, 2023) through various platforms, tiers, niches, and collaboration types while emphasizing the importance of transparency and authenticity.

The digital age has brought forth unprecedented opportunities for entrepreneurship, enabling individuals and businesses to leverage technology, the internet, and digital platforms to create, innovate, and grow. Key aspects of entrepreneurship in the digital age include:

- Access to global markets: The internet connects entrepreneurs with worldwide audiences, fostering growth and expansion (sustainable development in global outreach) (Leung et al., 2022).
- Lower barriers to entry: Digital platforms and online tools enable entrepreneurs to start businesses with minimal resources and increased efficiency (sustainable development of business models) (Göcke & Weninger, 2021).
- Digital marketing and social media: Entrepreneurs can leverage these channels for cost-effective promotion, brand awareness, and customer engagement (sustainable marketing practices) (Sundaram et al., 2020).

- E-commerce and online services: The rise of e-commerce has created new business models and opportunities across various industries (sustainable development of the e-commerce sector) (Kedah, 2023).
- Crowdfunding and alternative financing: Digital platforms provide access to funding outside traditional channels, such as banks and venture capitalists (Mora-Cruz & Palos-Sanchez, 2023).
- Remote work and gig economy: Technology enables entrepreneurs to collaborate globally and tap into freelancing or on-demand service opportunities (sustainable development in the workforce) (Manic et al., 2022).
- Constant innovation: The rapidly evolving digital landscape demands continuous adaptation and innovation, fostering a competitive business environment (sustainable innovation practices) (Bican & Brem, 2020).

The rise of social media influencers has led to a unique intersection with entrepreneurial ventures, with influencers leveraging their online presence and audience to create new business opportunities. The relationship between social media influencers and entrepreneurial ventures can be characterized by several key aspects that enable the positioning of influencers in creating successful ventures across various industries:

- Diversified revenue streams: Influencers explore multiple income sources, such as launching products, subscription services, and merchandise sales (Michaelsen et al., 2022).
- Brand collaborations: Influencers collaborate with brands through affiliate marketing, product placements, or co-creating products, benefiting both parties (Syed et al., 2023).
- Audience engagement: Influencers cultivate loyal communities around their content, which can become the foundation for launching ventures (Cartwright et al., 2022).
- Market validation: Influencers can quickly validate new ideas or identify market gaps by leveraging their audience's preferences and feedback (Cartwright et al., 2022).
- Influencer as a brand: Influencers' personal brands can be used to create and market entrepreneurial ventures, capitalizing on existing trust and recognition (Hennessy, 2018).

3. METHODOLOGY

The selection of successful YouTube influencers for case studies was based on criteria that ensured comprehensive and representative analysis. This included factors such as follower engagement, diverse content niches, different tiers of influence, innovation and creativity, as well as longevity and sustainability in maintaining relevance and success over time. Analyzing these factors will offer insights into the opportunities, strategies, and challenges of influencer-driven ventures online. A thorough study of entrepreneurial opportunities in YouTube influencer channels requires both qualitative (publicly accessible YouTube videos, social media posts, interviews, and blog posts will provide insights into influencers' strategies, audience engagement techniques, and experiences with brand collaborations) and quantitative data (metrics such as follower counts, engagement rates, video views, and estimated revenues will be collected. Public analytics tools and industry reports will support gathering these data, quantifying the influencers' success and scale of operations). Together, these data sources will provide a holistic view of the YouTube influencer ecosystem and the elements of successful influencer-driven entrepreneurship. To identify and assess the entrepreneurial strategies and tactics of YouTube influencers, the following data analysis methods will be used: examining descriptive statistics for quantitative insights, encompassing follower counts, engagement rates, and video views, to offer a comprehensive overview of influencers' audience reach and engagement; and performing

correlational analysis to uncover relationships between variables like video duration and view count. These methods will reveal the inventive strategies and tactics employed by influencers in their entrepreneurial pursuits, providing insights into the factors contributing to their achievements and the development of their business models.

4. DATA/CASE STUDIES

The selected case studies represent a diverse group of YouTube influencers who were not previously and otherwise famous but have achieved success in their respective niches through innovative strategies and entrepreneurial ventures. They include:

MrBeast (Jimmy Donaldson): With a follower count of over a hundred million and high engagement rates (Donaldson, 2012), MrBeast is a top-tier influencer known for his philanthropic stunts (Larson, 2023). His innovative entrepreneurial ventures include merchandise sales, the launch of the virtual restaurant chain "MrBeast Burger" (Conrad, 2021), and lucrative sponsorships with brands such as Honey and Microsoft. MrBeast joined the YouTube platform on February 20, 2012 (Donaldson, 2012) and he posted his first video the next day. For the first several years, MrBeast was posting videos of him playing video games, slowly introducing the other types of content. At this point, with 156 million subscribers and an average of 139 million views per video, MrBeast has a vast reach and considerable engagement with his audience. Despite publishing fewer videos (18) than others in the past year, each one tends to have a significant impact, aided by the average duration of 13 minutes.

Peter McKinnon: A Canadian photographer and filmmaker, McKinnon leverages his professional skills to create and sell photography gear and tutorials (McKinnon, 2010), co-create products with brands, and secure sponsorships (Youshaei, 2023). With several million followers, he represents mid-tier influencers and shows how professional skills can be monetized on YouTube. He started his YouTube channel on February 16, 2010 (McKinnon, 2010). However, the first available video is from November 25, 2016, and all previous videos are unavailable at the moment. Currently, Peter's channel focuses on the photography and filmmaking niche, boasting 5.88 million subscribers. Despite having lower average views per video (315.8 thousand) compared to some others, he managed to publish a significant number of videos (66) in the last year, each of approximately 9 minutes.

Kallmekris (Kris Collins): A comedienne with a substantial follower base, Kallmekris has monetized her comedic TikTok compilations through ad revenue, merchandise sales, and sponsorships, representing influencers in the entertainment niche (Kronbauer, 2022). Kris joined YouTube on January 14, 2015 (Collins, 2015). However, she started posting on August 11, 2020, after she became a big hit on TikTok. At the moment, Kris has 8.98 million subscribers, and her videos, which typically last around 15 minutes, average 1.9 million views. Her frequency of content production (108 videos in the last year) is notably high, indicating a consistent engagement strategy.

Julie Nolke: A Canadian actress and comedienne, Nolke uses her channel to showcase her acting skills and comedic sketches (Barnes, 2020). She represents a sustainable model for smaller influencers, using Patreon (Nolke, 2011) for fan-supported revenue and leveraging her platform to secure acting roles. She created her YouTube account on October 3, 2011 (Nolke, 2011), but the first video on her channel is from several years later, on May 22, 2015. Previous videos,

related to her She's Feeling Peckish blog have been unavailable. Julie now has a subscriber base of 1.07 million and an average view count of 229.8 thousand per video. She posted 32 videos in the last year, each with an average duration of 5.5 minutes, which is shorter compared to the others.

Stella Cini: An influencer from Malta, Stella Cini is known for her beauty and fashion-related content, specifically focusing on hair styling tutorials (Cini, 2012). With her creative approach to content creation and engagement, she's built a solid following and established brand collaborations with companies such as Schwarzkopf (Cini, 2012). Furthermore, Cini has launched her online store selling hair accessories, demonstrating an innovative entrepreneurial venture. Her channel was created on December 8, 2012, and she posted her first video almost a month later, on January 5, 2013. For the first three years, Stella was slowly increasing the number of posted videos. After that, she started posting more frequently. With a subscriber count of 791 thousand and an average of 83 thousand views per video, Stella focuses on hair and fashion content. Over the past year, she produced 64 videos, each typically lasting around 15 minutes.

These influencers were chosen due to their success in diverse niches, innovative entrepreneurial strategies, and their ability to monetize their channels effectively. Their experiences provide valuable insights into the strategies and tactics that can be employed by YouTube influencers to create and seize entrepreneurial opportunities.

Table 1. Statistics for Selected YouTube Influencers

YouTuber	Subscribers	Average video views	Average video duration	No. of videos in last year
MrBeast (Jimmy Donaldson)	156 M	139 M	13 minutes	18
Peter McKinnon	5.88 M	315.8 K	9 minutes	66
Kallmekris (Kris Collins)	8.98 M	1.9 M	15 minutes	108
Julie Nolke	1.07 M	229.8 K	5.5 minutes	32
Stella Cini	791 K	83 K	15 minutes	64

Source: Own research

Table 1 presents an overview of the activity and reach of our selected YouTube influencers – MrBeast, Peter McKinnon, Kallmekris, Julie Nolke, and Stella Cini – during the past year (as of June 2023). The reported metrics include the number of subscribers, average video views, average video duration, and the number of videos posted.

5. FINDINGS

Based on the case studies of MrBeast, Peter McKinnon, Kallmekris, Julie Nolke, and Shelby Church, several innovative revenue generation models can be identified among successful YouTube influencers: Ad Revenue (all these influencers earn money from ads displayed on their YouTube videos, with income directly tied to viewership); Sponsorships (influencers partner with brands for sponsored content, generating revenue while enhancing credibility. For instance, MrBeast has partnered with brands like Honey, a browser extension for finding discounts, and Microsoft. Stella Cini has worked with Schwarzkopf among others, while most of them worked with Squarespace); Merchandise Sales (MrBeast and Kallmekris have launched and sold branded merchandise, providing a substantial revenue stream and reinforcing their personal brands); Virtual Services (MrBeast has launched a virtual restaurant chain, "MrBeast Burger", capitalizing on his large follower base and the trend of virtual kitchens); Skill-Based

Products (Peter McKinnon profits from his professional skills as a photographer and filmmaker by selling his line of photography gear and tutorials); Crowdfunding and Patreon Support (some influencers use platforms like Patreon to receive direct financial support from their audience, fostering a sense of community and offering exclusive content or perks to supporters. For instance, Julie Nolke has a Patreon page where fans can support her work in return for exclusive content and other benefits); Co-Creation of Products and Services (influencers collaborate with brands or other creators to co-create products or services. Peter McKinnon, for instance, has collaborated with brands like PolarPro to co-create photography equipment tailored to his audience's needs. Stella Cini has developed her own hair accessories line in collaboration with hair product companies); Acting and Entertainment Opportunities (Julie Nolke has secured acting roles, showing how YouTube success can open doors to traditional entertainment industry opportunities); Affiliate Marketing and Investments (Stella Cini earns commissions from product sales through affiliate marketing, and she has launched her online store, creating additional income streams). These models show how YouTube influencers can leverage (Ahmad et al., 2020) their platforms, skills, and audiences to create diversified and innovative revenue streams, supporting their content creation and fostering various entrepreneurial ventures.

Based on these case studies three core techniques for audience targeting and engagement have been identified among successful YouTube influencers: Niche-Specific Content (Each influencer has carved out a unique niche (Pöyry et al., 2022), tailoring their content to specific interests. For instance, MrBeast specializes in philanthropic stunts and challenges, while Stella Cini offers unique hair styling tutorials, attracting dedicated followers. By focusing on niche-specific content, they attract a dedicated audience with shared interests); Community Building and Interaction (Influencers, like MrBeast and Kallmekris, build communities by actively engaging with their audience through comments, audience-suggested content and challenges, and involving them in videos, using platforms like TikTok and Instagram for regular interactions); Leveraging Analytics for Content Optimization (Successful influencers, like Peter McKinnon, use YouTube's analytics to study metrics such as view duration, likes, shares, and comments, to understand their audience's preferences, optimize content, and align it with their audience's interests and viewing habits). These techniques illustrate how influencers can effectively engage their target audience, an essential aspect of their entrepreneurial ventures on the platform.

Table 2. Correlation Analysis (r) of Video Duration and View Count for Various YouTubers

Youtuber	Video Duration (min)	View Count (millions)	$r = \frac{\sum (x_i - \overline{x})(y_i - \overline{y})}{\sqrt{\sum (x_i - \overline{x})^2 \ \sum (y_i - \overline{y})}}$
MrBeast	13	139	0
Peter McKinnon	9	0.3158	0.255
Kallmekris	15	1.9	-0.259
Julie Nolke	5.5	0.2298	-0.626
Stella Cini	15	0.083	0.231

Source: Own research

$$r \approx -0.0798$$

Based on the results obtained from the provided dataset (Table 2), it can be deduced that the average Pearson correlation (r) is approximately –0.0798. In this specific context, the negative and exceedingly weak correlation between video duration and view count implies a marginal probability of longer video content automatically attracting fewer views. This correlation also

highlights that video length is not the sole determinant influencing view count. Factors such as content engagement, audience relevance, and other variables are also factors that play a role in captivating viewers (Yang et al., 2022).

6. DISCUSSION

The case studies of MrBeast, Peter McKinnon, Kallmekris, Julie Nolke, and Stella Cini show that YouTube influencers have expanded entrepreneurial opportunities by diversifying revenue streams and building multi-faceted businesses, leveraging personal branding, audience engagement, and innovative content strategies. This indicates that YouTube has become an increasingly powerful tool for entrepreneurship (Ahmad et al., 2020) and sustainable growth. Influencer-driven entrepreneurship (Cooke et al., 2022) introduces a new dynamic to the traditional economy and contributes to sustainable development. It allows for a more direct and personalized connection between creators and consumers, thus disrupting conventional marketing and business models. These content creators embody the essence of a knowledge-based economy, where information, innovation, and individual skills are the primary drivers of growth. Their capacity to adapt and thrive by applying specialized knowledge and engaging directly with their audience underscores a shift towards a more resilient, diversified, and sustainable economic landscape. The insights and data harnessed from their digital interactions fuel continuous innovation and community building, which are central to achieving sustainable development in the digital sphere.

This evolution could potentially lead to a more diversified sustainable economy (Kamruzzaman, 2022) where individuals can directly monetize their creative skills, ideas, and audience reach. However, it also raises questions about market saturation and competition as more individuals pursue influencer-driven entrepreneurship. Despite the opportunities, YouTube influencers face several challenges in pursuing entrepreneurial ventures. They are subject to algorithmic changes by YouTube (Ardiansyah et al., 2023) that can affect their visibility and, consequently, their revenue. Furthermore, the success of an influencer is highly dependent on maintaining audience engagement and staying relevant, which can be a daunting task given the fast-paced nature of digital content consumption. There's also a high degree of uncertainty and risk, as success on these platforms is not guaranteed and can be fleeting (Xiang et al., 2022). As the line between advertising and content continues to blur in the area of influencer marketing, ethical considerations become more pertinent. Disclosure of sponsorships, the authenticity of content, and the potential manipulation of audience trust for monetary gains are significant issues. Transparency and honesty in these practices are crucial to maintaining trust with the audience and abiding by regulatory guidelines. It is essential for influencers venturing into entrepreneurship to navigate these ethical challenges responsibly (Ercegovac & Tankosic, 2023) and contribute to the sustainable development of the digital marketplace.

YouTube influencers present a new form of entrepreneurship, bringing both significant opportunities and challenges. This research has provided insights into these dynamics, but further research is needed as this field continues to evolve.

7. CONCLUSION

The research highlights the intersection of YouTube influencers and entrepreneurship by analyzing case studies of MrBeast, Peter McKinnon, Kallmekris, Julie Nolke, and Stella Cini. It shows that these influencers strategically leveraged their online popularity for successful

entrepreneurial ventures, contributing to sustainable business growth. The analysis also suggests a potential correlation between video duration and views, indicating that content length may not significantly affect audience engagement, a finding relevant to the development of content strategies.

It also contributes to the literature on digital entrepreneurship and marketing, showcasing the importance of personal branding, community building, and innovative monetization in the social media era. It underscores the potential of YouTube for entrepreneurship, highlights challenges and ethical considerations, and emphasizes the importance of audience engagement, content differentiation, and continuous innovation for aspiring entrepreneurs and marketers. It's crucial to focus not only on growing a large following but also on cultivating a loyal and engaged audience that trusts and values the content being produced (Chan-Olmsted & Kim, 2023), which is essential for sustainable development in influencer-driven markets. Future research directions could include exploring the impact of content genres, cultural influences, or collaborations with other influencers and brands on influencer entrepreneurship. The evolving nature of YouTube and digital entrepreneurship ensures a vibrant field of inquiry in the coming years.

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Demoethics and the Sustainable Development Paradigm

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Abstract: *This article explores the challenges faced by humanity in the age of globalization, specifically in the context of anthropological catastrophes. The authors argue that the rapid pace of technological advancement has created an imbalance between technical progress and cultural transformation, leading to a crisis of identity and morality. The article examines the root causes of this imbalance. In response to these challenges, the article proposes a new approach to creating good people and good societies through the cultivation of virtue and knowledge. Drawing on insights from anthropology, sociology, and philosophy, the authors argue that demoethics is the key to achieving sustainable development and social justice. The article provides a detailed analysis of the concept of demoethics, including its historical roots. This article offers a thought-provoking analysis of the complex challenges facing humanity in the 21st century and provides a compelling argument for the importance of cultural transformation and ethical values in achieving a more just and sustainable world.*

1. INTRODUCTION

The concept of sustainable development has gained increasing importance in recent years, as the global community recognizes the need to balance economic growth with environmental protection and social justice (UNESCO, 2014). Sustainable development is often described as a paradigm shift, which requires a new way of thinking about the relationship between human society and the natural world. One of the key challenges in this paradigm is the field of ethics, which plays a crucial role in shaping the values and principles that guide sustainable development.

The essence of sustainable development is to ensure that current generations meet their needs without compromising the ability of future generations to meet their own needs. This requires

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a long-term perspective that considers the environmental, social, and economic impacts of people's actions (Bakeeva & Biricheva, 2021; Hametner, 2022; Wang et al., 2023). Sustainable development is not just about preserving natural resources or reducing pollution; it is about creating a society that is equitable, just, and sustainable for all.

The sphere of ethics is central to sustainable development because it provides a framework for making decisions that are consistent with sustainable values and principles. Ethics is concerned with questions of right and wrong, good, and bad, and the moral principles that guide human behavior. In the context of sustainable development, ethical considerations include issues such as environmental stewardship, social justice, and economic equity (Zhanbayev & Irfan, 2022; Zhanbayev et al., 2023).

This article is devoted to studying the demoethical foundations of the sustainable development paradigm. The reason is that one of the main problems in the field of ethics and sustainable development is the tension between short-term economic interests and long-term environmental and social concerns. Many businesses and governments prioritize economic growth over environmental protection and social justice, leading to unsustainable practices such as overconsumption, pollution, and inequality. This is often exacerbated by a lack of political will and public awareness, as well as the difficulty of balancing competing interests and values.

The paradigm of sustainable development requires a new way of thinking about the relationship between human society and the natural world. Demoethics plays a crucial role in shaping the values and principles that guide sustainable development, but there are many challenges to overcome. Demoethics prioritized environmental stewardship, social justice, and economic equity.

2. METHODOLOGY

The methodology employed in this research is rooted in the theoretical principles of communicative practical philosophy (Apel, 1990; Habermas, 1987; Hösle, 1995) that highlight a fundamental distinction between technological and ethical rationality.

Technical rationality involves the mastery of objects and the need for control and is characterized by a focus on analyzing goals and identifying means to achieve them.

On the other hand, ethical rationality is concerned not with means and methods, but with the fundamental question of determining the legitimacy of the end goal itself (Hösle, 1995).

The attainment of mutual understanding among all stakeholders regarding the acceptability of the development goal is a key feature of ethical rationality.

In this study, the concept of ethical rationality is crucial as it is one of the primary components of the sustainable development paradigm that is currently being investigated. This paradigm takes into account the totality of economic relationships, including factors such as economic growth, socioeconomic inequality, and environmental responsibility.

The term "demoethics" is a relatively new concept that has been gaining traction in the field of ethics. It is a combination of two words: "demo" which means people, and "ethics" which refers to the moral principles that guide human behavior. Therefore, demoethics can be defined as the study of the ethical principles and values that govern the behavior of individuals and groups in a democratic society.

The concept of demoethics is closely related to the idea of social responsibility. In a democratic society, individuals and groups have a responsibility to promote the common good and work toward the betterment of society. This responsibility is not limited to the government or other institutions but extends to all members of society.

In connection with the research of demoethics, network demoethics is of particular importance. Network demoethics is an emerging field that addresses the ethical concerns associated with the use of networks in various domains such as healthcare, finance, and social media. As networks have become an integral part of our daily lives, it is essential to ensure that they are used responsibly and ethically.

3. RESULTS AND DISCUSSION

3.1. Anthropological Catastrophe in the Age of Globalization: The Imbalance between Technical Advancement and Cultural Transformation

Currently, during the period of globalization, an anthropological catastrophe arises, which according to some researchers is no less significant than planetary catastrophes such as thermal, ecological, and nuclear catastrophes. It should be noted that the essence of the anthropological problem itself arises now of equilibrium of the stable life of society, that is, the balancing of military technologies and cultural means of restraint.

The relationship between human industrial growth and the change in cultural mechanisms of restraint leads to a growing disproportion between the rapid growth of the technical power of human society and its slow cultural transformation, which can lead to the destruction of humanity. The anthropological crisis is related to the fact that the technical power of human society is rapidly growing, while the relationships between people are regulated based on moral traditions of past epochs.

A certain and quite predictable emphasis of researchers and representatives of social planning on achieving scientific and technical progress in constructing social models has led to the absence of a crucial component – social relations. This circumstance means that precisely due to the influence of scientific and technical progress, a new type of social relations emerges, based on the change in the way of life of modern society resulting from the implementation of scientific and technical developments in every day and production spheres, and the change in society's mentality due to the uneven adaptation of the population to them. The media play an important role in this process (Kirillova, 2021; Kirillova & Shlykova, 2022; Loginov & Rudenkin, 2020; Tomyuk et al., 2022). The transformation of the educational system also leaves a huge imprint on the implementation of social relations (Gilyazova & Zamoshchanskii, 2020; Shutaleva et al., 2020).

Moreover, in recent years, the global economy has been transitioning to the fifth technological order associated with human-machine interaction technologies based on artificial intelligence systems and machine learning. The near future will be built on a system of digital data exchange between process participants, which, in turn, will activate further development of neural networks and AI systems. According to many researchers (Lee et al., 2023; Magistretti et al., 2019; Tomiltseva & Zheleznov, 2020), the field of AI is one of the most important elements in the transformation of countries' economies, towards a new stage of human-machine interaction, which promotes accelerated development through digitization.

In 2023, the world will not only face a crisis of nuclear weapons use but also the possibility of a new pandemic and famine, which may occur in many regions due to natural conditions. There is also a serious risk of the indistinguishability of truth from lies in all aspects of individual life. The consequences of materializing this risk may have a negative impact on existing civilizations on Earth (all of which have cultural differences in the concept of truth and lies).

One of the authoritative specialists in the field of Artificial Intelligence, Kai-Fu Lee (entrepreneur, investor, PhD in Computer Science), wrote about this danger in his New Year's address (Lee et al., 2023). The new opportunities provided by AI will allow for increased influence on many people, that is, to lean toward decisions that are beneficial to virtual platform owners. Kai-Fu Lee offers a smart analysis of the coexistence of humans and AI. We must seek values and wisdom within ourselves to guide the development of artificial intelligence (Lee et al., 2023). In this case, much depends on the presence of a personal ethical code among virtual platform owners, which cannot be violated by any norms, and is uncontrollable and immune to external influence. This can lead humanity to social, and then global catastrophe. Today, online platform users are becoming victims of dishonest manipulators – sellers of various goods and services.

To meet people's expectations for the construction of a safe and sustainable society (without wars, violence, excessive economic inequality, and significant anthropogenic pressure on the environment), it is important to recognize the moral problems of the past and identify the ethical challenges that will need to be addressed in the future. The threatening realities of today actualize the demoethical searches of humanity, seeking to find answers to the eternal problems of ensuring freedom, justice, responsibility, happiness, and health.

3.2. The Big Problems: Creating Good People and Good Societies through Cultivating Virtue and Knowledge

All the diversity of moral and ethical problems can be reduced to two general problems:
1) the creation of a good person and
2) the creation of a good society.

A. Maslow refers to these two problems as the Big Problems (Maslow, 1968).

The first problem consists of the fact that for moral and ethical progress, healthy, developed, and good people are needed, capable of comprehending existing problems, creatively approaching their solutions, offering acceptable solutions, and, most importantly, having the desire to implement new approaches properly. Without a critical mass of such people, it is difficult to imagine the progressive development of any society.

The second problem is related to the fact that human behavior depends not only on internal factors but also on the organization of society, which can motivate a person to either "good" or "bad" behavior. Whether a person behaves well or poorly depends on the conditions in which he or she finds himself or herself. For example, in a law-abiding society, a person is motivated to comply with the laws of that society, and conversely, in a society where legal nihilism flourishes, a person seeks opportunities to bypass the law.

In the development of these approaches, Abu Nasr al-Farabi notes that "Adam should not only receive knowledge but also education. Knowledge without education is the enemy of humanity."

Translated into Arabic, this means:

بادئ ذي بدء ، يجب أن يحصل الإنسان على التعليم وليس التعليم ، والتعليم دون تعليم هو ألد أعداء الإنسانية

Translated into Chinese, this means:

«人首先要接受教育, 而不是知识。没有教育的知识-人类最大的敌人».

Thus, the idea of Al-Farabi about a virtuous society (man, ruler, and city) is the basis of the new model of demoethics. We agree with Al-Farabi's opinion that offers a solution to social problems through specific methods of cultivating virtue through knowledge (Al-Farabi, 1985, 2001). He divided them into "soft" and "hard."

If the students themselves show a desire to learn sciences, work hard, and perform good deeds, then in this case, "soft methods" of education that help strengthen these aspirations are appropriate. If the wards are malicious, wayward, and lazy, then "hard methods," i.e., coercion, may be applied. However, the use of such methods should be determined by the level of morality of the educator himself.

The widespread dissemination of the key ideas of Al-Farabi is not only the basis for national revival but also contributes to the formation of new universal values that ensure the sustainable development of human civilization. In conclusion in the analysis of Al-Farabi's philosophy as a partial source of the development of demoethics, we note his statement, that a virtuous society is a community of people who have precise knowledge of true happiness and the ways to achieve it and act following this knowledge.

One of the key concepts related to the socio-moral virtues is the concept of "industriousness," as suggested by A. Kunanbayeva. We agree with A. Kunanbayeva's opinion, at the time considered this problem, believes that the gain mastery, learn, work hard, be educated, and be a person who knows the measure; we should care about the fate of the people, believed that one should work for the sake of humanity, and called for loving people as if they were relatives (Aimautov, 1918).

A characteristic feature of the thinker's views is the close connection between social issues and ethics. Abai praised the labor of the peasant-cattle breeder, the labor of the craftsman, and any honest individual labor that not only creates new values but also ennobles the human soul. He placed simple labor above origin, wealth, and high positions, but also believed that one could become rich by working hard and thriftily spending accumulated wealth, while laziness and wastefulness were the causes of poverty and destitution. It is in this area that, from our point of view, the most significant changes have taken place. It can now be confidently stated that the attitude towards labor has lost the high moral status it had in previous epochs.

One of the main instruments for developing industriousness in a person is a craft. Craft skills and the development of entrepreneurship in society are some of the instruments for developing competitiveness and strengthening the potential for life sustainability of local communities in the region in terms of ecological, and economic vulnerabilities, as well as issues related to population health.

This is confirmed by the great thinker Yusuf Balasaguni who wrote about craft as a reliable source of independence and prosperity for a person, it is higher than wealth and positions

(Malikov, 2011). According to the Turkic philosopher, wealth and positions can be lost once, but a craft, a profession, is both wealth and a pledge of a person's dignity, and respect for him by those around him, wherever fate may throw him.

Yusuf Balasaguni, revealing the content of his thoughts, reduces them to four benefactors: the first is Justice, the second is Happiness, the third is Reason, and the fourth is Unpretentiousness. It should be noted that ancient Greek philosophers also distinguished four similar virtues: wisdom, courage, prudence, and justice. As can be easily seen, among the four virtues, Yusuf Balasaguni places justice in the most important first place.

Al-Farabi wrote: "A virtuous city is one in which the inhabitants help each other to achieve the most sublime things that are associated with the true existence of man, his sustenance, and the preservation of his life" (Al-Farabi, 1973, p. 195). The description of an "ignorant" city is a veiled form of protest against the social norms of that time. In various types of "ignorant" cities, the thinker condemned the vices inherent in the society of his time: greed, unbridled passion, ambition, and the oppression of the weak.

In dividing society into "virtuous" and "ignorant", Al-Farabi based his criteria on the goals pursued by these societies. The correctness of the goal contributes to the achievement of happiness, which in the thinker's understanding means the triumph of virtue and reason. Al-Farabi compared a virtuous ruler to the First Being, as he brings the same orderliness and organization to the governance of the city as the First Being brings to the world harmony.

According to Al-Farabi, the dignity of a ruler is determined by the presence of virtues, not the power of authority. The thinker is convinced that the ruler should set an example for people to follow in the pursuit of perfection and live a life worthy of emulation. Abu Nasr Al-Farabi dealt with philosophical questions of uniting people – the "virtuous city", which we would now classify as an ethical problem of the relationship between society following established norms and rules. Thus, Al-Farabi more than 1000 years ago raised questions about the harmonious development of the individual and noted that harmony lies in the unity of intellectual and moral perfection in the interaction of man with the external world. These questions are relevant at the present stage of development in the context of sustainable societal development.

4. CONCLUSION

As a result of our research, we have determined that "Demoethics" is a branch of ethics aimed at revealing common understandings of the essence of the world and the place of humans in it based on the sustainable development of society. The theoretical foundations of demoethics have been developed in the works of Abu Nasr Al-Farabi, A. Kunanbayeva, and Yu. Balasaguni. Their works show that phenomena such as education, reason, knowledge, science, and honest work ensure the effective implementation of socially sustainable best available technologies.

In the future, our research will be conducted within the framework of "Digital (Network) Demoethics", based on the theory of Demoethics. The study of this direction is associated with the rapid development of deep learning technologies of computer systems, and the creation of Artificial Intelligence, which in some tasks surpasses humans, but this direction must develop by moral, ethical, and legal norms, characterized by the observance of individual safety in the virtual space.

The need for the development of new ethical norms is one of the main issues at present, as over the past 5 years, the development of digital technologies has been associated with the emergence of Artificial Intelligence. With unlimited possibilities, AI does not possess ethical norms that are inherent in humans, and agreeing with authors studying this aspect (Barinova & Barinov, 2022), this can lead to unpredictable results.

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